

E-WASTE MINING FOR REFUSING, REDUCING, REUSING, REPAIRING, REFURBISHING REMANUFACTURE, REPROCESS, RECYCLES AND RECOVERY OF E- WASTE MANAGEMENT TOWARDS SUSTAINABLE DEVELOPMENT IN INDIAN SCENARIO:

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Abstract:

E-waste consists of Waste Electrical and Electronic Equipment (WEEE) The term E-Waste applies to all the wastes from or caused by Electronic items. E-Waste Mining is a simple technique where e-waste can be dumped in an open pit and then using the usual mining techniques the metal and mineral components used in the electrical and electronic products can be extracted.

Objectives

- To identify the components, Sources and causes/reasons for E-Waste.
- Identifying e-mining/manufacture both the formal and informal recyclers allowing for their maximum but safe participation in future e-waste management
- Identifying the Importance of 3R's, 5R's & 9R's to attain sustainable Development.
- Reduce the health risks of the population and the pollution of the environment resulting from unsafe handling.
- Focus on Knowledge transfer to and skills upgrade of all involved stakeholders through training and seminars/conferences.
- To create awareness among the public towards e-waste management, to safeguard the environment.

Methodology

This study is designed as a descriptive analysis based on secondary data. The data are drawn from various published and unpublished records of the various Departments, besides journals, articles, books, reports and website sources.

Results

E-Mining and 9R's such as Refusing, Reducing, Reusing, Repairing, Refurbishing Remanufacture, Reprocess, Recycles and Recovery is the efficient waste management enables the protection of human health,

reducing environmental pollution, saving of natural resources, Create Jobs, Protects our surrounding and saves Landfill space and achieving sustainable and profitable management of e-waste.

Conclusion

There are 10 States that contribute to 70 per cent of the total e-waste generated in the country, while 65 cities generate more than 60 per cent of the total e-waste in India. In fact e-waste has far higher concentration of the metals than raw ore. This mining is both economically and environmentally sustainable. If we all aware of our duties and responsibility, definitely we can achieve-Waste Management and the Sustainable Development of Our Nation.

Introduction

Advances in the field of science and technology brought about industrial revolution in the 18th Century which marked a new era in human civilization. In the 20th Century, the information and communication revolution has brought enormous changes in the way we organize our lives, our economies, industries and institutions. *The technological boom has led to a fierce increase in the demand of electronic products in India. These electronic products; which were considered to be a luxury in the past, in the present have become a burning need of almost every individual.* These spectacular developments in modern times have undoubtedly enhanced the quality of our lives. At the same time, these have led to manifold problems including the problem of massive amount of hazardous waste and other wastes generated from electric products. These hazardous and other wastes pose a great threat to the human health and environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and environment. It constitutes a serious challenge to the modern societies and requires coordinated efforts to address it for achieving sustainable development.

E-waste Mining/Manufacturer/Industries



E-Waste Mining is a simple technique where e-waste can be dumped in an open pit and then using the usual mining techniques the metal and mineral components used in the electrical and electronic products can be extracted. In fact e-waste has far higher concentration of the metals than raw ore. This mining is both economically and environmentally sustainable.

E-waste mining is a process where valuable materials like gold, copper, iron and plastic are extracted from the circuitry of computers and cell phones, by using same techniques that miners “use to process mineral ores and there's plenty to dig from,” says Satish Sinha, Associate Director of Toxics Link, an NGO that deals with environmental issues. “The junk that we are throwing away contains more aluminum, gold and copper than we find in the ores. These metals are used in the circuit boards of computers and electronic gadgets.” One tons of scrap from discarded computers contains more gold that can be produced from 17 tons of gold

ore. Mumbai alone throws away 20,000 tons of electronic waste a year, excluding the large e-waste imports from developed nations through its port. The trend is likely to increase manifold in proportion to the growth in the electronics industry and the life-span of electronics go down. The projected growth for the e-waste generation for India is about 35 per cent year on year.

A large-scale **organised** e-waste recycling facility, the Attero Recycling Plant in Roorkee opened in January 2010. Despite 23 units currently registered with the Government of India, Ministry of Environment and Forests/ Central Pollution Control Board, as e-waste recyclers/reprocesses, having environmentally sound management facilities, the entire recycling process more or less still exists in the **unorganised** sector. The Ministry of Environment and Forests (MoEF) has notified the Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008 for effective management of hazardous wastes, including e-waste in the country. But these rules do not apply to the radioactive wastes such as Cobalt – 60 which are covered under the Atomic Energy. Attero Recycling uses a two-pronged strategy to tackle the problem of e-waste – refurbishing and recycling. If a product received by Attero can be refurbished it is repaired, tested, packaged and re-sold. If refurbishing is not an option, the product goes to the recycling routine.

Currently, there are 23 **formal/organized** recycling and reprocessing units having environmentally sound management facilities which are registered with the Central Pollution Control Board (CPCB) located in Andhra Pradesh, Karnataka, Maharashtra, Haryana, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttarakhand. The formal units perform collection, segregation, and shredding and resource recovery employing automated, semi-automated or manual operations for the recycling of e-waste. Some of the viable recycling facilities in the formal sector are the Attero Recycling Plant in Roorkee, Uttarakhand, E-Warrrd and E-Parisara in Bengaluru and Earth Sense in Hyderabad. That the e-waste sector can be made into a viable business model is indicated by a Bengaluru-based successful conglomeration of 70 informal/unorganised recyclers – *kabariwalas*- called the Harit

Other recycling and re-processing units registered with the MoEF/CPCB are Ramky E-waste Recycling Facility (Ramky Engineers Ltd.) in Andhra Pradesh; Ash Recyclers, Unit-II, New Port Computer Services (India) Private Limited, Surface Chem Finishers, E-R3 Solutions Pvt. Ltd. and Ash Recyclers, Unit-I in Karnataka; Eco Recycling Pvt. Ltd., Hi-Tech Recycling India (P) Ltd. In Maharashtra; Green scrape eco Management Pvt. Ltd. in Rajasthan; Trishyiraya Recycling India Pvt. Ltd., TES AMM Private Ltd., Global E-waste Management and Services (GEMS), Victory Recovery & Recycle Technologies India Pvt.Ltd., Ultrust Solutions (India) Pvt. Ltd., INAA Enterprises in Tamil Nadu; TIC Group India Pvt. Ltd. in Uttar Pradesh and Jhagadia Copper Ltd. in Gujarat. There are also two other e-waste recyclers in Gujarat namely, MCT Enviro Infrastructure Ltd. and E-process House.

E-Waste components

E-waste consists of Waste Electrical and Electronic Equipment (WEEE) are loosely discarded, E-waste surplus, obsolete, broken, electrical or electronic devices all waste from electronic and electrical appliances which have reached their end- of- life period or are no longer fit for their original intended use and

are destined for recovery, recycling or disposal. It includes computer and its accessories monitors, printers, keyboards, central processing units, i-pods, typewriters, fax machine, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD&LED/Plasma TVs, air conditioners, refrigerators and other household appliances. The composition of e-waste is diverse and falls under 'hazardous' and 'non-hazardous' categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete, ceramics, rubber and other items. Iron and steel constitute about 50 per cent of the waste.

Meaning of (3 R's, 5R's & 9rs) such as Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurposes/Reprocess, Recycles and Recovery: Learn how reducing, reusing/refurbishing and recycling/preprocessors/Recovery can help our community, and the environment by saving money, energy, and natural resources. Recycling programs are managed at the central, state and local level-find information on recycling in your community to attain sustainable development.

Reduce

The most effective way to reduce waste is to not create it in the first place. Making a new product requires a lot of materials and energy: raw materials must be extracted from the earth, and the product must be fabricated and then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money.

Volume reduction

Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These techniques are usually to reduce the volume, and thus the cost of disposing of a waste material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: **source segregation** and **waste concentration**. Segregation of wastes is in many cases a simple and economical technique for waste reduction. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc. For example, an electronic component manufacturer can use compaction equipments to reduce volume of waste cathode ray-tube.

Benefits of Reducing and Reusing

- Prevents pollution caused by reducing the need to harvest new raw materials;
- Saves energy;
- Reduces greenhouse gas emissions that contribute to global climate change;
- Helps sustain the environment for future generations;
- Saves money;

- Reduces the amount of waste that will need to be recycled or sent to landfills and incinerators;
- Allows products to be used to their fullest extent.

Recovery and reuse

This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a salable waste. E-Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. For example, a printed-circuit board manufacturer can use electrolytic recovery to reclaim metals from copper and tin-lead plating bath. However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use nonhazardous materials, such recycling is a false solution. In the realm of E-waste, **reuse** means the equipment is still working and can be sold or donated, thus continuing the "life" of the product.

Ideas on How to Reduce and Reuse

- Buy used. You can find everything from e-waste materials at specialized reuse centers and consignment shops. Often, used items are less expensive and just as good as new.
- Look for products that use less packaging. When manufacturers make their products with less packaging, they use fewer raw materials. This reduces waste and costs. These extra savings can be passed along to the consumer. Buying in bulk, for example, can reduce packaging and save money.
- Buy reusable over disposable items. Look for items that can be reused; the little things can add up. For example, you can bring your own silverware and cup to work, rather than using disposable items.
- Maintain and repair products and appliances, so that they won't have to be thrown out and replaced as frequently.

Refurbishment

It is the distribution of products (usually electronics) that have been previously returned to a manufacturer or vendor for various reasons. Refurbished products are normally tested for functionality and defects before they are sold, and thus are the approximate equivalent of certified pre-owned cars.

The main difference between "refurbished" and "used" products is that refurbished products have been tested and verified to function properly, and are thus free of defects, while "used" products may or may not be defective. Refurbished products may be unused customer returns that are essentially "new" items, or they may

be defective products that were returned under warranty, and resold by the manufacturer after repairing the defects and ensuring proper function. Other types of products that may be sold as "refurbished" include:

- Items used in field tests, sales displays or demonstrations.
- Items returned for reasons other than defect and tested by the manufacturer.
- Items returned to the manufacturer because the box or item was damaged in shipping.
- Previously leased units that are turned in and resold after the lease ends.
- Used electronics that have been turned in to an electronic recycling program.
- Used items that have been donated to a charity or non-profit organization.

Different companies and industries may have different types of "refurbished" products. Since the electronics industry doesn't have a firm, widely accepted definition of "refurbished", its exact meaning may vary from one product to the next or one company to the next. In various cases "refurbished" may be synonymous with "used", "reconditioned", "remanufactured", "refreshed", "recycled", "repaired", or "like new". Merchants do not often specify the exact reason an item is "refurbished", so buyers may be assuming some.

Recycling

Electronics "recycling" is a misleading characterisation of many disparate practices, including de-manufacturing, dismantling, shredding, burning or exporting. Recycling is mostly unregulated and often creates additional hazards itself. Although the amount of e-waste rises steadily, the industry has not yet developed very sophisticated or Radios and televisions are devices that can be found in nearly every home. Personal computers (PCs) assisted us first in our offices, then in our homes, and now during our travels as laptops as well as pocket-PCs. Personal digital assistants (PDAs) are expected to make our lives easier. Today, e-waste comprises more than 10 per cent of all municipal solid waste, which is nearly the same amount as all plastic packaging, and is growing steadily. E-waste contains hazardous but also valuable and scarce materials, recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved and air and water pollution caused by hazardous disposal is avoided. Additionally, recycling reduces the amount of greenhouse gas emissions caused by the manufacturing of new products and diminished use of landfills.

Benefits of e-waste Recycling

- Conserve the Natural Resources, that to non-renewable resources are safeguarded
- Create Jobs
- Protects our Surroundings

- Saves Landfill space
- Avoids Air and Water pollution
- Avoids Greenhouse Gas Emissions that are caused by manufacturing virgin materials.
- Saves Energy (Recycling one million laptops saves the energy equivalent to the electricity used by more than 3,500 homes in a year.)
- Recovery of Valuable resources (For every million cell phones we recycle, 35 thousand pounds of copper, 772 pounds of silver, 75 pounds of gold, and 33 pounds of palladium can be recovered.)

Donation

One person's trash is another person's treasure. Instead of discarding unwanted electronic appliance/tools, try selling or donating them. Not only will you be reducing waste, you'll be helping others. Local churches, community centers, thrift stores, schools, and nonprofit organizations may accept a variety of donated items, including used books, working electronics, and unneeded furniture.

Benefits of Donation

- Prevents usable goods from going into landfills
- Helps your community and those in need
- Tax benefits may be available

Before Donating or Recycling Your Used Electronics

- For your computer or laptop, consider upgrading the hardware or software instead of buying a brand new product.
- Delete all personal information from your electronics.
- Remove any batteries from your electronics; they may need to be recycled separately.

Where to Donate or Recycle

Manufacturers and retailers offer several options to donate or recycle electronics. Search below to find programs developed by Sustainable Materials Management (SMM) Electronics Challenge participants. Participation in the SMM Electronics Challenge is voluntary. EPA does not endorse any of the participants or their products and services.

E-Waste in Indian Scenario

While the world is marveling at the technological revolution, countries like India are facing an imminent danger. E-waste of developed countries, such as the US, disposes their wastes to India and other Asian countries. A recent investigation revealed that much of the electronics turned over for recycling in the

United States ends up in Asia, where they are either disposed of or recycled with little or no regard for environmental or worker health and safety. Major reasons for exports are cheap labour and lack of environmental and occupational standards in Asia and in this way the toxic effluent of the developed nations 'would flood towards the world's poorest nations. The magnitude of these problems is yet to be documented. However, groups like Toxic Links India are already working on collating data that could be a step towards controlling this hazardous trade. It is imperative that developing countries and India in particular wake up to the monopoly of the developed countries and set up appropriate management measures to prevent the hazards and mishaps due to mismanagement of e-wastes.

There are 10 States that contribute to 75 per cent of the total e-waste generated in the country, while 65 cities generate more than 60 per cent of the total e-waste in India. Among the 10 largest e-waste generating States, Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab. Among the top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

The main sources of electronic waste in India are the government, public and private (industrial) sectors, which account for almost 70 per cent of total waste generation. The contribution of individual households is relatively small at about 15 per cent; the rest being contributed by manufacturers. Though individual households are not large contributors to waste generated by computers, they consume large quantities of consumer durables and are, therefore, potential creators of waste.

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 tons for the year 2005, which was exceeded 9,00,000 tons by 2017. However, at present E-waste thus needs to be disposed off in a different way. India generated 10, 00,000 tons of e-waste in 2018, and almost all of it is being recycled in many poor urban localities.

Around 25,000 workers including children are involved in crude dismantling units in Delhi alone where 10,000–20,000 tons 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.

E-Waste Pollution in India

E-waste includes the broad spectrum of electrical and electronic appliances, products, components, and accessories that have reached the end of their life due to use or obsolescence. It is one of the fastest growing waste streams around the world and needs imperative action today. About 42 per cent of e-waste is used home appliances, 34 per cent IT equipment, 14 per cent consumer electronics and rest other small equipment. The traditional way of dumping the waste in landfills does not help, as most of this is non-biodegradable, toxic and radioactive with a potential to pollute both the land and water near the landfills

impacting the health of people living in the vicinity. The toxicity is due to lead, mercury, cadmium and a number of other substances. A typical computer monitor may contain approximately 7 per cent lead by weight. Up to thirty eight separate chemical elements are incorporated into e-waste items. E-waste now makes up 10 per cent of all municipal solid waste worldwide, nearly the same amount as all plastic packaging, but it is much more hazardous. E-waste thus needs to be disposed off in a different way. The lack of sustainability of discarded electronics and computer technology is another reason for the need to recycle.

What are the causes/reasons for E-Waste?

The main causes or reason for the increasing e waste is the increased number of products (because of development, technology, human mentality/Money Power and population) because of these reasons the disposal problems are caused as excess and it is the threat to the environment.

The following are major causes-

- **Development:** It is believed that sales of computers and internet usage have gone up by 500 per cent in India as well. As the digital divide narrows we must address the question of disposal of large numbers of "end of life" computers and other IT equipment. We can now also understand that this industry is globalizing at a fast rate or rather an alarming rate. All of this is because of development caused by globalization.
- **Technology:** In this modern era technology is growing at lightning fast speed. This technology results in the coming of newer products and appliances. The major reason for this can be none other than MNC's (Multinational corporations). MNC's now a days are so powerful that they can influence the whole market system of a country in number of time. It is these MNC's that provide better technology.
- **Human mentality:** This has given more **money power** to the common people (middle class people) and this money power has helped them buy more products and in our case or the case of computers increase e waste by kind of changing their mentality. Because of money power people now a day's tend to substitute their older materials with the newer ones and these older materials if electronic related is what is termed as e-waste.
- **Population:** With the increasing population all these have been triggered even more. It's simple to understand by one of the simplest theories of unitary method. So if 1 person buys 1 computer so with increasing population the number of computers would also increase with this method. So we can say that with increasing population the amount of e- waste would also increase because these computers and electronic gadgets they bought after sometime would be thrown with the introduction of better technology devices which would be bought by them. Moreover all these are interlinked with each other and together contribute to a major environmental concern caused by e waste.

Effects of E-waste

- Discarded electronics contain Hazardous materials.
- If disposed improperly, they pose a potential threat to human health and the environment.
- May contaminate groundwater
- E-waste accounts for 40 per cent of the lead and 75 per cent of the heavy metals found in landfills.

Current Status of E-Waste Management

For the recycling of e-waste, India heavily depends on the unorganized sector as only a handful of organized e-waste recycling facilities are available. Over 95 per cent of the e-waste is treated and processed in the majority of urban slums of the country, where untrained workers carry out the dangerous procedures without personal protective equipment, which are detrimental not only to their health but also to the environment.

Recycling and treatment facilities require a high initial investment, particularly those fitted with technologically advanced equipments and processes. For the dismantling of one computer piece, these workers only get Rs. 5 or 10. For such a small amount, workers ruin their lives. Such “backyard recyclers” **do not have wastewater treatment facilities, exhaust-waste gas treatment, and personal health protection equipment** in India the problem is apparently worsening. Therefore, health risk assessments are also required for the analysis of the consequences and of inappropriate management of end-of-life electronic wastes in India.

E-Waste Management Initiative

In Environmental (Protection) Act 1986, the “**polluter pays principle**” is enacted to make the party responsible for producing pollution responsible for paying for the damage done to the natural environment. In international environmental law, it is mentioned in principle 16 of the Rio Declaration on Environment and Development. Polluter pays is also known as Extended **Producer Responsibility** (EPR). Under the Environment (Protection) Act 1986, central and state governments can enact legislations to safeguard the environment and people from exposure to toxic and hazardous nature of waste. Any violation of the provision of this act or notified rules is liable for punishment. Such penalty can be imposed on the violator if specific rules and regulations on e-waste are violated.

CPCB India is finalizing the set of rules and most recently issued a formal set of guidelines for proper and eco-friendly handling and disposal of the electronic waste. The Ministry of Environment and Forests is now processing the rules framed by electronics equipment manufacturers with the help of NGOs.

As an effort to make the users aware of the recycling of e-waste, many electronic companies such as Apple, Dell, and HP have started various recycling schemes. Nokia India announced its “recycling campaign”

for the Indian region. The program encouraged mobile phone users to dispose of their used handsets and accessories, irrespective of the brand, at any of the 1,400 green recycling bins put up across the priority dealers and care centers. Nokia is also planning to launch an electronic waste management program.

Conclusion

E-Mining and 3R's, 5R's & 9R's such as Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurposes/Reprocess, Recycles and Recovery is the efficient waste management enables the protection of human health, reducing environmental pollution, saving of natural resources, Create Jobs, Protects our surrounding and saves Landfill space and achieving sustainable and profitable management of e-waste. In India the general guidelines for e-waste management are set by national, State and local waste management plans. The hazardous nature of e-waste is one of the rapidly growing environmental problems of the world. The ever-increasing amount of e-waste associated with the lack of awareness and appropriate skill is deepening the problem. For e-waste management many technical solutions are available, but to be adopted in the management system, prerequisite conditions such as legislation, collection system, logistics, and manpower should be prepared. This may require operational research and evaluation studies.

Clean technologies today offer big investment opportunities covering areas such as LED lighting, water purification, recycling of e-waste. India expected to produce around 1 million tons of e-waste by 2014 up from the current level of 8, 00,000 tons per annum, the business of recycling e-waste alone is a billion dollar opportunity. Technology transfer has to be addressed taking into account a broader vision. E-waste recycling does not simply mean installing or transferring state-of-the-art, environmentally sustainable and effective technologies in a country. Any effort for solving the e-waste problem or, in other words, sustainable recycling of e-waste will always demand for an appropriate framework, including a proper collection network, and a financing scheme. However, lack of dedicated legislation dealing with e-waste, unclear application of the Basel Convention, high level of corruption in law enforcement, undefined roles and responsibilities of stakeholders (Manufacturers, Users/Public, E-Mining/Recyclers and Government/policy makers) low technologies and skills, poor logistics and vulnerable business and financing conditions are identified as barriers for the transfer of e-waste technology in India. If we all aware of our duties and responsibility, definitely we can achieve the E-Waste Management and the Sustainability of the Nation.

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