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E- WASTE AND ITS EFFECTS

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ABSTRACT

The changes experienced in societies across the world due to the application of electronics are far more deep and widespread than the impact of industrial revolution. The electronics age has made an impact on human society and has enhanced our connectivity across the globe.

The massive use of electronic items has made communication easier, enhanced business activities and created employment opportunities for all. However, along with the merits, it has brought many challenges, like the rising problem of e-waste, that have to be dealt with by society. In the current situation, it is always possible that human health and environment would be drastically endangered if effective legislations and actions are not taken for efficient management and disposal of e-waste.

This paper attempts to provide a brief insight into this relatively new concept of e-waste, its generation in India and the environmental and health concerns attached to it. It highlights the e-waste recycling economy in the thriving informal and the nascent formal sector and the urgent need for a more clear-cut legislation and forward looking vision.

OBJECTIVE OF THE STUDY

- To get an insight into the current scenario of E Waste.
- How the society at large is affected by it
- Role played by all in E Waste Management
- To highlight the legislation issued by the government from time to time
- Methods suggested to reduce E Waste
- Initiative taken by the Industry at large to manage and effectively dispose the electronic waste.

STATEMENT OF HYPOTHESIS –

It includes computer and its accessories monitors, printers, keyboards, central processing units; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other household appliances. 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% of the waste

IMPORTANT FACTS / TERMS

- Act' means the Environment (Protection) Act, 1986 (29 of 1986);
- Authorisation means permission for generation, handling, collection, reception, storage, transportation, refurbishing, dismantling, recycling, treatment and disposal of e-waste, granted to manufacturer, dismantler, refurbisher and recycler
- Bulk consumer' means bulk users of electrical and electronic equipment from Central Government or State Government Departments public or private companies that are registered under the Factories Act, 1948 (63 of 1948) and the Companies Act,2013 (18 of 2013)
- Collection Centre' means a centre or a collection point or both established by producer individually or as association jointly to collect e-waste f
- Component' means one of the parts of a sub-assembly or assembly Consumables' means an item, which participates in or is required for a manufacturing process
- Consumer' means any person using electrical and electronic equipment
- Channelisation' means to direct the path for movement of e-wastes from collection onwards to authorised dismantler or recycler
- Dealer' means any individual or firm that buys or receives electrical and electronic
- Dismantler' means any person or organisation engaged in dismantling of used electrical and electronic equipment
    - End-of-life' of the product means the time when the product is intended to be discarded by the user
    - Environmentally sound management of e-waste' means taking all steps required to ensure that e-waste is managed in a manner which shall protect Health and environment
    - Electrical and electronic equipment' means equipment which are dependent one electric current or electro-magnetic field in order to become functional
    - E –Retailer means an individual or company or business entity that uses an electronic network such as internet, telephone, to sell its goods
    - E-Waste' means electrical and electronic equipment**,** whole or in part discarded as waste by the consumer or bulk consumer

- Historical e-waste' means e-waste generated from electrical and electronic Equipment as specified in Schedule I,
- Manufacturer' means a person or an entity or a **company a**s defined Factories Act1948 (63 of 1948)
- Orphaned products' means non-branded or assembled electrical and electronic equipment
- Part' means an element of a sub-assembly or assembly not normally useful by itself
- Refurbisher for the purpose of these rules engaged in refurbishment
- Spares" means a part or a sub-assembly or assembly for substitution

E WASTE

What is e-waste? Like hazardous waste, the problem of e-waste has become an immediate and long term concern as its unregulated accumulation and recycling can lead to major environmental problems endangering human health. It consists of end of life electrical and electronic equipment products.

COMPOSITION OF E-WASTE It consist of 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; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other household appliances.

TYPE OF E WASTE The composition of e-waste is diverse and falls under

- Hazardous' and 'non-hazardous' categories.
- 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% of the waste,

E WASTE GENERATION IN INDIA

Central Pollution Control Board (CPCB) estimated India's e-waste at 1.47 lakh tons or 0.573 MT per day.11 A study released by the Electronics Industry Association of India (ELCINA) at the electronics industry expo – "Componex Nepcon 2009" had estimated the total e-waste generation in India at a whopping 4.34 lakh tons by end 2009.12 The CPCB has estimated that it will exceed the 8 lakh tons or 0.8 MT mark by 2012.13 and is likely to double in next 4-5 years due to vast dependency on electronic medias

ENVIRONMENT CONCERNS AND HEALTH HAZARDS.

The rising quality of life and high rates of resource consumption patterns has had an unintended and negative impact on the environment through the generation of wastes far beyond the handling capacities of governments and agencies. Electronic waste is emerging as one of the most important environmental problems of developing countries, especially India. Approximately 2 lakh tonnes of e-waste was generated in the country in 2007. With the prediction that nearly 8 lakh tons of e-waste would be generated by the end of 2012.
E-waste is getting generated at a 10 per cent annual growth rate which is one of the highest in the world.

COMPONENTS OF ENVIRONMENT AND HEALTH HAZARDS

Computer / E-Waste Components	**Process**	**Potential Occupational hazard**	**Potential Environment hazarerd**
Cathode Ray tubes (CRT`s)	Breaking removal of copper yoke and dumping	Silicosis ♦ Cuts from CRT glass in case of implosion ♦ Inhalation or contract with phosphor containing cadmium or other metals	Lead, Barium and other heavy metals leaching into groundwater, release of toxic phosphor
Printed circuit boards	Desoldering and removing computer chips	Tin and lead inhalation ♦ Possible brominated dioxin, beryllium, cadmium, mercury inhalation	Air emission of same substances
Dismantled printed circuit boards processing	Open burning of waste boards that have had chips removed to remove	♦ Toxicity to workers and nearby residents from tin, lead, brominated dioxin, beryllium, cadmium and mercury inhalation ♦ Respiratory irriatio	Tin and lead contamination of immediate environment including surface and ground waters. Brominated

	final metals		dioxins beryllium, cadmium and mercury emissions
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid along riverbanks	♦Acid contact with eyes, skin may result in permanent injury. ♦Inhalation of mists and fumres of acids, chlorine and sulphur dioxide gases can cause respiratory irritation to severe effects including pulmonary edema, circulatory failure and death	♦Hydrocarbons, heavy metals, brominated substances, etc., discharged directly into river and banks. ♦Acidifies the river destroying fish and flora.
Plastics from computer and peripherals e.g printers ,keyboards etc	Shredding and low temperature melting to be reutilized in poor grade plastics	Probable hydrocarbon, brominated dioxin and heavy metal exposure	Emissions of brominated dioxins and heavy metals and hydrocarbons
Computer wires	Open burning to recover copper	Brominated and chlorinated dioxin, polycyclinc aromatic hydrocarbons (PAH) (carcinogenic) exposure to workers living in the burning works area	Brominated and chlorinated dioxin, polycyclinc aromatic hydrocarbons (PAH) (carcinogenic) exposure to workers living in the burning works area
Miscellaneous computer parts encashed in rubber or plastic e.g. steel rollers	Open burning to recover steel and other metals	Hydrocarbon including PAHs and potential dioxin exposure	Hydrocarbon ashes including PAHs discharged to air, water and soil.

Toner cartridges	Use of paintbrushes to recover toner without any protection	• Respiratory Tract infection • Carbon Black possible human carcinogen • Cyan ,yellow and Magneta toners unknown toxicity	Cyan . tallow and magenta toners unknown toxicity
Secondary steel or copper and precious metal smelting	Furnaces recovers steel or copper from waste including organics	Exposure to dioxins and heavy metals	Emission of dioxins and heavy metals

Import of hazardous e-waste in India

India is one of the largest waste importing countries in the world. All types of wastes are imported into the country, in the form of cheap raw materials including hazardous and toxic wastes. Data released by the Customs Department reveal imports of even prohibited wastes like clinical waste, incineration ash, municipal waste and e-waste, all of which exceed 50 lakh tons annually. In 2009 and is likely to double in next five years. It generates about 3,50,000 tons of electronic waste every year and imports another 50,000 tons

The lopsided effect of undue , unjust and uncontrolled exports of x rated electronic /electrical equipment has had an very negative impact on the rising quantities of e waste in India effect

- 50 to 80% E-wastes collected are exported for recycling by U.S. Export is legal in U.S.
- Export is due to cheaper labour and laxed standard in poor countries.
- E-waste recycling and disposal in China, India and Pakistan are highly polluting.
- China has banned import of E-waste.
- Lack of responsibility on the part of Federal Government and Electronics Industry, Consumers, recyclers and local governments towards viable and sustainable options for disposal of E-wastes.

Responsibilities Matrix of all involved in E Waste Management

Manufacturer:

Involved in generating e waste are responsible to do the following

- collect e-waste and channelise it for recycling or disposal
- Apply for an authorisation in Form 1 (a) in accordance to sub rule (2) of rule 13 from the concerned State Pollution Control
- ensure that no damage is caused to the environment during storage and transportation of e-waste
- maintain records of the e-waste generated, handled and disposed in Form-2 and make such records available for scrutiny
- file annual returns in Form-3, to the concerned State Pollution Control Board .

Producer:

The producer of electrical and electronic equipment listed in Schedule I shall be responsible for the following aspects:-

- Collection and channelisation of e-waste generated from the 'end-of-life pattern
- The mechanism used for channelisation of e-waste from 'end-of-life' products including those from their service centres to authorised dismantler or recycler
- Responsibility – Authorisation incases of fluorescent and other mercury containing Lamps
- Disposal Facility for disposal in Treatment, Storage and Disposal
- Providing contact details such as address, e-mail address, toll-free telephone no`s
- Bulk consumer through their website and product
- Creating awareness through media, publications, advertisements, posters, or by any other means of communication
- Information on address, e-mail address, toll-free telephone numbers or info of web site along with information on effects of hazardous , improper handling ,accidental breakage and instruction on disposal is very essential
- Affixing a visible, legible symbol on the products to prevent e-waste from being dropped in garbage bins (vi) means and mechanism available for their consumers to return e-waste for
- Collection of end-of-life products and their channelisation to authorised dismantlers
- Provided that the producer shall refund the deposit amount that has been taken
- The import of electrical and electronic equipment shall be allowed only to producers having Extended Producer Responsibility authorisation;
- Maintaining records in Form-2 of the e-waste handled and make such records available
- Filing annual returns in Form-3, to the Central Pollution Control Board on or before the 30th day of June

Collection Centres.

- Collect e-waste on behalf of producer or dismantler or recycler or refurbisher
- Ensure that the facilities are in accordance with the standards or guidelines issued by Central Pollution Control Board from time to time
- Ensure that the e-waste collected by them is stored in a secured manner till it is sent to authorised dismantler or recycler
- Ensure that no damage is caused to the environment during storage and transportation
- Maintain records in Form-2 of the e-waste handled as per the guidelines of
- Make such records available for scrutiny by the CPCB or SPCB

Dealers –

- Responsibility of collection on behalf of the producer
- Providing the consumer a box, bin or a demarcated area to deposit e waste,
- Send the e-waste so collected to collection centre or dismantler or recycler
- Refund the amount as per take back system to retailer
- Deposit Refund Scheme of the producer to the depositor of e-waste
- Dealer shall ensure that the e-waste is safely transported to authorised dismantlers
- Ensure that no damage is caused to the environment during storage and transportation

Refurbisher –

- Collect e-waste generated during the process of refurbishing
- Channelise the waste to authorised dismantler or recycler through its collection centre;
- Make an application in Form 1(a) in accordance with the procedure laid down in sub-rule (4) of rule 13 to the concerned SPCB for grant of one time authorisation
- Authorisation would be deemed as considered if not objected within thirty days;
- Refurbisher shall be required to submit details of e-waste to SPCB
- Ensure that no damage is caused to the environment during storage and transportation
- Ensure that the refurbishing process do not have any adverse effect on the health
- Ensure that the e-waste thus generated is safely transported to authorized collection centres or dismantlers or recyclers
- File annual returns in Form-3 to concerned SPCB on or before the 30th day of June following the financial year to which that return relates
- Maintain records of the e-waste handled in Form-2 and keep them ready for scrutiny

Consumer or bulk consumer –

- shall ensure that e-waste generated by them is channelised through collection centre
- Or through the designated take back service provider to authorised dismantler
- They shall maintain records of e-waste generated by them in Form-2
- Available for scrutiny by the concerned State Pollution Control Board
- Shall ensure that such end-of-life electrical and electronic equipment are not admixed with e-waste containing radioactive material (4) bulk consumers of electrical and electronic equipment listed in Schedule I shall file
- Annual returns in Form-3, to the concerned SPCB on or before the 30th day of June .
- In case of the bulk consumer with multiple offices in a State, one annual return combining information from all the offices shall be filed

Dismantler –

- Ensure that the facility and dismantling processes are in accordance with SPCB
- Dismantler obtain authorisation from the concerned State Pollution Control Board
- Ensure that no damage is caused to the environment during storage / transportation
- Ensure that the dismantling processes do not have any adverse effect on the health and the environment
- Ensure that dismantled e-waste are segregated and sent to the authorized recycling facilities for recovery of materials
- Ensure that non-recyclable or non-recoverable items are sent to authorized centre
- Maintain record of e-waste collected / dismantled /sent to authorised recycler
- File a return in Form-3, to the concerned SPCB before 30th day of June
- Not process any e-waste for recovery or refining of materials, unless he is authorized
- Operation without Authorisation by any dismantler, shall beconsidered as causing damage to the environment.

Recycler –

- Shall ensure that the facility and recycling processes are in accordance with the standards or guidelines prescribed by the
- CPCB from time to time obtain authorisation from concerned SPCB
- Ensure that no damage is caused to the environment during storage and transportation
- Ensure that the recycling processes do not have any adverse effect
- Make available all records to the Central Pollution Control Board or the concerned SPCB
- Ensure that the fractions or material not recycled in its facility is sent to the respective authorised recyclers

- Ensure that residue generated during recycling process is disposed of in an authorised treatment storage disposal facilityMaintain record of e-waste collected, dismantled, recycled and sent
- fills in return and maintain records for scrutiny of SPCB officials by 30 th June of following year
- Operation without Authorisation by any recycler, as consider as damage to environment

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State Government/ other Governmental bodies

- Department of Industry in State or any other government agency authorised in this regard by the State Government, to ensure earmarking or allocation of industrial space or shed for e-waste dismantling and recycling
- Department of Labour in the State or any other government agency authorised in this regard by the State Government shall ensure recognition and registration of workers involved in dismantling and recycling
- Assist formation of groups of such workers to facilitate setting up dismantling facilities;
- Undertake industrial skill development activities for the workers involved in dismantling and recycling
- Undertake annual monitoring and to ensure safety & health of workers involved in dismantling and recycling
- State Government to prepare integrated plan for effective implementation of these provisions and to submit annual report to Ministry of Environment, Forest and Climate Change

Effective Means to standardize the Systems of E Waste Management

There is a clear need to have proper information system through standardized mechanisms.Eco-design can have a positive impact in reducing the rate of WEEE generation, facilitating the management of e- waste and recovery of materials, achieving cost reductions. MoEF is also promoting the 3R Concept (Reduce, Reuse and Recycle) for Hazardous Waste Management MoEF has also defined the responsibilities of **Central Pollution Control Board**(CPCB)and **State Pollution Control Board**(SPCB) who are acting as monitoring authorities in respect of management of e-waste in India. Briefly the main functions of CPCB are:

- Coordination with State Pollution Control Boards
- Preparation of Guidelines for Environmentally Sound Management of e-waste
- Conduct assessment of e-waste generation and processing

- Recommend standards and specifications for processing and recycling e-waste
- Documentation & compilation of data on e-waste
- Conducting training & awareness program
- Enforcement of reduction in use of hazardous substances(RoHS)
- Incentives and certification for green design/products

The collection, storage, transportation, segregation, refurbishment, dismantling recycling and disposal of e-waste is also defined by the guidelines issued by the Central Pollution Control.

The DoT guidelines in the direction

> "*…to develop a robust and secure state-of-the-art telecommunication network providing seamless coverage with special focus on rural and remote areas for bridging the digital divide*"

Also specific regulations for the environmental and health issues arising from the telecom network. The remuneration for adoption of green policy and incentive for use of renewable energy sources can be one practical and sustainable method for managing e-waste in Indian socio cultural environment. By promoting the use of energy efficient equipment and renewable energy technologies, and also adopting measures for reduction of carbon footprint, the concern for e-waste is also addressed in direction of long term sustainability.

Recommendations: A multi programme approach is required to improve upon the e-waste management in the country which is summarised in the recommendation belongs:

- Tax incentive may be considered to telecom product manufacturing companies which institute environmentally safe production systems and products, to offset any incremental
  cost involved in the process. Tax incentive may be given to companies engaged in scientifically recycling of e-waste till end of life of the product.
- There is an urgent need of generating awareness among the people about the best practices for collection mechanism of e-waste, to be followed to avoid dumping of waste in landfills, and to channelize the waste through standard methods of e-waste disposal management.
- All the equipment manufacturers, service providers and Government sectors should bemandated to spread awareness regarding hazards of e-waste.
- All the telecom equipment manufacturers specifically mobile hand set manufacturers should disclose to the customer harmful materials used in their products so as to make customers aware of safe disposal ways

- Telecom equipment manufacturers and service providers may be advised to create a setup within the organization for safe disposal of e-waste. Providing training and education to the people engaged in recycling, recovery of material and safe disposal of e-waste
- The concept of donating used EEE to the poor/ backward children for developing theirskills is to be encouraged, mainly among schoolchildren and youth, which in turn will help in cleaning the environment.
- Legislations for imports have Clear Guidelines regarding entry of hazardoussubstances along with the import of products. If required appropriate legislative measures
  may need to be taken.
- As the waste disposal is a subject of state, municipal authorities in each city may also be entrusted with the job of collection of e-waste and its disposal in accordance with the guidelines and coordination with State Pollution Control Board which in turn can be transported to the recycler for proper management in environment friendly way.
- Collection and maintenance of data on e-waste is extremely important to start corrective actions on policy and implementation. For e-waste management, there is a need for conducting assessment of e-waste generation, and formulation of standards and specifications for processing and recycling e-waste.
- Finally, Case studies in different areas depending on socio economic conditions may be started for sustainable decisions in respect of e-waste management.

Procedure for storage of e-waste –

Every manufacturer, producer, bulk consumer, collection centre, dealer, refurbisher, dismantler and recycler may store the e-waste for a period not exceeding one hundred and eighty days and shall maintain a record of collection, sale, transfer and storage of wastes and make these records available for inspection. Provided that the concerned SPCB may extend the said period up to three hundred and sixty five days in case the waste needs to be specifically stored for development of a process for its recycling or reused.

General Trend adopted by Industry to dispose its e waste

- Take the report from the respective Incident Manager (IM) / Support engineer about the condition of the asset. If it is unusable / beyond repair please consider it as e-waste.
- Handover the old hard disk, CD / DVD media, External storage media which may contain data to Corporate Information Center (CIC) and maintain a register of the same.

- Prepare a disposal note giving details of the items, its Asset codes and its book value.
- Get the approval from the respective Plant or RO Head, IT Head, CFA and CMD.
- Give it to the Central Pollution Control Board Approved e-waste recycler vendor for recycling.
- Collect the e-waste certificate from the vendor.

CONCLUSION

ITU has agreed to the fact that there is no unique or ideal model for e-waste management in developing countries, each of which is characterized by its own specific environmental, social, technological, economic and cultural conditions. With a view to bridge the digital divide, there is exponential growth in the use of **Electrical and electronic equipment** (EEE) and so there is alarming effect on environment and human health when the ICT wastes are not disposed of scientifically. There is an emergent need to implement the existing policies and guidelines in line with the international standards and practices for an healthy e-waste management system. Government policies should encourage the reuse of EEE aiming to minimize and recycle **Waste Electrical and Electronic Equipment** (WEEE).

There is a clear need to have proper information system through standardized mechanisms. Eco-design can have a positive impact in reducing the rate of WEEE generation, facilitating the management of e- waste and recovery of materials, achieving cost reductions. MoEF is also promoting the 3R Concept (Reduce, Reuse and Recycle) for Hazardous Waste Management MoEF has also defined the responsibilities of **Central Pollution Control Board**(CPCB)and **State Pollution Control Board**(SPCB) who are acting as monitoring authorities in respect of management of e-waste in India.

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