PROJECT REPORTED ON E-WASTE IN COLLEGE

Abstract

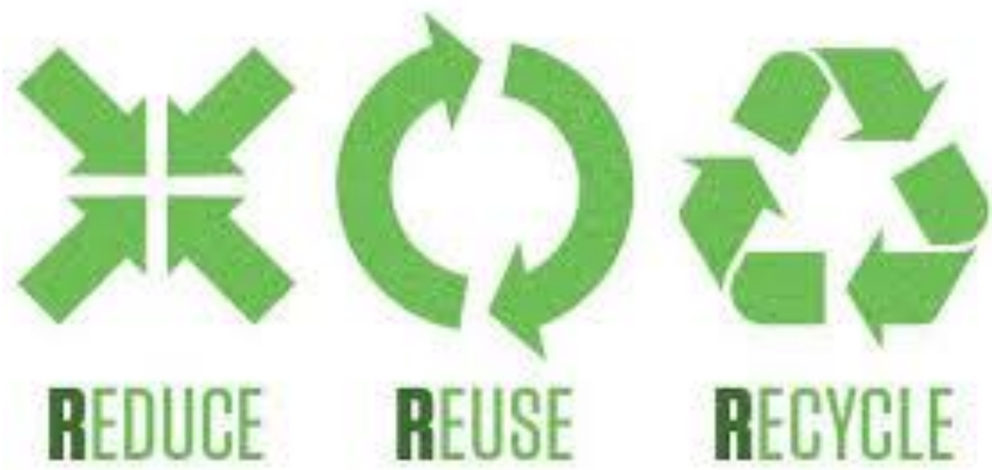
E-waste is a term used to cover all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse. In this paper, it investigates the behavior of people towards e-waste, how they are segregating or managing e-waste among other household waste. The mobile phone waste (m-waste) has been found to be the highest number of mobile waste generation owing to its rapid change in technologies. With this goal in mind, questionnaire survey was performed in the campus of college of science and technology where it includes students from different family background and households which includes lecturers, cooks, security guards and sweeper.

Introduction

Electronic waste or e-waste describes discarded electrical or electronic devices. Used electronics which are destined for refurbishment, reuse, resale, salvage recycling through material recovery, or disposal are also considered e-waste. Informal processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution.

Electronic scrap components, such as CPUs, contain potentially harmful materials such as lead, cadmium, beryllium, or brominated flame retardants. Recycling and disposal of e-waste may involve significant risk to health of workers and their communities.

To “Go Green” means to implement certain lifestyle changes designed to help us live in a more eco-friendly way. It means becoming more environmentally aware and changing our behavior and lifestyles to reduce the amount of pollution and waste we generate. The decision to go green is a gradual process for most people. Any action one takes that contributes to sustainable living makes a positive impact on the environment. Everyone can implement small changes into his or her current lifestyle to make a difference for the Earth and future generations.



The 3 R’s are a great way to reduce our waste and consuming habits, which in the end helps the Earth.   Reduce, reuse, and recycle are the most imperative for going green. VIT has put in a number of efforts to generate awareness about going green on campus in an attempt to do its bit to make the environment and the world a better place to live in.

Electronic waste has been around for a very long time; however, the need for the proper disposal of that electronic waste began in the mid-70s. Soon thereafter the United States passed the Resource Conservation and Recovery Act (RCRA). This law made it illegal to dump electronic waste in the United States.

This is when the recycling industry was formed and the proper disposing and recycling electronic waste and old worn out electronic equipment of all kinds began.

Old electronics, aka e-waste, consists of electronic equipment scrap components like CPUs, etc. This e-waste contains potentially harmful materials like lead, cadmium, beryllium, brominated flame retardants, and many more toxic elements that poison and destroy our environment and the world we have to live in.

Properly disposing of and recycling all this e-waste is the only way to help prevent the destruction of our planet, but it will only work if everyone does their part in wanting to make a difference and do whatever it takes to save it.

In 1976, the United States passed the Resource Conservation and Recovery Act (RCRA) and several other countries followed suit.

According to the EPA, the purpose of the Resource Conservation and Recovery Act was to:
Protect the health of humans, as well as the environment from the obvious hazards of waste disposal.To help conserve our energy and all natural resources.Help reduce the amount of waste being generated.

To ensure that all wastes are managed in a way that will protect our environment.
In order for the EPA to achieve these goals, they had to set up three specific, but interconnected programs, which were the solid waste program, the hazardous waste program, and the underground storage tank program. All of which had/have their own requirements for helping to preserve our planet and all life contained therein.

Shortly after the RCRA was passed, there were a series of events that took place paving the way for international dumping laws. The first of these events started in the 1980s, when a Liberian ship was commissioned to pick up and dispose of 14,000 tons of e-waste ash from Philadelphia. This ash was supposed to go to New Jersey; however, that jurisdiction refused it. So rather than finding another way to properly dispose of the e-waste, that Liberian ship headed out to sea and proceeded to randomly dump the entire 14,000 tons of e-waste into the ocean all the way from the Caribbean to Asia. Later, there was another incident that took place in Nigeria. About 3,500 tons of toxic waste from Italy was illegally dumped in a small town called Koko in 1988.

These illegal dumps were just a few of the events that led to the Basel Convention in 1989 when the world began demanding that international dumping laws be put into place to help ensure these types of events never happen again.

The Basel Convention is an international treaty designed to reduce the way hazardous waste is moved between nations. The Basel Convention was put up for a vote on March 22, 1989, and passed into law on May 5, 1992. As of October 2018, 186 states and the European Union all belong to the Convention. Additionally, Haiti and the United States have signed the Convention but it has not yet been ratified.

And all of these historical events resulted in recycling going from small potatoes to a huge international industry with a vested interest in protecting the world's citizens and our planet.

The manufacturing of electrical and electronic equipment (EEE) is one of the emerging global activities. The main factors identified to be responsible for the increased consumption and productions of electrical and electronic equipment are rapid economic growth, coupled with urbanization and industrialization. The Indian Information Technology (IT) sector is one of the major contributors to the global economy. At the same time, it is responsible for the generation of the bulk of E-waste or Waste Electrical and Electronic Equipment (WEEE) in India. Although the global E-waste problem has been able to attract attention across the world,not much emphasis has been given to the E-waste engendered in developing countries.

Developing countries like India, today, is burdened with the colossal problem of E-waste which is either locally generated or internationally imported, causing serious menace to human health and environment. The hazardous components in electrical and electronic

equipment are a major concern during the waste management phase. In the context of India,recycling of Waste Electrical and Electronic Equipment is not undertaken to an adequate degree.

However, one of the major issues related to E-waste is that there is no standard definition of WEEE/E-waste. A number of countries have come out with their own definitions, interpretation and usage of the term "E-waste/WEEE". The most widely accepted definition and description of WEEE/ E-waste is as per the European Union directive. The Directive2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste world a better place to live in electrical and electronic equipment (WEEE) covers all electrical and electronic equipment used by consumers. For the purposes of this Directive, following definitions are applied:

1. ‘electrical and electronic equipment’ or ‘EEE’ means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields falling under the categories set out in Annex IA and designed for use with a voltage rating not exceeding 1 000 Volt for alternating current and 1 500 Volt for direct current.

2. ‘Waste electrical and electronic equipment’ or ‘WEEE’ means electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/ EEC, includingall components, subassemblies and consumables which are part of the product at the time of discarding.

Categories of electrical and electronic equipment covered by this Directive within ANNEXIA are as follows:

1. Large household appliances

2. Small household appliances

3. IT and telecommunications equipment

4. Consumer equipment

5. Lighting equipment

6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)

7. Toys, leisure and sports equipment

8. Medical devices (with the exception of all implanted and infected products)

9. Monitoring and control instruments

10. Automatic dispensers

A wide range of products are included within each category mentioned above. In India, E-waste is covered in Schedule 3 of "The Hazardous Wastes (Management and Handling) Rules, 2003". Under Schedule 3, E-waste is defined as "Waste Electrical and Electronic Equipment including all components, sub-assemblies and their fractions except batteries falling under these rules". "Guidelines for Environmentally Sound Management of E-waste" formulated by the Ministry of Environment and Forest, Government of India, in the year 2008 followed the same definition. According to the very recent "the e-waste (Management and Handling) Rules, 2011",'electrical and electronic equipment' means equipment which is dependent on electric currents or electro-magnetic fields to be fully functional and 'e-waste' means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded.

In 2016, Asia was the territory that brought about by significant the most extensive volume of e-waste (18.2 Mt), accompanied by Europe (12.3 Metric ton), America (11.3 Metric ton), Africa (2.2 Metric ton), and Oceania (0.7 Metric ton). The smallest in terms of total e-waste made, Oceania was the largest generator of e-waste per citizen (17.3 kg/inch), with hardly 6% of e-waste cited to be gathered and recycled. Europe is the second broadest generator of e-waste per citizen, with an average of 16.6 kg/inch; however, Europe bears the loftiest assemblage figure (35%). America generates 11.6 kg/inch and solicits only 17% of the e-waste caused in the provinces, which is commensurate to the assortment count in Asia (15%). However, Asia generates fewer e-waste per citizen (4,2 kg/inch). Africa generates only 1.9 kg/inch, and limited information is available on its collection percentage. The record furnishes regional breakdowns for Africa, Americas, Asia, Europe, and Oceania. The phenomenon somewhat illustrates the modest number figure linked to the overall volume of e-waste made that 41 countries have administrator e-waste data. For 16 other countries, e-waste volumes were collected from exploration and evaluated. The outcome of a considerable bulk of the e-waste (34.1 Metric tons) is unidentified. In countries where there is no national e-waste constitution in the stand, e-waste is possible interpreted as an alternative or general waste. This is land-filled or recycled, along with alternative metal or plastic scraps. There is the colossal compromise that the toxins are not drawn want of accordingly, or they are chosen want of by an informal sector and converted without well safeguarding the laborers while venting the contaminations in e-waste. Although the e-waste claim is on the rise, a flourishing quantity of countries are embracing e-waste regulation. National e-waste governance orders enclose 66% of the world population, a rise from 44% that was reached in 2014.

Electronic waste is emerging as a serious public health and environmental issue in India.[1] India is the "fifth largest electronic waste producer in the world"; approximately 2 million tons of e-waste are generated annually and an undisclosed amount of e-waste is imported from other countries around the world.

E-waste is a popular, informal name for electronic products nearing the end of their "useful life." Computers, televisions, VCRs, stereos, copiers, and fax machines are common electronic products. Many of these products can be reused, refurbished, or recycled. There is an upgradation done to this E-waste garbage list which includes gadgets like smartphone, tablets, laptops, video game consoles, cameras and many more.India of the E-waste rules 2016 shall ensure that e-waste generated by them is channelized through collection center or dealer of authorized producer or dismantler or recycler or through the designated take back service provider of the producer to authorized dismantler or recycle r; (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 centers. Environmentally sound E-waste treatment technologies are used at three levels as described below:

- 1st level treatment
- 2nd level treatment
- 3rd level treatment

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 folliwing technologies.

1. Dismantling
2. Pulverization/ Hammering
3. Shredding
4. Density separation using water

REVIEW OF LITERATURE

Objectives of study:

The main objective of the study is to understand the disposal of end of life appliances which includes their collection, financing and recycling through the description, analysis and comparison of the prevalent practices. The other objectives are explained as follows.

1. Identify the actual quantity of e-waste in Mumbai Metropolitan Region
2. Study the present e-waste management practices and different risks associated with it.
3. Estimate the future e-waste generation in region
4. Suggest new e-waste management system for long term in MMRDA.
5. Suggest alternative solutions for end users , manufactures and producers of e-waste

Components Of E-Waste

E-waste contains many hazardous substances which have been found to be extremely dangerous to human health and the environment; e-waste is often disposed of under less than ideal safety conditions. Since most e-waste is illegally processed by workers operating outside of formally-organized systems, these informal workers commonly practice unregulated and often dangerous recycling techniques that can have serious health consequences

Primary constituents of e-waste from end-of-life (EOL) computers consist of glass, metals and plastics. Thus the quality of recycling of e-waste is dependent upon individual indicators like cathode ray tube (CRT) recycling, plastics recycling and recovery of metals which in turn is dependent upon various other attributes. The problem of assigning a single overall measure of quality to each system in a set of similar EOL computers recycling systems has not been duly addressed in literature. An aggregate measure of total quality of recycling system for EOL computers would be helpful to top management in accessing overall development where different versions of recycled products are produced. Thus, the central idea in this research is to combine different types of recycling process parameters into an aggregate value representing the overall quality of recycling of each of the systems. In this research, we have used Multi-Attribute Global

Inference of Quality (MAGIQ) technique for accomplishing this objective. Results of research conducted in a case company show that application of this technique can provide decision makers with a clear picture on the quality of various recycling systems under evaluation.

This work describes the composition of the products from solvolysis of thermoset polyester in an acetone/water mixture. A qualitative and quantitative evaluation of the compositions of the aqueous and oil phases was achieved by the combination of liquid chromatography with electrospray ionization mass spectrometry (LC-ESI-MS/MS), gel permeation chromatography (GPC), and total organic carbon (TOC). Close to 100% of the organic carbon in the aqueous phase was explained by the monomers phthalic acid and dipropylene glycol, co-solvent acetone, and a secondary reaction product, isophorone. In the oil, the most abundant compounds were isophorone, 3,3,6,8-tetramethyl-1-tetralone, and dihydroisophorone. While the first two compounds were intermediates in the self-condensation of acetone, dihydroisophorone has not been reported previously as the by-product of the conventional acetone self-condensation reaction pathway. The quantification results have shown that solvolysis can be successfully used to close the loop in the polymer life cycle while producing a broad spectrum of high-value products that could be recycled for production of polymers, used as a building blocks, or as fine chemicals.

Following are hazardous substances included in E-waste:

Components	Effect on Humans
Americium	It is known to be carcenegonic.
Lead	Adverse effects of lead exposure include impaired cognitive function, behavioral disturbances, attention deficits, hyperactivity, conduct problems, and lower IQ. These effects are most damaging to children whose developing nervous systems are very susceptible to damage caused by lead, cadmium, and mercury.
Cadmium	Health effects include sensory impairment, dermatitis, memory loss, and muscle weakness. Exposure in-utero causes fetal deficits in motor function, attention, and verbal domains. Environmental effects in animals include death, reduced fertility, and slower growth and development.

Hexavalent Chromium	The inhalation of cadmium can cause severe damage to the lungs and is also known to cause kidney damage. Cadmium is also associated with deficits in cognition, learning, behaviour, and neuro motor skills in children
Sulphur	A known carcinogen after occupational inhalation exposure. There is also evidence of cytotoxic and genotoxic effects of some chemicals, which have been shown to inhibit cell proliferation, cause cell membrane lesion, cause DNA single-strand breaks, and elevate Reactive Oxygen Species (ROS) levels.[1]
.	Health effects include liver damage, kidney damage, heart damage, eye and throat irritation. When released into the environment, it can create sulfuric acid through sulfur dioxide.
Perfluorooctanoic Acid (PFOA)	Studies in mice have found the following health effects: Hepatotoxicity, developmental toxicity, immunotoxicity, hormonal effects and carcinogenic effects. Studies have found increased maternal PFOA levels to be associated with an increased risk of spontaneous abortion (miscarriage) and stillbirth. Increased maternal levels of PFOA are also associated with decreases in mean gestational age (preterm birth), mean birth weight (low birth weight), mean birth length (small for gestational age), and mean APGAR score.
Beryllium Oxide	Occupational exposures associated with lung cancer, other common adverse health effects are beryllium sensitization, chronic beryllium disease, and acute beryllium disease.
Polyvinyl Chloride (PVC)	In the manufacturing phase, toxic and hazardous raw material, including dioxins are PVC such as chlorine tend to bio accumulate Over time, the compounds that contain chlorine can become pollutants in the air, water, and soil. This poses a problem as human and animals can ingest them. Additionally, exposure to toxins can result in reproductive and developmental health effects

Electronic and Electrical Equipment are composed of an enormous amount of components.Many of them fall under the hazardous category. Majority of these components contain toxic substances that have adverse impacts on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes that are in practice in most of the developing countries including India. Such offensive practices can have serious aftermath for those staying in proximity to the places where E-waste is recycled or burnt.

Disposal of E-wastes is an unembellished problem faced by many regions across the globe.Electronic wastes that are landfilled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. For example, Guiyu, Hong Kong a flourishing area of illegal E-waste recycling, is facing acute water shortages due to the contamination of water resources. This is due to disposal of recycling wastes such as acids, sludges etc. in rivers. Mercury leaches when certain electronic devices, such as circuit breakers are destroyed. The same is true for polychlorinated biphenyls (PCBs) from condensers. When brominated flame retardant plastic or cadmium containing plastics are landfilled, both polybrominated diphenyl ethers (PBDE) and cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ion are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, gets mixed with acid waters and are a common occurrence in landfills.In addition, uncontrolled fires may arise at landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD tetrachloro dibenzo-dioxin, PCDDs- polychlorinated dibenzodioxins. PBDDs-polybrominated dibenzo-dioxin and PCDFs-poly chlorinated dibenzo furans) from halogenated flame retardant products can be emitted1. The most dangerous form of burning E-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects the local environment and broader global air currents, depositing highly toxic byproducts in many places throughout the world.Incineration of E-waste possesses another threat. It can emit toxic fumes and gases, thereby polluting the surrounding air.Moreover, shipping of hazardous waste to developing countries is a major alarm. It happens because of cheap labour and lack of environmental legislations in developing countries.

E-waste products do not decompose or rot away. The disposal of e-waste is a particular problem faced in many regions across the globe. Environment and human health is affected by e-waste. E-waste takes up space in the communities it invades and can be very harmful to humans and animals. E-waste is of concern mainly due to the toxicity and carcinogenicity of some of the substances if processed improperly. As discussed in earlier issues of this journal, there is an urgent need to improve e-waste management covering technological improvement, institutional arrangement, operational plan, protective protocol for workers working in e-waste disposal and, last but not the least, education of general population about this emerging issue posing a threat to the environment as well as public health. To deal with the ever-growing issue of this new type waste various solutions and efforts are underway globally, some of such initiatives are discussed in this article.

Amongst the important initiatives in dealing with e-waste, one is "Plug-in to E-cyling". It is a partnership of Environmental Protection Agency (EPA) and consumer electronics manufacturers, retailers, and service providers that offers more opportunities to donate or recycle - to "E-cycle" used electronics. E-cycling includes recycling and recovers valuable materials from old electronics which can be used to make new products. It also includes reducing greenhouse gas emission, reducing pollution, saving energy and resources by extracting fewer raw materials from the Earth. Safe recycling of outdated electronic items promotes sound management of toxic chemicals such as lead and mercury and helps others. California's Department of Toxic Substances Control (DTSC) requires that used electronics be handled in an environmentally responsible manner. This means that old cellular phones , pagers , telephones and the like cannot be placed in the normal trash. Department of Environmental Health and Safety (EH and S) makes it easy to safely discard these devices. DTSC placed a number of drop-off locations around campus where electronic waste can be discarded. EH and S would collect these items and ensure that they are not sent to landfill for disposal. In fact, majority of these devices would be dismantled and recycled for other uses. Amongst the initiatives taken by developing nations the Nigerian initiative is an important one. To avoid being turned into a dumping ground for e-waste, the Nigerian government has decided to slap duties on old computers imported for spare parts. The decision was made at the federal executive council's meeting in Abuja. There is a growing market for computers and other information and communications technology equipment. But since Nigerians are financially hard-pressed, they mostly depend on affordable second-hand equipments or electronic spare parts. In the absence of proper waste management facilities, burning huge piles of refuse is a common practice in Nigerian cities.

In India also many initiatives regarding e-waste management have gained momentum. Of these, "E-Parisaraa" is a project supported by the Indo-German e-waste initiative. The pilot project to manage e-waste without causing ecological damage has been set up with the backing of the Karnataka State Pollution Control Board in Bangalore city, which would like to see the project replicated in other cities of the country as well. The business model is simple. Most software firms in Bangalore city have agreements with E-Parisaraa to collect their e-waste. E-Parisaraa pays these firms for the e-waste and brings it to their processing facility at Dobbespet in the outskirts of the city. What makes E Parisarra different is that unlike the backyard handling of e-waste, there is no melting involved in the sorting. The waste enters the disassembly-line process where it is dismantled and sorted in plastics, rubber and metal sheets. The leftover printed circuit boards and glass items such as tube lights and picture tubes go to the next stage where they are then cut into strips and powdered. A Delhi-based company has launched the country's first helpline dedicated to safe and environment-friendly disposal and recycling of e-waste. Toll-free telephone number is provided to get e-waste picked up from home and recycled. A few e-waste recycling companies providing e-waste management consultancy, electronic and electrical waste recycling are also working in some metropolitan cities. In future, the Mumbai Metropolitan Region (MMR) will soon be relieved of the ever growing problem of e-waste. The state government will start the first of its kind plant for scientific recycling of e-waste generated in the region. In Bangalore city installation of e-bins to ensure safe disposal of e-waste generated at government offices in is set to become a reality shortly. Saahas, the Jayanagar-based non-governmental organization (NGO) involved in this pioneering effort, plans to hold campaigns in government offices to create awareness about e-waste and the need to dispose it safely.

The term ‘waste’ usually relates to materials produced by human activity, and process is generally undertaken to reduce their effect on the health and environment. Waste that is not properly managed can create serious health or social problems in a community

In many countries, solid waste management has become a top priority. Solid Waste Management (SWM) is a system for handling of all type of garbage. The end goal is to reduce the amount of garbage clogging the streets and polluting the environment.

Climate change and effects of greenhouse gas emissions have made SWM, one of the most pressing environmental challenges globally as well as locally. It is well understood that inappropriate SWM practices, such as improper incineration and uncontrolled disposal of wastes are major contributors to greenhouse gas emissions.

Based on the source of generation, solid waste can be classified into residential, commercial, institutional, industrial, agricultural etc. There are mainly two categories of wastes based on the type-biodegradable and non-biodegradable.

This classification is based on physical, chemical and biological characteristics of wastes. Biodegradable wastes mainly refer to substances consisting of organic matter such as leftover food, vegetables and fruit peels, paper, textile, wood, etc, generated from various household and industrial activities. Because of the action of micro-organisms, these wastes are degraded from complex to simpler compounds. Non- biodegradable wastes consist of inorganic and recyclable materials such as plastic, glass, cans, metals, etc.

Tropical climates, on the other hand, are subject to sharp seasonal variations from wet to dry season, which cause significant changes in the moisture content of solid waste, varying from less than 50% in dry season to greater than 65% in wet months. Collection and disposal of wastes in the wet months are often problematic. High temperatures and humidity cause solid wastes decompose far more rapidly than in colder climates.In India usually a community storage system is practiced where individuals deposit their waste in bins located at street corners and at specific intervals. The containers generally are constructed of metal, concrete, or a combination of the two.

Community storage may reduce the cost of waste collection, and can minimize problems associated with lack of onsite storage space. However, unless these community storage arrangements are conveniently located, householders tend to throw their wastes into the roadside gutters for clearance by street sweeping crews.

Even where storage arrangements are conveniently located, wastes tend to be strewn around the storage area, partly due to indiscipline and partly as a result of scavenging of the wastes by rag-pickers and stray animals. While the petrochemical sector is regarded as the backbone of plastic production, it is also considered a yardstick for measuring global economic growth, wherein e-waste was processing and production is of vital importance. It is expected that in the current financial year (2018) exports would cross 8 billion USD with an increased growth of 9.5% in the first half of FY 2018 as compared to the past year. It is also envisaged that exports are expected to double in the next 5 years, owing to the growing domestic production.

However, at a matching rate the volume of e-waste has also grown over the years, not just in India, but globally. As per reports on the status of India, only 60 per cent of this waste even gets recycled. The major challenge, however, is segregation and re-aggregation of e-waste streams such as packaging waste, including laminated plastic.

In India, the quantity of "e-waste" or electronic waste has now become a major problem. Disposal of e-waste is an emerging global environmental and public health issue, as this waste has become the most rapidly growing segment of the formal municipal waste stream in the world. E-waste or Waste Electrical and Electronic Equipment (WEEE) are loosely discarded, surplus, obsolete, broken, electrical or electronic devices. In India most of the waste electronic items are stored at households as people do not know how to discard them. This ever-increasing waste is very complex in nature and is also a rich source of metals such as gold, silver, and copper, which can be recovered and brought back into the production cycle. So e-waste trade and recycling alliances provide employment to many groups of people in India. Around 25,000 workers including children are involved in crude dismantling units in Delhi alone where 10,000–20,000 tonnes of e-waste is handled every year by bare hands. Improper dismantling and processing of e-waste render it perilous to human health and our ecosystem. Therefore, the need of proper e-waste management has been realized. It is necessary to review the public health risks and strategies to combat this growing menace.

In India, solid waste management, with the emergence of e-waste, has become a complicated task. 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 is expected to exceed 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 authorized recyclers' facilities. 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) stated in a report that 50-80% of e-waste collected by the USA is exported to India, China, Pakistan, Taiwan, and a number of African countries. India is one of the fastest growing economies of the world and the domestic demand for consumer durables has been skyrocketing. 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, accelerating the rate of e-waste generation, which is around 10%, annually going to affect environmental health indicators.

Electronic equipments contain many hazardous metallic contaminants such as lead, cadmium, and beryllium and brominated flame-retardants. The fraction including iron, copper, aluminum, gold, and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70%. Of many toxic heavy metals, lead is the most widely used in electronic devices for various purposes, resulting in a variety of health hazards due to environmental contamination. Lead enters biological systems via food, water, air, and soil. Children are particularly vulnerable to lead poisoning – more so than adults because they absorb more lead from their environment and their nervous system and blood get affected. It is found that the e-waste recycling activities had contributed to the elevated blood lead levels in children living in China, which is one of the popular destinations of e-waste. This was due to that fact that the processes and techniques used during the recycling activities were very primitive. Various studies have reported the soaring levels of toxic heavy metals and organic contaminants in samples of dust, soil, river sediment, surface water, and groundwater of Guiyu in China. In the same areas, the residents had a high incidence of skin damage, headaches, vertigo, nausea, chronic gastritis, and gastric and duodenal ulcers. Further it was found that the blood lead levels of children were higher than the mean level in China, and there was no significant difference between boys and girls.

Methodology part

Vidyalankar School Of Information Technology Institute makes efforts to minimize e-waste. Non-working computers, monitors and printers are discarded on a systematic basis. 70% of monitors used by Institute are LCD to reduce e-waste. To manage e-waste e-bin is installed for e-waste collection which was provided by an NGO Ecoreco.

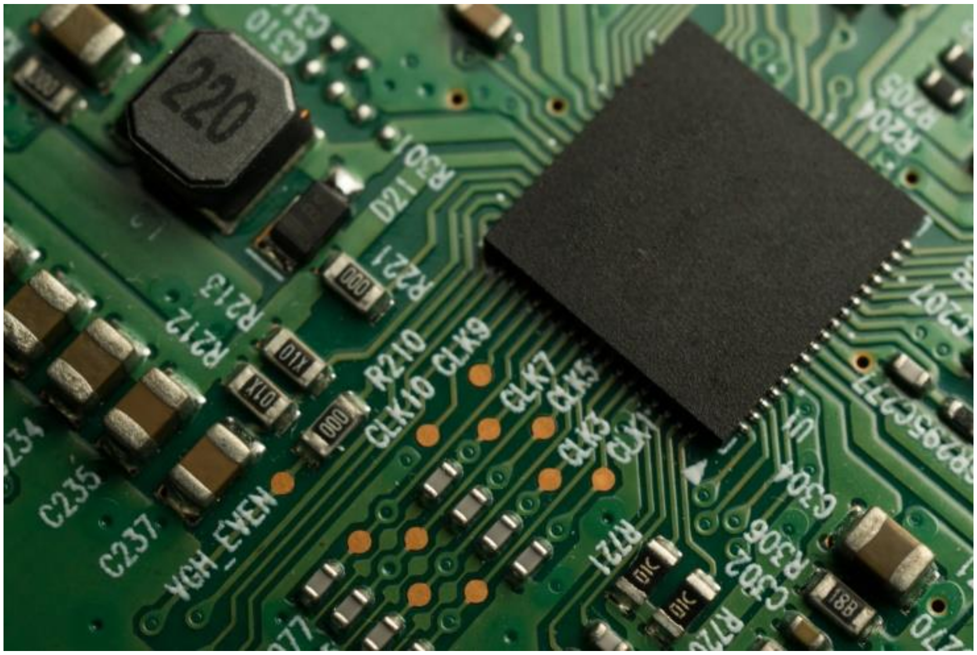
Green VSIT Club organizes e-waste collection drives from time to time to create awareness amongst the stakeholders of Institute.To motivate students and staff to reduce e-waste generation supporting sustainable development. To prevent adverse effects of E-pollution and maintain health and welfare of students and staff.

The recent collection was held on 28th February 2020, from 9am to 1pm, where all the students, teaching and non-teaching staffs were told to bring e-waste and drop it in the drop box as shown in the above picture. More than 500 people contributed in it and have collection of more than 550 E-waste. This E-waste was later taken by an NGO Ecoreco from college. The core committee team had gone class to class to make an aware about this campaign. The students were asked to write their name, stream, roll no, contact details, on the entry book. Also, there is a benefit of contributing E-waste, students get the certificate of participation so that they can add in their CV as a social activity.

The major reason for the domination by unorganised units is economics of metal recovery in the e-waste recycling business and abundance of low cost labour. The present situation does not appeal to the unorganised sector to divert waste materials to professional recyclers due to obvious economic reasons. They are compelled to extract precious metals mainly copper and gold through unhygienic practices. Due to their lack of knowledge, the recovery yield of the precious metals is very poor and, thereby, substantial percentage of the metals like cooper, gold, silver, and other precious metals (palladium, tantalum, platinum, etc.) are lost. The author feels that if suitable prices for the precious metal present in PCBs/connectors are offered to unorganised units, primitive extraction of metals can be discouraged. A study by government agency had predicted that electronic waste, comprising of personal computers, mobile phones, and televisions would reach 8,00,000 MT by 2012[9]. The unorganised operators can efficiently manage a large quantum of e-waste (~>95% by weight) without polluting the environment. Therefore, out of the estimated e-waste inventory, the 95% of the mass (7,60,000 MT) could have been easily managed by the unorganised sector without polluting the environment. The rest 5% of the weight (40,000 MT) of e-waste consists actually of PCBs and connectors, which need environmentally friendly recycling treatment to manage. In the proposed approach, unorganised units will concentrate on collection, disassembly, and segregations. The segregation of metals, glass and plastics from e-waste by non-destructive methods and channelizing them for further processing by professional smelters can be safely carried out by unorganised sectors as these will not harm the environment. The metal extraction from PCBs and connectors requires innovative approach for environment friendly disposal approach. In this article, a novel methodology involving unorganised sectors has been devised so that ill effects on the environment can be eliminated. The proposed approach will have following steps.

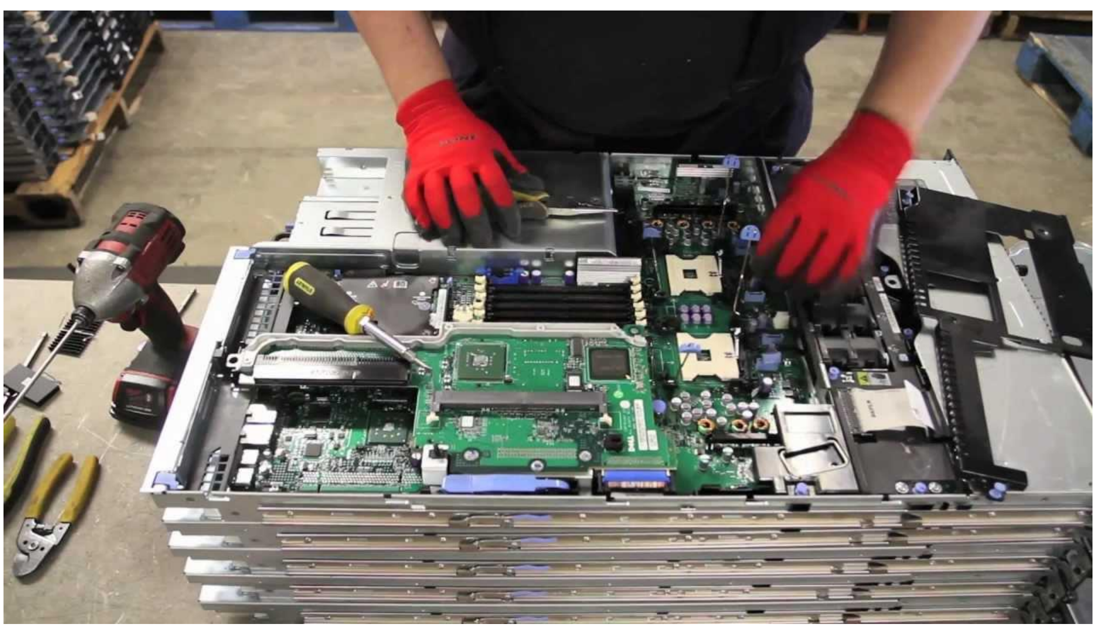
8.1. Step: 1 <u>- Collection, Disassembly and Segregation</u>: E-wastes will be collected by unorganized e-waste collectors (Kawaries) from various consumers from home, offices, industry and corporate houses, private and public organizations etc. The e-waste collectors (Kawaries) can form a co-operative domain. The collected e-waste will be segregated in to various categories, dissembled and segregated to separate populated PCBs and connectors. Variety of electronic, electrical (WEEE) products will be segregated from e-waste depending on their market demand. The concentrated e-waste will be created by manual removing of items such as glass components, metal fittings, screws, connectors etc., cables, heat sinks, plastic enclosures, fans, transformers, batteries etc. The kawaries can sell the recovered items with suitable market price. The PCBs and connectors are most valuable parts as it contains gold, silver copper and other precious metals. The treatment of the PCBs in primitive means by unorganised recyclers could be discouraged if one could ensure them to provide remunerative returns for collection and segregation of quality materials including gold rich PCBs. The populated PCB containing connectors, chips etc. will be separated for further process to recover precious metals such as copper, silver, gold, palladium, tantalum etc.

8.2. Step: 2 - Shredding, Crushing and Pulverization: Sustainable Electronic Waste Management and Recycling Process The pulverisation of populated PCBs and connectors and other gold rich components will be carried out to make homogeneous mixture of populated PCBs, obtained from various electronic products. The pulverised powders will primarily be assessed to know the exact quantity of saleable metals present in wide variety of populated PCBs. Once metal assay is completed, the pulverized powder will be subjected to appropriate metal extraction technology to separate different types of metal contents, also to liberate metals from plastic part of individual components and laminate of PCBs. The particle size of pulverized PCBs needs to be further processed by suitable method to improve the homogenized powder of PCBs. The pulverization will also help to maximize separation of metal particles from plastic to which it is normally adhered. The PCBs populated with whole range of passive, active, electro mechanical and inductive components in both leaded and surface mount configuration will be shredded in a mechanical shearing machine down to a size of about 3mm x 3mm. Finally, these shredded pieces will be subjected to dry grinding in a ball mill to a top size of 1.0 mm. The shredded materials will then be pulverized less than 1.0 mm size for liberation of metal and plastic by physical beneficiation techniques[1,3]. Fine shredding will be helpful to liberate metals from the cladding materials or composite laminates such as resin, fibreglass and plastics. In the proposed approach, the industrial acceptable standards of pulverization will be used to ensure the standardization of the powder with respect to their particle size distribution, homogenization, sampling procedure and sample collection. These industrial acceptable PCB powder would be analysed for metal assay content from international recognised laboratory.



8.3. Step: 3 - <u>Valuation Methods for PCBs</u>: Assay Metal Contents The metal rich powders are subjected to essay content by professional agencies having adequate instrumental facilities. It is essential as different metals in PCBs are very unevenly distributed. The standardized method of sampling and assay analysis of metal content in PCBs and subsequent certification from professional (private/public) agencies will be done to motivate unorganized recyclers to know the presence various metals in transparent manner. The exact quantitative data on the metal composition of PCBs in pulverized form can be obtained by using atomic absorption spectroscopy (AAS) or inductively coupled plasma/atomic emission spectroscopy (ICP/AES). This process includes acid or caustic leaching of the powdered material with, HCL, HF, in appropriate proportion and sequence. All of the metals can be extracted and determined by AAS or ICP/AES, using atomization by either flame or hydride system or graphite furnace. Although AAS can analyze a number of elements in the range of ppm or ppb concentration, it is more time and cost intensive. The standard sampling from homogenized pulverized powder is important for valuation method. The proper worth of the PCBs, segregated by unorganized sector will be decided from the assay analysis report, and the market value of the metal. The price of such powders can be ascertained in a transparent manner and suitable money can be paid to the collector. The confidence of e-waste collector can be earned in a progressive manner, thereby, encourage them to sell the collected populated PCBs to agencies for processing them in environment friendly manner.

8.4. Step: 4 - Metals Extraction:The pulverized PCB powder will then be sold to the professional authorised smelters who have the adequate knowledge and facilities to extract metals like lead, copper, gold, silver, palladium, platinum etc. The powder can be segregated into various groups containing rich copper rich, iron rich, aluminium rich, lead rich and other mixed metal rich. The magnetic separation can be used for separating iron, nickel and cobalt metal and aluminium will be separated by eddy current separation. The electrostatic separation will be used for separating plastic and metals and various embedded plastic and metal clusters are separated by gravity separation methods. The extraction of the precious metal will be carried out by the well-established techniques, which are discussed in details at various articles[1, 3-6, 15-17]. Alternatively, pulverized PCB powder can be pyrolysed with suitable technology to recover the precious metals. Through gasification or pyrolysis, over 50% of PCB powder will be decomposed and its total heat value nearly 20000MJ/Kg can be used as energy for metal recovery.



8.5.Step 5-Secure recycling:-Countries have developed standards, aimed at businesses and with the purpose of ensuring the security of Data contained in 'confidential' computer media [NIST 800-88: US standard for Data Remanence][HMG CESG IS5, Baseline & Enhanced, UK Government Protocol for Data Destruction]. National Association for Information Destruction (NAID) "is the international trade association for companies providing information destruction services. Suppliers of products, equipment and services to destruction companies are also eligible for membership. NAID's mission is to promote the information destruction industry and the standards and ethics of its member companies." There are companies that follow the guidelines from NAID and also meet all Federal EPA and local DEP regulations.

The typical process for computer recycling aims to securely destroy hard drives while still recycling the byproduct. A typical process for effective computer recycling:

1. Receive hardware for destruction in locked and securely transported vehicles.
2. Shred hard drives.
3. Separate all aluminum from the waste metals with an electromagnet.
4. Collect and securely deliver the shredded remains to an aluminum recycling plant.
5. Mold the remaining hard drive parts into aluminum ingots.

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FINDINGS

Global E-Waste Management Market is expected to garner $49.4 billion by 2020, registering a CAGR of 23.5% during the forecast period 2014 - 2020. It is one of the fastest growing waste streams in emerging as well as developed regions. The reduced life spans of electrical, electronic and consumer electronic devices are generating large E-Waste, which is growing rapidly every year. The growth of E-Waste market is supplemented by the growing need for upgrading to the latest technologies. A desire towards the adoption of new technologically advanced devices leads to generation of millions of tons of E-Waste across various regions. According to the United Nations initiative to estimate E-Waste production, the world produced approximately 50 million tons of E-Waste in 2012, on an average 15 of lbs per person across the globe. In 2012, UN also stated that, UK produced, 1.3 million tons of electronic waste. China generated 11.1 million tons of E-Waste, which was followed by United States that accounted for 10 million tons in 2012.

To reduce the E-Waste generated across the world, E-Waste management initiatives are being taken by the government agencies of various regions. Market players are taking measures to recycle the E-Waste in order to reduce the pollution and environmental hazards caused by it. In June 2014, Dell, a leading computer manufacturer, launched its first computer made of plastics obtained from recycled electronics. The company has started selling its first computer "the OptiPlex 3030" which is made up of old electronics using closed loop recycling process. Recently, Dell has also started using recycled plastics in its other desktops and monitors. Millions of refrigerators, TV sets and cell phones are replaced with newer versions due to user's growing inclination towards technologically advanced gadgets. In 2010, US discarded about 258 million units of computers, cell phones, TV sets and monitors. North America is a leader in exporting E-waste to the developing countries such as China and Japan. This exported E-Waste is then recycled in developing regions which generates revenue for the market.

This time the institute has collected more than 550 E-Waste comparing to the last which had collection about 400 E-Waste.

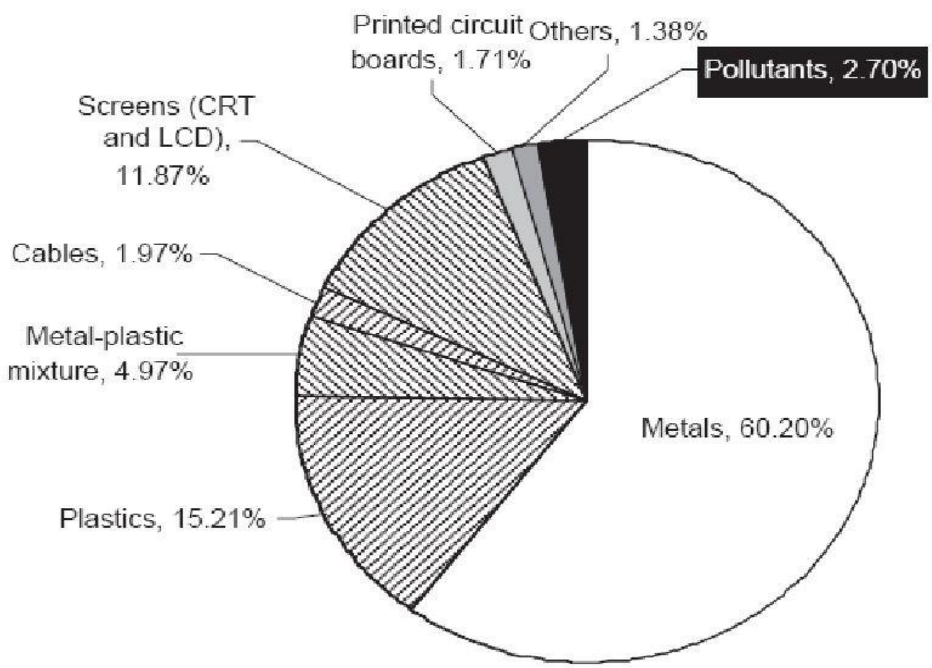
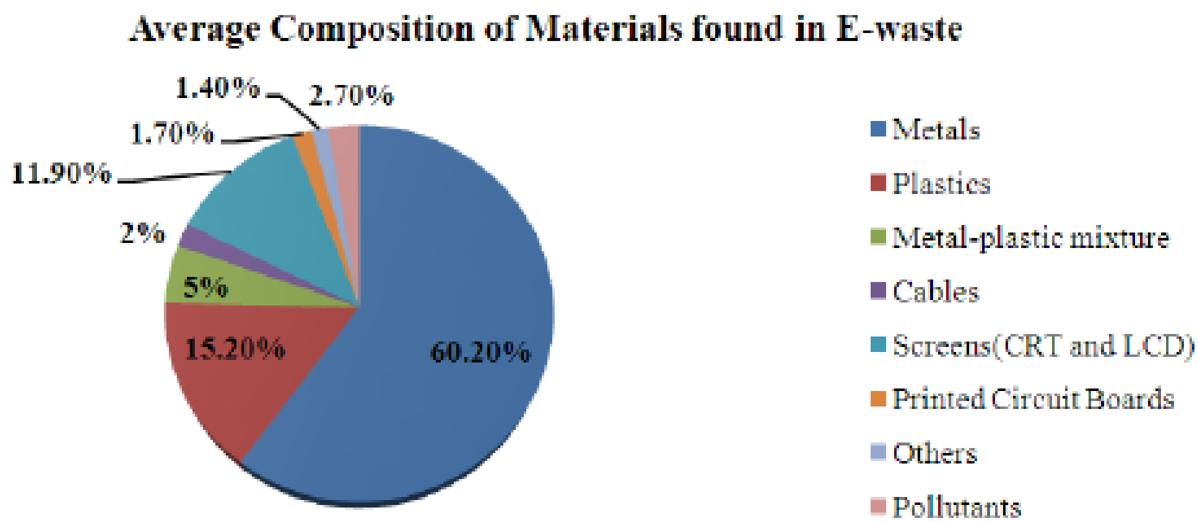


Fig: metals that can be recycled thought e-waste generated in campus per year

In Indian context, the electronics industry has emerged as the fastest growing segment of Indian industry both in terms of production and exports. The Information Technology Revolution of the early 1990s intensified the problem of E-waste in India. Sixty-five cities in India generate more than 60% of the total E-waste generated in India. Ten states generate 70% of the total E-waste generated in India. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of E-waste generating states in India. Among the top ten cities generating E-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur (Guidelines for Environmentally Sound Management of E-waste, 2008).

According to a Delhi-based non-governmental organization (NGO) Toxics Link, India annually generates $1.5 billion worth of E-waste domestically, with the booming IT sector being the largest contributor, as 30 percent of its machines reach obsolescence annually. Bangalore, the IT hub of India, alone generates 8,000 tons a year.

Annually, computer devices account for nearly 70% of e-waste, 12% comes from the telecom sector, 8% from medical equipment and 7% from electric equipment. The government, public sector companies, and private sector companies generate nearly 75% of electronic waste, with the contribution of individual household being only 16%.



The Average composition of Materials found in E-waste in 2019 include Metals, Plastics, Metal-plastic mixture, Cables, Screens (CRT and LCD), Printed Circuit Boards, Others, Pollutants. The percentage or average of this materials are as follows:

1. Metals is the highest composition of materials found in e-waste it is of 60.20%.
2. Plastics is the second highest composition of materials found in e-waste it is of 15.20%.
3. Screens (CRT and LCD) includes 11.90% of average composition of materials found in e-waste.
4. Metal-plastic mixture includes 5% of average composition of materials found in e-waste.
5. Cables includes 2% of average composition of materials found in e-waste.
6. Pollutants includes 1.70% of average composition of materials found in e-waste.
7. Others includes 1.40% of average composition of materials found in e-waste.

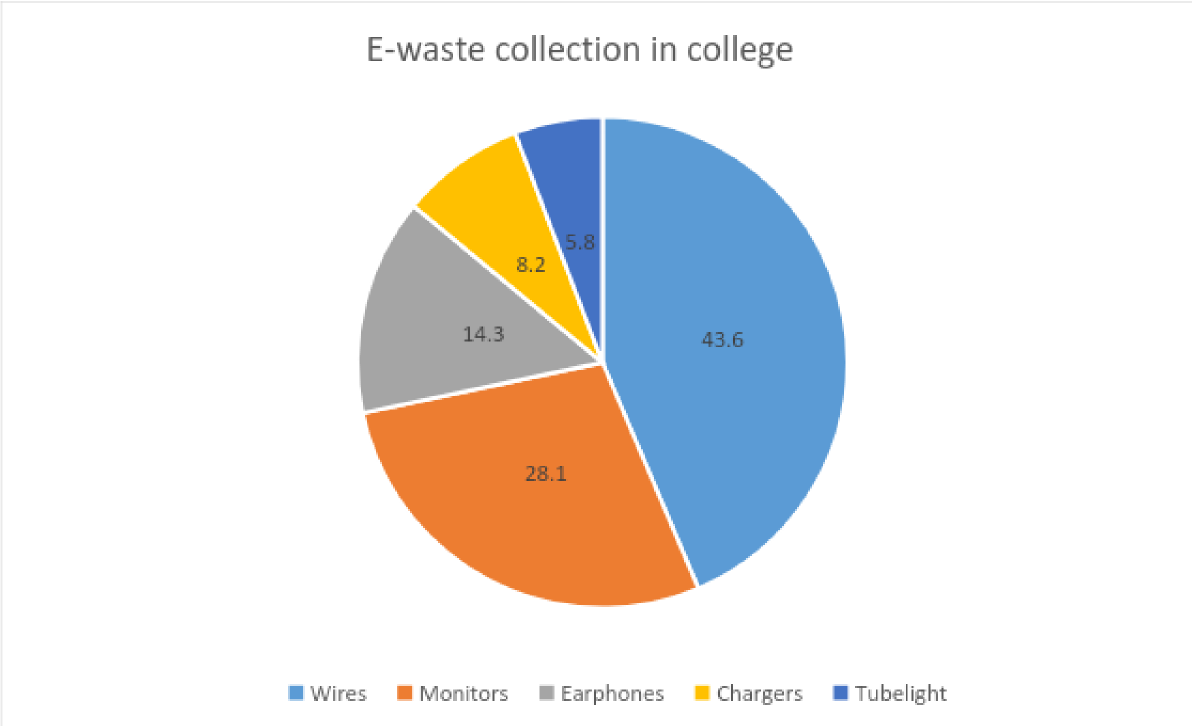
TOP CITIES IN E-WASTE:

TOP STATES	TONES
MAHARASHTRA	20,270
TAMIL NADU	13,486

ANDHRA PRADESH	12,780
UTTAR PRADESH	10,381
WEST BENGAL	10,059
DELHI	9,729
KARNATAKA	9118
GUJARAT	8,994
MADHYA PRADESH	7,800

TOP CITIES IN E-WASTE:

CITIES	TONES
PUNE	2,584
MUMBAI	11,017
SURAT	1,836
BANGALORE	4,648
AHMEDABAD	3,287
HYDERABAD	2,833



The E-waste collection in college are based on the electric waste which further will be recycled through a NGO. These are the materials which were mostly found in the e-waste campaign which was organized by an NGO named Ecoreco. The Materials were Monitors, Wires, Earphones, Chargers, Tubelight.

1. The average collection of e-waste in college of wires is 43.6% which is also the highest collection or highest average in the e-waste.
2. Monitors include 28.1% of average e-waste in colleges which is also the second highest e-waste material .
3. Earphones is of 14.3% of average e-waste which is been found.
4. Chargers are also included with 8.2% of average e-waste collection which is been found
5. Tubelight is found at lowest average which is of 5.8% in the campaign of e-waste collection in college.

FUTURE ESTIMATION OF E-WASTE

E-waste will increase as economies grow and new technologies are developed (Robinson B.H.2009). In order to develop capacity and awareness of e-waste, we have calculated future e-waste in all six Municipal Corporations. We have used the per capita e-waste generated, annual growth and number of units in each municipal corporation. It is explained in the following table.

E-WASTE ESTIMATED FOR FUTURE PERIOD (MT PER YEAR)

Municipal Co-orperation	2021	2031	2041
Mumbai	46663.20	63163.20	79663.20
Thane	4969.94	6406.34	7842.74
Kalyan-Dombivali	4466.52	5686.52	6906.52
Ulhasnagar	2825.46	3897.86	4970.26
Navi-Mumbai	4202.31	5154.91	6107.51
Mira-Bhayandar	2961.02	3907.12	4853.22
Bhiwandi-Nizampur	2797.27	3670.27	4543.27

Table shows that E-waste in Mumbai metropolitan region is increasing fast due to number of reasons. It is important to consider e-waste for different Municipal Corporations and periods. In 2012, the e-waste generated in Mumbai city is 31622.40MT but in 2041, it will reach up to 79663.20 MT. In 2051, it will be 96163.20MT. In city, the use of electronic items will rise very fast. Due to high income, standard of living and work preference, people will replace and buy electronic items. In Thane Municipal Corporation, the e-waste in 2012 is estimated as 3598.59MT. In 2051, it will be 9279.14MT. In Thane population, academic institutions and hospitals are the main drivers of e-waste. In Kalyan-Dombivali Municipal Corporation, the e-waste generated in 2012 is 3282.72MT. In 2051, e-waste in such municipal corporation will rise up to 8126.52MT annually. Industrial units will contribute more e-waste in this area. In Ulhasnagar, the e-waste in 2012 is estimated as 1769.15 MT but in 2051, it is estimated as 6042.66MT. Population growth and industrial development are the major determinants of e-waste in the area. In Navi- Mumbai, the e-waste in 2012 is 3254.11MT. In 2051, it is estimated as 7060.11MT. Navi Mumbai is a modern and planned city in MMR. It is twenty first century city, therefore population, theaters, education institutions will rise fast and therefore the e-waste generation would be very high. In Mira-Bhayandar Municipal Corporation, e-waste is 2006.64MT in the year 2012. But in 2051, it is estimated as 5799.32MT annually. There is moderate growth of all the constituents in corporation area till 2051. The e-waste will rise moderately and same along with other municipal corporations. In Bhiwandi-Nizampur, the e-waste is 1935.18MT in 2012 but in 2051, it is estimated as 5416.27MT. Again in this municipal corporation, there is moderate rise in the e-waste till 2051. In 2051, e-waste will be double of present e-waste in all municipal corporations of Mumbai Metropolitan Region. E-waste generation in Ulhasnagar, Mira-Bhayandar and Bhiwandi-Nizampur Municipal Corporation will be almost same in 2051. Such huge amount of e-waste in region sparks number of issues and problems. If ewaste issue is not taken seriously then metropolitan region will have water, air pollution. It will also affect on health of human being.

DISCUSSION

Aimed at small and medium-size businesses that recycle, refurbish or reuse electronic waste in India, the event will foster the exchange of experiences among experts, regulatory. The sound management of e-waste is an issue of concern to NAFTA partners due to a rapidly growing number of electronic devices disposed of each year, compounded by a lack of infrastructure and comprehensive strategies to face this challenge

Electronic devices—televisions, computers and cell phones among others—contain between 40 and 60 chemical elements, including precious and heavy metals, as well as persistent organic compounds and carcinogens that pose risks to human health and the environment if not treated appropriately.

By fostering the recycling and refurbishment of e-waste, the CEC also aims to help fight the illegal trade of these components in and from India

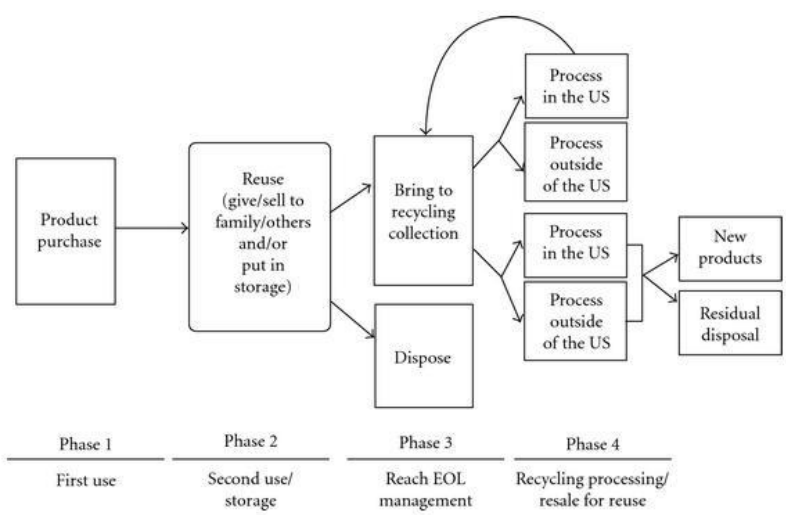
The coexistence of harmfulness and resource is a characteristic of e-waste. Non-standard dismantling activities will lead large quantities of pollutants to be released into the environment, and numerous studies have shown that the environment of e-waste dismantling areas has been polluted seriously, the pollution level of various environmental mediators around the dismantling areas are high, and all kinds of creatures, even the human body, are subject to the direct harm of pollutants, representing certain risks for the local ecosystem, dismantling workers and local residents. From 2002, the pollution problems caused by the e-waste dismantling has attracted the government and the public's attention, all levels of government departments have made a numbers of limitations in policies and laws. Besides cracking down on the illegal immigration of e-waste, the problem of e-waste dismantling needs cooperation from other countries' environmental protection departments, especially developed country'. In addition to the e-waste imported from abroad, our country has become the largest producer of electronic products. With the development of economic, the demand for a variety of electronic products will greatly increase, and all these electronic products will eventually be discarded. Therefore, the management for safe dismantling of 610 self-generated e-waste needs to be strengthened when we are cracking down on illegal immigration of e-waste.

According to a report published by UNEP in 2005, 80% of e-waste around the world had flowed into Asia, with 90% of e-waste flowed into China. On the other hand, the internal needs of our residents for a variety of electronic products is also increasing year by year, since 2013, China's self-generated electronic waste has reached 1.1 million tons per year, and the growth rate is more than 5%. Currently, the industry of e-waste dismantling is distributed in the coastal areas, where Guiyu, Guangdong and Taizhou, Zhejiang have become important bases for international electric and electronic waste. Gui yu which has a total area of about 52 square kilo meters is located in the west of Chaoyang District, Shantou City, Guangdong Province. It belongs to the subtropical climate zone, and the annual average temperature is 21.4C, with an average annual rainfall of 1515mm. The electronic waste dismantling activities have been raised in Gu iyu in the early 1990s. Currently, the amount of e-waste and electronic products and plastic recycled in Guiyu have reached 1.55 million tons annually. The division of “junk industry” in the villages of Gu iyu is more clear, the villages are divided into plastic villages, metal processing and utilization villages, electronic and circuit board dismantling villages, electric product dismantling villages, and wire and cable dismantling villages, according to the different types of waste for dismantling. Three villages of Huamei, Beiling and Nanyang which are located in the center of Guiyu are the main areas for e- waste dismantling, and Longgang, Xianpeng, Xianma, Dutou and other villages are mainly engaged in the waste plastic recycling. If the population of Guiyu is about 150,000, about 80% of families has been engaged in the dismantling and recycling industry of waste electric and electronic products as well as reproduced hardware plastic products. In addition, there are about 200,000 migrant workers in Guiyu, almost all of them have involved in the local e-waste industries. Guiyu has formed a relatively complete industrial chain from garbage collection to dismantling, and from the processing to marketing, the output value of this industry accounts for more than 90% of the gross industry output value in this town, make it become a pillar industry in the local economy and the main source of farmers’ income.

In many cases, the cost of recycling e-Waste exceeds the revenue recovered from materials especially in countries with strict environment regulations. Therefore, e-Waste mostly ends up dumped in countries where environmental standards are low or nonexistent and working conditions are poor. Historically Asia has been a popular dumping ground, but as regulations have tightened in these countries, this trade has moved to other regions, particularly West Africa Most developing countries lack the waste removal infrastructure and technical capacities necessary to ensure the safe disposal of hazardous waste. And e-Waste has been linked to a variety of health problems in these countries, including cancer, neurological and respiratory disorders, and birth defects. Therefore, the fight against illegal imports of WEEE has become one of the major challenges. From another perspective, some regulations, which have beenestablished to handle e-Waste, are often limited since they exclude many hazardous substances that are used in electronics. Moreover, many regulations simply fail to address the management of e-Waste.

Osibanjo states that in Africa, for example, there is a highly ineffective infrastructure for e-Waste management. More precisely, there is no well-established system for separation, sorting, storage, collection, transportation, and disposal of e-Waste. Even worse, there is little or no effective enforcement of regulations related to e-Waste management and disposal. Under these circumstances, practical e-Waste management in Africa is unregulated, and rudimentary techniques are widely used. These techniques include manual disassembly of WEEE without concern of the hazardous chemicals, heating printed circuit boards (PCBs) to recover solder and chips, melting and extruding flame-retardant plastics, and burning plastics to isolate metals; generating an average of US $6 worth of material from each computer (Basel Action Network). This value is not much especially considering the environmental and health costs of burning plastic, sending dioxin and other toxic gases into the air and the large volumes of worthless parts dumped in nearby landfills, allowing the remaining heavy metals to contaminate the area and harm life.

In order to predict the number of units and the tons of e-Waste for the targeted years, Microsoft Excel was used to apply linear regression technique. Framework for modeling the product lifecycle is illustrated in. For Phase 1, we assembled product sales data, as well as data on the average weight of products by year. The model considered product sales from 1980 through 2007 and predicted the annual quantity needing end-of-life (EOL) management through 2007



The modeling effort resulted in estimates of the quantity of products that are generated annually for EOL management. EOL management consists of recycling or disposal. This corresponds to the two options in Phase 3 of “Dispose” or “Bring to Recycling Collection.” Disposal was estimated as the difference between what was generated for EOL management and what was recycled

When China banned 24 kinds of solid waste last September, countries such as the U.S., the United Kingdom, Australia, and Japan realized they had a big problem. Until last year,of the world's electronic waste—discarded computers, cell phones, printers, televisions, India accepted 70 percentage of e-waste of microwaves, smoke alarms, and other electronic equipment and parts. After India stopped accepting this e-waste out of concern for its environment, Europe and North America began shipping more of it to Southeast Asia—but now Vietnam and Thailand, whose ports have been overwhelmed, are curbing imported e-waste as well.

In 2016, the world's population discarded 49 million tons of e-waste (equivalent to about 4,500 Eiffel Towers). It's estimated that by 2021, that number will grow to more than 60 million tons.

Meanwhile, the life span of devices is getting shorter—many products will be thrown away once their batteries die, to be replaced with new devices. Companies intentionally plan the obsolescence of their goods by updating the design or software and discontinuing support for older models, so that now it is usually cheaper and easier to buy a new product than to repair an old one. Meanwhile, the companies continue to profit from steady sales. And because prices are dropping, electronic devices are in demand around the world as a growing middle class goes digital. Globally, half of all households now have internet access, and 7.7 billion people have cell phones.

Electronic devices also comprise toxic heavy metals like lead, mercury, cadmium and beryllium, polluting PVC plastic, and hazardous chemicals, such as brominated flame retardants, which can harm human health and the environment.

In 2016, the estimated value of recoverable materials in global e-waste was $64.6 billion, but only 20 percent of it was properly recycled to enable recovery of the valuable materials. Much of the rest is dumped in landfills where toxic chemicals can leach from the e-waste and end up contaminating the water supply.

As more people buy electronic equipment, manufacturers are beginning to face shortages of the raw materials needed to make their products, so reclaiming and reusing the materials from discarded products and waste—a process called urban

Recycling e-waste is practiced both formally and informally.Proper or formal e-waste recycling usually involves disassembling the electronics, separating and categorizing the contents by material and cleaning them. Recycling e-waste is practiced both formally and informally.

Proper or formal e-waste recycling usually involves disassembling the electronics, separating and categorizing the contents by material and cleaning them. In order to reduce e-waste, manufacturers need to design electronics that are safer, and more durable, repairable and recyclable. Most importantly, this means using less toxic materials. Chemical engineers at Stanford University are developing the first fully biodegradable electronic circuit using natural dyes that dissolve in acid with a pH 100 times weaker than vinegar. One group of scientists is pulverizing e-waste into nano dust by cooling the various materials, then grinding them up into homogenous powders that are "easy to reuse." Canada-based Ronin8 has developed a technology that uses minimal water and energy as it separates metals from non-metals through sonic vibrations in recycled water Extended producer responsibility requires companies that make products to be responsible for the management and disposal of them at the end of their lives. The idea is to turn waste materials into a resource for producing new products. The New York State Electronic Equipment Recycling and Reuse Act requires manufacturers to provide consumers with free and convenient e-waste recycling.

To reduce health and environmental hazards while maintaining the informal recycling system that supports so many people, India and China are looking at ways to integrate the informal and formal recycling systems. One strategy would give informal recyclers financial incentives to divert e-waste to formal collection or recycling centers. For example, they could be paid more to deliver cathode ray tube screens to a formal collection center than they would get for dismantling it by hand themselves. The best thing you can do is to resist buying a new device until you really need it. Try to get your old product repaired if possible and if it can't be fixed, resell or recycle it responsibly. Before you recycle your device, seal up any broken parts in separate containers so that hazardous chemicals don't leak. Wear latex gloves and a mask if you're handling something that's broken.

China and by 500 per cent in India. Additionally, e-waste from discarded mobile phones would be about seven times higher than 2007 levels and, in India, 18 times higher by 2020.19 Such predictions highlight the urgent need to address the problem of e-waste in developing countries like India where the collection and management of e-waste and the recycling process is yet to be properly regulated. According to the UN Under-Secretary General and Executive Director of the United Nations Environment Programme (UNEP), Achim Steiner, China, India, Brazil, Mexico and others would face rising environmental damage and health problems if e-waste recycling is left to the vagaries of the informal sector. China already produces about 2.3 million tonnes of e-waste domestically, second only to the U.S. with about three million tonnes.20 The EU and the U.S. would account for maximum e-waste generation during this current decade. As per the Inventory Assessment Manual of the UNEP, 2007, it is estimated that the total e-waste generated in the EU is about 14-15 kg per capita or 5MT to 7MT per annum. In countries like India and China, annual generation per capita is less than 1kg.21 In Europe, e-waste contributes up to 6 million tonnes of solid waste per annum. The e-waste generation in the EU is expected to grow at a rate of 3 per cent to 5 per cent per year. In the past, e-waste had increased by 16 per cent to 28 per cent every five years which is three times faster than average annual municipal solid waste generation. In the U.S., e-waste accounts for 1 to 3 per cent of the total municipal waste generation. As per the United States Environmental Protection Agency (USEPA), it generated 2.6 MT of e-waste in 2005, which accounted for 1.4 per cent of total wastes. Electronic waste is generated by three major sectors in the U.S

Advantages of recycling E-Waste:

Vast quantities of phones, appliances and other electronic waste (e-waste) end up in landfill every day, even though most of it can be recycled.

E-waste can be anything that is no longer needed and plugs into a power point or runs on batteries, including old televisions, refrigerators, lighting and even hearing aids.

Australia is one of the world's biggest producers of e-waste, so every effort to recycle electronic waste at home and work helps.

Here are five advantages of recycling e-waste

1. It protects the environment

Recycling e-waste can keep a range of harmful materials out of the environment.

Lighting, including fluorescent tubes and lamps, contains toxic mercury that can leach into waterways when it is thrown into landfill.

However, when lighting is recycled, the mercury is recovered and safely used again in products like dental amalgam.

The same goes for batteries, which can feature lead, mercury and cadmium.

For example, when a lead-acid battery is recycled, the plastic parts and toxic lead are recycled, while the sulphuric acid is neutralised and then converted into sodium sulphate to make fertiliser and detergent.

2. It reduces business costs

E-waste recycling is not only good for mother nature, it can also be good for a business' bottom line.

Most state and territory governments have now incentivised e-waste recycling by hiking the cost of dumping or outright banning it.

There are also some non-tangible dividends of recycling to consider, such as lowering the future costs of non-renewable materials and boosting staff morale and retention.

3. It supports non-renewable recycling

The growing demand for electronic devices and appliances means a range of metals and other non-renewable resources need to be mined and processed.

However, many of the materials used to make smartphones, appliances and other e-waste can be re-used again.

These resources include steel, aluminium, copper and gold — not to mention large amounts of plastic that can be turned into new products.

Recycling e-waste puts these materials back to work after you're done with your device, while dumping e-waste in landfill means more resources need to be dug up to make your next laptop or TV.

4. It shows your eco-friendly credentials

Employees increasingly want to work for businesses that do their part for the environment and the community.

Recycling is a simple and tangible way to demonstrate your organisation's commitment to social and environmental values, and reinforces those principles to your employees.

Ecocycle provides recycling certificates that illustrate your achievements, and also outline how your business is performing against your own green goals.

5. It's super easy to recycle e-waste

Recycling e-waste has never been easier.

There are a range of places and businesses where you can drop off an old phone, TV or other household appliances.

It can save natural resources

Most of the natural resources happen to be non-renewable in nature. With e waste recycling, the valuable components can easily be separated and allowed to recover. This allows the production of new items with the use of the same components. This allows reducing pollution, save the resources and also save energy.

It can minimize pollution

E wastes have a lot of toxic chemicals which are harmful for the health of human beings, as well as the environment. Those around electronic wastes are always at risk of suffering from some serious ailments and health disorders, due to breathing of toxic chemicals in these materials. Once e-wastes are allowed to remain on the land in an unprocessed form, they can contaminate ground resources. By recycling e waste matters, you can reduce the amount of pollution in soil, water and air.

It can lower landfill space

By opting for electronic waste recycling Adelaide, you can lower the amount of space required for landfills which are the areas that are needed to cover waste materials. By reducing space needed for landfill purposes, you can ensure that these areas can be used for housing or agricultural purposes.

It can create employment

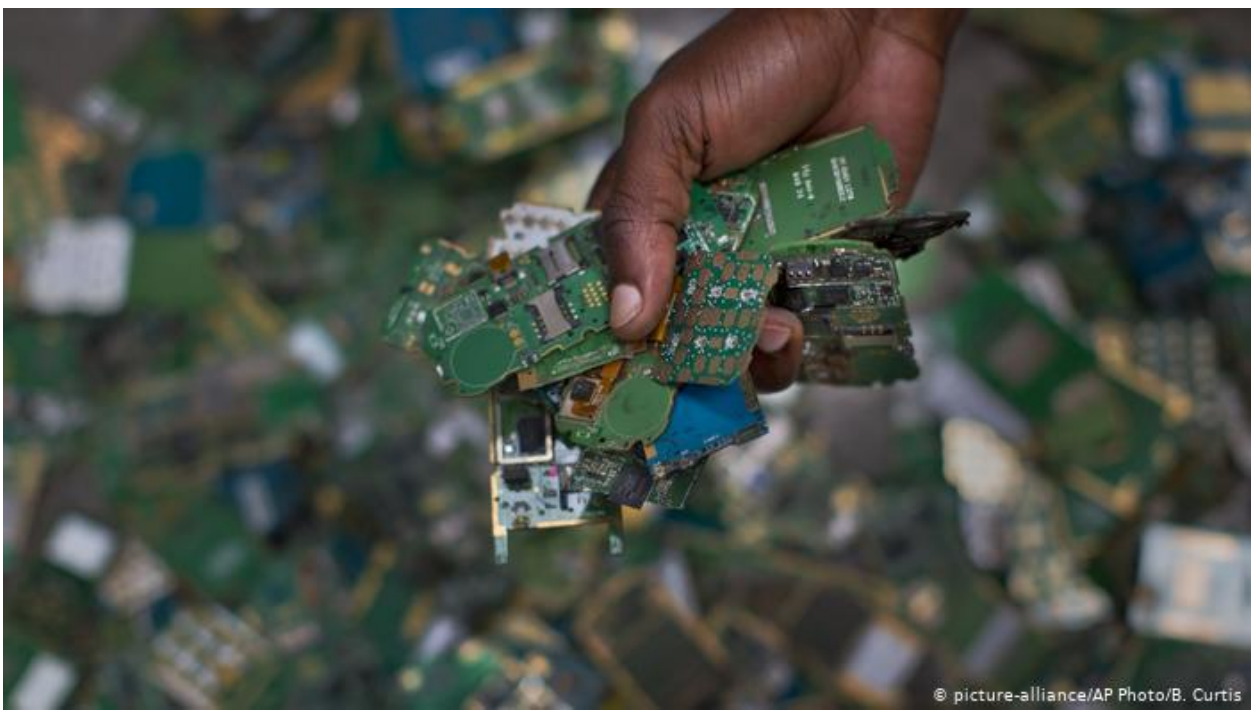
With recycling, more and more employment opportunities can be created. With more e waste recycling facilities being set up and the existing agencies hiring more employees for the reprocessing, you will be able to save nature and support the economy.

It can prevent long-term damage

Exposure to nickel, cadmium, lithium, mercury, glass and various other components contained within electronic materials can cause long-term damage to health and the environment. There can also be cancerous developments in some cases, which is not uncommon. Other than humans, domesticated animals and pets may also suffer from cancers and other conditions. This can affect livestock and meat products, and affect the health of grown-ups as well as kids. With recycling, you can prevent all such issues and safeguard health and ecosystem.

Disadvantages of E-Waste

- E-waste contains a lot of harmful chemicals such as lead in CRTs of computers and mercury in flat panel display screens. This can be absorbed by humans through contaminated drinking water.
- E-waste can affect the environment as well as humans.
- The process of recycling means burning wires to recover metals, melting circuits and also acid stripping. Just this causes so many problems to the environment.
- Long-term affects on our planet are still unknown.



CONCLUSION

E-waste is is a relatively new segment in the global problem of waste removal. It is also the fastest growing segment worldwide in discarded waste. This growing problem in the world is largely ignored or misunderstood. Many people do not understand what it is or how it affects them, the world, or the environment. So the question "What is e--waste" needs to be addressed before any solutions can be effective. E-waste comes from the improper disposal of any number of electronic devices. These devices include computers, televisions, cell phones, or most other electronic equipment. Consumers in developed nations are quick to replace their devices because of continuous technological advances. This upgrading leads to an excess of unused electronic devices. What is done with old computers and phones is what is contributing to the ewaste problem. Some people understand the importance of properly disposing of these old units, but many more still throw them in the garbage or incinerators.

Most developed nations in the world have laws and regulations requiring that ewaste not be disposed of in landfills or be incinerated. Cities and states have set up programs accross the United States where consumers can drop off used electronic devices to be properly disposed of. The best method of disposal is to recycle this equipment. Many people do not understand that the parts in old devices can be reused in new products. There is a popular mantra used by many recylcing advocates, "Reduce, Reuse, and Recycle." This slogan has widely been promoted with plastics and glass, but its message is also applicable to the disposal of ewaste. Many electronic stores offer services to help customers bring in old electronics or parts so as to dispose of them safely and properly.

Unfortunately, there is another alternative being used for the removal of ewaste in the world. Much of the e-waste in developing nations is being exported to developing countries. Many developed countries have enacted laws to prevent this from happening, but ewaste is still often being exported. The bulk of the world's e-waste is being shipped to Nigeria, Ghana, Pakistan, India, and China, among others. While it seems odd that a country would willingly import another's waste, the waste is imported, sometimes illegally. This practice provides jobs and valuable scraps. Ewaste is a source of valuable metals such as gold, nickel, copper, iron, and silicon. The countries that are receiving this ewaste have lax laws protecting their workers or the environment. Many of the workers are children, or are working countless hours each day. There is also the reality that much of the refuse from electronic devices is hazardous. The dumping of these materials following the harvesting of scrap can lead to contamination of soil or water, damaging an area's environment and potentially their food sources.

The proper management e-waste is very new and upcoming concept even in an IT specialist country like India. Our nation is producing e-waste not less than any developed country. Moreover, our country is on receiving end to accept e-waste from many developed nations which increases this problem many folds. The reviews of various research focus on variety of aspects of research under study. According to reviews maximum proper practices are accepted and adopted by many developed nations and it is very important to understand and find out what sort of practices and up to what extend these practices are carried out in our own country where environmental related laws and rules are not that stringent and observe that effectively. Our country is a proper mix of developed, developing and under-developed areas, and Mumbai, economical capital and area under research is the best representative of this mixture where MPCB (State government pollution control board), Private players, and unorganized sectors like slum areas (sakinaka, Andheri, Kurla, Panvel-Taloja, Thane, Ulhas nagar, Bhiwandi and many others) follow and undertake different practices to tackle this problem at their own level.

The purpose of this webquest was to alert students and make them aware of the problem. Tons and tons of ewaste is dumped each year and the problems continues to grow. The tasks we have assigned are intended to increase awareness of this global situation and encourage students to research not only the problem, but potential solutions. The numbers are mind blowing and awareness is a good way to begin resolving or attending to the problem.

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