CHAPTER 8

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATION
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Legislation in India on E-waste Management:

Ministry of Environment and Forests, Govt.of India, New Delhi have published E-waste Rules (Management and Handling) on 12th May 2011, which will come into force from 1st May 2012. Rules cover producer, consumer, bulk consumer, sale, purchase, processing, dismantler and recycler of e-waste. A few of these are taken for discussion on their positive and negative impacts in the recovery of metals from EOL-PCs.

- Every dismantler or recycler of e-waste shall be registered.
- It is noteworthy and welcome rule that 'Extended Producer Responsibility (EPR)'. This allows the producer that once the equipment reaches its end of life; he ensures that it goes to the authorised recycler and the unauthorised one.
- Information on hazardous constituents, handling, accidental breakage, damage and/or improper recycling should be provided on the equipment.
- Ensure that no damage is caused to the environment during storage and transportation of E-waste.
- Personal Computer manufacturers, mobile handset makers and white goods makers will be required to come up with e-waste collection centres or introduce 'take back' systems.
- "These rules will apply to every producer, consumer and bulk consumer involved in manufacture, sale, purchase and processing of electronic equipment or components," an environment ministry official said.
The ministry is giving the producers of electrical and electronic equipment a breathing period of one year to set up their collection centres. The rules will come under the Environment Protection Act (EPA).

E-wastes are considered dangerous, as certain electronic components contain substances- lead, cadmium, lead oxide (in cathode ray tubes), toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives. These substances are considered hazardous depending on their condition and density.

Under the new rules, producers will have to make consumers aware about the hazardous components present in the product. Also, instructions for consumers for handling the equipment after its use along with the do's and don'ts. They will also have to give information booklets to prevent E-waste from being dropped in garbage bins.

However, according to the rules, bulk consumers such as enterprises and government will be responsible for recycling of the e-wastes generated by them. The bulk users have to ensure that the e-waste generated by them is channelised to authorised collection centres or is taken back by the producers.

They also have to maintain records of e-wastes generated by them and make such records available with State Pollution Control Boards or the Pollution Control Committees.

The State Pollution Control Board will be required to prepare and submit to the Central Pollution Control Board (CPCB) an annual report (based on the data received by consumers) with regard to implementation of these rules, by September 30 of every year.
On receiving which, the CPCB will have to prepare a consolidated annual review on management of e-waste and forward it to the Government along with its recommendations by December 30 of every year.

- Residues, non recyclables/non recoverable components generated should be disposed of in a hazardous waste treatment storage disposal facility (TSDF).

It is strange to note that the detailed study of E-waste rules indicates that, some of the metals and materials Phosphor used in CRT monitor, lead, Chromium, Cadmium, etc are known potential hazards for plant and animal life and also the environment like used in not covered under hazardous substances.

8.1 Discussion on the Present study

Minerals are the treasures of the state. They are the finite and non renewable primary resources, valuable and most essential for the modern society. Systematic, scientific and sustainable harnessing of mineral wealth besides, the development of suitable substitution for this primary resource shall be the cornerstone of development objectives of the states. Fortunately, many of the metals and minerals are reusable and efficiently, recyclable and this makes them the basis for sustainable products and services.

Study on inventorization is made to analyze the data available to understand the resource potentials of E-waste in general EOL-PC in particular. The evolution of personal computers from the first generation to the present laptop iPod, Palmtop, computers clearly indicates that the considerable reduction in the size, shape and the space occupied by the early computers was
huge, unmanageable. Miniaturisation of electronic hardware are driven by innovations in new materials and associated process technologies.

Thus, computer has been literally yanked out of the labs and brought in to our rooms. Detailed study of evolution of computers clearly indicates that miniaturization in computer technology refers to the evolution of electronic devices as they become smaller, faster and more efficient.

- miniaturisation lower material costs, and hence lowers the cost of production
- higher production output, and
- potentially faster operation

However, miniaturisation has certain disadvantages too such as,

- increased complexity in circuit design (may lead to poorer performance)
- increased engineering/R&D costs
- Not serviceable after manufacture and once they reach their end of life, they have to discarded and such a huge quantity of E-waste in general and EOL-PC in particualr.

There is need to change the dominant paradigm that has prevailed over the past three decades. The lust for faster, smaller and cheaper must be governed by the new, paradigm of sustainability which demands that the products are cleaner, long lived, up gradable and recyclable (BAN, SVTC).

Recycling is key feature of EOL-PC and can be the best secondary resource for many metals, plastics and glass. Characterization of EOL-PCs clearly indicates the following...

- Economic criteria & advancement of technology has made the designers to conserve precious natural resources with environment friendly designs.
- Reduction in the contents of Au and Platinum Group Elements (PGE) and increased usage of Ag and Fe.
• Helps in identifying recyclable, non recyclable and hazardous content of EOL-PCs.

• Becomes an important data for optimum recyclable resource recovery especially for the developing countries like India.

The informal sector, the poorest people in developing countries, use basic metal recovery processes for the recovery of predominantly gold and copper from circuit boards to make their living. Their sole purpose is economic gain, only the parts considered valuables are kept. The rest is discarded causing environmental burden.

Recycling and disposal of e-waste and EOL-PC in developing countries are causing an increasing concern due to its effect on the environment and associated with human health risks. To understand the contamination status during the present study, presence of Trace Elements (TEs) in soil, air and human hair samples collected from e-waste recycling sites (form approved and backyard). Concentrations of Cu, Zn, Ag, Cd, In, Sn, Sb, Hg, Pb and Bi estimated have been found to be higher in some soils collected from backyard sites compared to those present in the approved recycling sites. Infact the concentrations are found to be more than screening values proposed by the World Health Organisation (WHO). To retrieve Copper from copper cables and circuit boards burning method practiced has severe negative impact on the human health and environment. Burning of copper releases dioxins, infact Copper catalyses the release of such potentially carcinogenic substance which bio accumulate and cause problems in the long run.

The ill ventilated small rooms used to recover gold, silver and copper, handling of Hg, Nitric acid by bare hands, absence of PPEs., inhaling of NOx and SOx in the so called recycling facility of backyard practioners, located in
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densely populated areas are well illustrated with pictures taken during the field study.

Collaborative research carried out (with Dept.of Environmental Science, Ehime University, Japan). The most important outcome of the present study, is perhaps, the first ever study carried out on blood serum samples have indicated the presence of relatively higher in the of back yard practitioners than what is observed in the workers of approved facility.

During the course of the present study, one good development noted is that, some of the backyard practitioners of Bangalore city, convinced by the consequences of unscientific method of E-waste recycling and advantages of scientific methods of recovery of valuables have registered and are now functioning as approved recyclers. Thanks to the sustained joint efforts made by the Karnataka State Pollution Control Board, E-Parisara and Umicore Precious Metal Refinery, Belgium. Under the “Crystal Project”, E-Parisaraa has been offering training and guidance to the registered practitioners about the advantages of scientific methods of E-waste recycling.

The outcome of the Chapter VII is remarkable and helps in the estimation of conservation of natural resources and mineral substitution. Resources must be used more and more efficiently to meet growing population. Estimations made have been presented in terms of raw materials, energy, water, and man power etc. in the production of metals from minerals (primary resources) and EOL-PC (secondary resources). The Environmental benefits of recycling are expressed in terms of savings in carbon dioxide equivalent emissions with reference to the recovery of metals like Aluminum, Iron, Copper, Gold, etc. are also discussed. By recovering metals from EOL-PCs as secondary source for metals and non metals large amounts of raw materials like mineral/ore can be saved. The economics involved in the recovery of metals and non metals like glass and polymers has been estimated taking in to

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account their present rates. Mineral substitution in this way, one can increase the life span of the reserves of the various materials by making shift towards large recycling of E-waste in general and EOL-PC in particular.

The problem of mineral scarcity can be postponed. In order to do this, mankind will have to mobilise its collective creativity and ingenuity. Although recycling is nothing new, generally the intensity could be further enhanced.

The benefits of recycling and substitution help in building community. People band together and build communities around common cause, issues and advocacies. Recycling to conservation of natural resources builds strong economy. Every cost reduction, energy efficiency, materials conservation and job generation benefit of recycling adds up to help build a strong economy for the country. Recycling done on a country-wide scale has a huge positive impact on the economy.

8.2 Scope for Future Research

- The present study on P-III model paves way for extensive study on characterisation, resource recovery etc. of P-IV model EOL-PCs which have been entering in to recycling stream.
- Study on the comparison of the materials-quality and quantity used in P-III, P-IV model can be explored.
- Survey and field study be taken up to prepare inventorization of EOL-PC at Taluka and District level
- Awareness about toxic and valuable substance present in E-waste be given priority
8.3 Recommendations

- Producers of Electrical and Electronic equipments should so design that they replace hazardous metals and other substances by non hazardous ones.

- Create awareness about E-waste, EOL-PCs, resources that can be recovered scientifically, irreversible damage that could be on the environment if recycled unscientifically.

- Global problem there can be local solution of effective collection for effective resource recovery.

- Massive awareness is more than 50% solution to the problem. Mobilise and train College NSS students and NGOs to set up collection centres. Door to door campaign about segregation E-waste from the rest of biodegradable waste at source is taken up vigorously. Print and electronic media should come forward in this direction, as these are the bulk consumers of Electronic gadgets, are producing huge quantities of E-waste.

- The highest intrinsic value of a PC is in the circuit boards. The pre processing must secure that the precious metals present in the boards are transported to a fraction for precious metals recovery.

- There should be committed efforts to start, may be initially small scale furnaces to recover copper and other precious metals from circuit boards in our own country so that we can save foreign exchange.

- Individuals/ Instituions, who wish to enter E-waste recycling stream, should be trained to adhere to the recent E-waste rules of Govt.of India.

- Study of Economics of EOL-PC clearly indicates that, recycling is just sustainable and not profit making venture. All the efforts of the approved recyclers it seems, is only to clean the environment. Therefore,
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- Recyclers should be permitted to reuse certain component that compensates to make the business more workable and sustainable.
- It is learnt that corporate sector expects huge margin while disposing E-waste/EOL-PCs to the recyclers. This tendency should be curbed.
- Recyclers should be given tax break.
- Land should be provided on long term lease to carry out recycling operations.
- Unauthorised E-waste recycling should be checked and people who have concern for health and environment should act as "whistle blowers" and bring such activity to the notice of the concerned authorities. Suitable incentives/rewards may be given to the "whistle blowers".
- In India research in the direction of E-waste recycling, especially on the resource recovery, conservation of natural resources and mineral substitution is scares. State Govt., Central Govt. UGC and even ICT industry should come forward for liberal funding for research on characterisation, resource recovery and mineral substitution by recovering resources from EOL-PCs. Since the configuration of such an indispensable tool is fast changing.