International Journal of Applied Research 2016; 2(7): 611-614

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(7): 611-614
www.allresearchjournal.com
Received: 28-05-2016
Accepted: 29-06-2016

Gurcharan Dass
Bharat Group of Colleges, Sardulgarh-151507, Distt. Mansa, Punjab, India.

Correspondence
Gurcharan Dass
Bharat Group of Colleges, Sardulgarh-151507, Distt. Mansa, Punjab, India.

E-Waste management: Solid waste management in India

Gurcharan Dass

Abstract
The electronic industries are largest and fastest growing manufacturing industry in the world. The current practices of e-waste management in India suffer from a number of drawbacks like the difficulty in inventorisation, unhealthy conditions of informal recycling, inadequate legislation, poor awareness and reluctance on part of the corporate to address the critical issues. The consequences are that (i) toxic materials enter the waste stream with no special precautions to avoid the known adverse effects on the environment and human health and (ii) resources are wasted when economically valuable materials are dumped or unhealthy conditions are developed during the informal recycling. In this paper we are also discuss how sufficient recovery of material can be achieved to guarantee recycling firms a reliable and adequate flow of secondary material. The paper highlights the associated issues and strategies to address this emerging problem, in the light of initiatives in India & presents a waste management system with shared responsibilities.

Keywords: CRT, LCD, PCB, PVC, CPCB, EPR etc

1. Introduction
According to the US EPA, the products that are considered consumer electronics (i.e., discarded electronics) include televisions, computers/computer peripherals, audio/stereo equipment, VCRs, DVD players, video cameras, telephones, fax and copying machines, cell phones, wireless devices, and video game consoles. However, for the purposes of electronics management, environmental groups, regulatory agencies and manufacturers have not uniformly agreed on a definition. Most initiatives across the country to manage and/or collect consumer electronics have focused on computer components and televisions. However, audio and video discards exceed the tonnage of computer equipment wastes. Cell phone discards are growing at a rapid rate. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them. The fraction including iron, copper, aluminium, 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% (Widmer *et al*., 2005) [17]. Solid waste management, which is already a mammoth task in India, is becoming more complicated by the invasion of e-waste, particularly computer waste. E-waste from developed countries find an easy way into developing countries in the name of free trade (Toxics Link, 2004) [15] is further complicating the problems associated with waste management. The paper highlights the associated issues and strategies to address this emerging problem, in the light of initiatives in India.

2. E-Waste in India
It is estimated that the total number of obsolete personal computers emanating each year from business and individual households in India will be around 1.38 million. According to a report of Confederation of Indian Industries, the total waste generated by obsolete or broken down electronic and electrical equipment in India has been estimated to be 1,46,000 tons per year (CII, 2006) [5]. The average usage and life of the personal computers (PCs), television (TV) and mobile phone showed that the average household usage of the PC ranges from 0.39 to 1.70 depending on the income class (Shobbana Ramesh and Kurian Joseph, 2006) [13]. In the case of TV it varied from 1.07 to 1.78 and for mobile phones it varied from 0.88 to 1.70.

The low-income households use the PC for 5.94 years, TV for 8.16 years and the mobile phones for 2.34 years while, the upper income class uses the PC for 3.21 years, TV for 5.13 years and mobile phones for 1.63 years. The growth rate of the mobile phones (80%) is very high compared to that of PC (20%) and TV (18%). The public awareness on e-wastes and the willingness of the public to pay for e-waste management as assessed during the study based on an organized questionnaire revealed that about 50% of the public are aware of environmental and health impacts of the electronic items. The willingness of public to pay for e-waste management ranges from 3.57% to 5.92% of the product cost for PC, 3.94% to 5.95% for TV and 3.4% to 5% for the mobile phones. Additionally considerable quantities of e-waste are reported to be imported (Agarwal, 1998; Toxics Link, 2004) [1, 15]. However, no confirmed figures available on how substantial are these trans-boundary e-waste streams, as most of such trade in e-waste is camouflaged and conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations. The government trade data does not distinguish between imports of new and old computers and peripheral parts and so it is difficult to track what share of imports are used electronic goods.

3. Impacts of E-Waste

Hazardous materials such as lead, mercury and hexavalent chromium in one form or the other are present in such wastes primarily consisting of Cathode ray tubes (CRTs), Printed board assemblies, Capacitors, Mercury switches and relays, Batteries, Liquid crystal displays (LCDs), Cartridges from photocopying machines, Selenium drums (photocopier) and Electrolytes. Although it is hardly known, e-waste contains toxic substances such as Lead and Cadmium in circuit boards; lead oxide and Cadmium in monitor Cathode Ray Tubes (CRTs); Mercury in switches and flat screen monitors; Cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that releases highly toxic dioxins and furans when burned to retrieve Copper from the wires. All electronic equipments contain printed circuit boards which Sardinia 2007, Eleventh International Waste Management and Landfill Symposium are hazardous because of their content of lead (in solder), brominated flame retardants (typically 5-10% by weight) and antimony oxide, which is also present as a flame retardant (typically 1-2% by weight) (Devi *et al*, 2004) [6].

4. Status of E-Waste in India

As per the Hazardous Waste Rules (1989), e-waste is not treated as hazardous unless proved to have higher concentration of certain substances. Electronic waste is included under List-A and List-B of Schedule-3 of the Hazardous Wastes (Management & Handling) Rules, 1989 as amended in 2000 & 2003. The Government has taken the following action/steps to enhance awareness about environmentally sound management of electronic waste (CII, 2006) [5]

- A National Working Group has been constituted for formulating a strategy for E-Waste management.
- Demonstration projects have also been set up by the DIT at the Indian Telephone Industries for recovery of copper from Printed Circuit Boards.
- A comprehensive technical guide on "Environmental Management for Information Technology Industry in India" has been published and circulated widely by the Department of Information Technology (DIT), Ministry of Communication and Information Technology.
- Several Workshops on Electronic Waste Management was organized by the Central Pollution Control Board (CPCB) in collaboration with Toxics Link, CII etc.
- The lack of a safe e waste recycling infrastructure in the formal sector and thus reliance on the capacities of the informal sector pose severe risks to the environment and human health.
- The existing e waste recycling systems are purely business-driven that have come about without any government intervention. Any development in these e waste sectors will have to be built on the existing set-up as the waste collection and pre-processing can be handled efficiently by the informal sector, at the same time offer numerous job opportunities.

The Swiss State Secretariat for Economic Affairs mandated the Swiss Federal Laboratories for Materials Testing and Research (EMPA) to implement the programme "Knowledge Partnerships in e-Waste Recycling" and India is one of the partner countries. The programme aims at improving e-waste management systems through Knowledge Management and Capacity Building. It has analyzed e-waste recycling frameworks and processes in different parts of the world (Switzerland, India, China, South Africa) in its first phase (2003-04) and all results of the project are documented on the website http://www.ewaste.ch/.

5. Elements of E-Management System for India

It is high time the manufactures, consumers, regulators, municipal authorities, state governments, and policy makers take up the matter seriously so that the different critical elements depicted in Figure 1 are addressed in an integrated manner. It is the need of the hour to have an "e waste-policy" and national regulatory frame work for promotion of such activities. An e Waste Policy is best created by those who understand the issues. So it is best for industry to initiate policy formation collectively, but with user involvement. Sustainability of e-waste management systems has to be ensured by improving the effectiveness of collection and recycling systems (e.g., public–private-partnerships in setting up buy-back or drop-off centers) and by designing-in additional funding e.g., advance recycling fees.

The best option for dealing with E wastes is to reduce the volume. Designers should ensure that the product is built for re-use, repair and/or upgradeability. Stress should be laid on use of less toxic, easily recoverable and recyclable materials which can be taken back for refurbishment, remanufacturing, disassembly and reuse. Recycling and reuse of material are the next level of potential options to reduce e-waste (Ramachandra and Saira, 2004) [11]. Recovery of metals, plastic, glass and other materials reduces the magnitude of e-waste. These options have a potential to conserve the energy and keep the environment free of toxic material that would otherwise have been released.

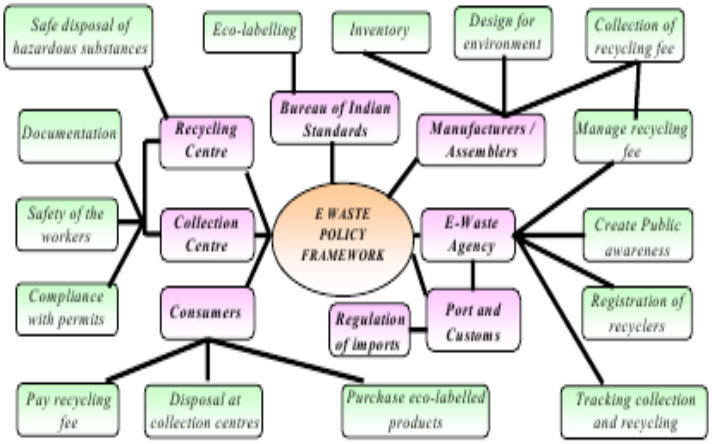

Fig 1: E-Waste System in India

6. Policy & Regulation

The Policy shall address all issues ranging from production and trade to final disposal, including technology transfers for the recycling of electronic waste. Clear regulatory instruments, adequate to control both legal and illegal exports and imports of e-wastes and ensuring their environmentally sound management should be in place. The Port and the Custom authorities need to monitor these aspects. Policies and regulations that cover Design for Environment (DfE) and better management of restricted substances may be implemented through measures such as:

- specific product take-back obligations for industry
- financial responsibility for actions and schemes
- greater attention to the role of new product design
- material and/or substance bans including stringent restrictions on certain substances
- greater scrutiny of cross-border movements of Electrical and Electronic Products and e-waste
- Increasing public awareness by labeling products as 'environmental hazard

The key questions about the effectiveness of legislation would include:

- What is to be covered by the term electronic waste?
- Who pays for disposal?
- Is producer responsibility the answer?
- What would be the benefits of voluntary commitments?
- How can sufficient recovery of material be achieved to guarantee recycling firms a reliable and adequate flow of secondary material?

The efforts to improve the situation through regulations, though an important step; are usually only modestly effective because of the lack of enforcement. While there has been some progress made in this direction with the support of agencies such as GTZ, enforcement of regulations is often weak due to lack of resources and underdeveloped legal systems. Penalties for non-compliance and targets for collection or recycling are often used to ensure compliance.

7. Extended Producer Responsibility

EPR is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle, including its final disposal. Consumers can affect the environmental impacts of products in a number of ways: via purchase choices (choosing environmentally friendly products), via maintenance and the environmentally conscious operation of products, and via careful disposal (e.g., separated disposal of appliances for recycling). Suppliers may have a significant influence by providing manufacturers with environmentally friendly materials and components. Manufacturers can reduce the life-cycle environmental impacts of their products through their influence on product design, material choices, manufacturing processes, product delivery, and product system support (Sergio and Tohru, 2005) [12]. The system design needs to be such that there are checks and balances, especially to prevent free riders. The goals of the product designer could include reducing toxicity, reducing energy use, streamlining product weight and materials, identifying opportunities for easier reuse, and more.

Manufacturers have to improve the design by:

- The substitution of hazardous substances such as lead, mercury, cadmium, hexavalent chromium and certain brominated flame retardants
- Measures to facilitate identification and re-use of components and materials, particularly plastics
- Measures to promote the use of recycled plastics in new products.

Collection systems are to be established so that e-waste is collected from the right places ensuring that this directly comes to the recycling unit. Collection can be accomplished through collection centers. Each electronic equipment manufacturer shall work cooperatively with collection centers to ensure implementation of a practical and feasible financing system. Collection Centers may only ship wastes to dismantlers and recyclers that are having authorization for handling, processing, refurbishment, and recycling meeting environmentally sound management guidelines.

8. E-Waste Recycling

Environmentally sound recycling of e-waste requires sophisticated technology and processes, which are not only very expensive, but also need specific skills and training for the operation. Proper recycling of complex materials requires the expertise to recognize or determine the presence of hazardous or potentially hazardous constituents as well as desirable constituents (i.e. those with recoverable value), and then be able to apply the company's capabilities and process systems to properly recycle both of these streams. Appropriate air pollution control devices for the fugitive and point source emissions are required. Guidelines are to be

developed for environmentally sound recycling of E Wastes. Private Sector is coming forward to invest in the e-waste projects once they are sure of the returns. Many discarded machines contain usable parts which could be salvaged and combined with other used equipment to create a working unit. It is labor intensive to remove, inspect and test components and then reassemble them into complete working machines. Institutional infrastructures, including e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and/or regional levels for the environmentally sound management of e-wastes. These facilities should be approved by the regulatory authorities and if required provided with appropriate incentives. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with governments, NGOs and manufacturers.

9. Training & Awareness Programme

Consumers are to be informed of their role in the system through a labelling requirement for items. Consumers to be educated to buy only necessary products that utilize some of the emerging technologies (i.e. lead-free, halogen-free, recycled plastics and from manufacturers or retailers that will `take-back' their product) to be identified through eco-labelling. The future of e-waste management depends not only on the effectiveness of local government, the operator of recycling services, but also on the attitude of citizens, and on the key role of manufactures and bulk consumers to shape and develop community participation. Lack of civic sense and awareness among city residents will be a major hurdle to keep e- waste out of municipal waste stream. Collaborative campaigns are required to sensitize the users and consumers should pay for recycling of electronic goods. Awareness raising programmes and activities on issues related to the environmentally sound management (ESM), health and safety aspects of e-wastes in order to encourage better management practices should be implemented for different target groups. Technical guidelines for the ESM of e-wastes should be developed as soon as possible.

10. Conclusion

Solid waste management, which is already a mammoth task in India, is becoming more complicated by the invasion of e-waste, particularly computer waste. There exists an urgent need for a detailed assessment of the current and future scenario including quantification, characteristics, existing disposal practices, environmental impacts etc. Institutional infrastructures, including e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and/or regional levels for the environmentally sound management of e-wastes. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with private entrepreneurs and manufacturers. Model facilities employing environmentally sound technologies and methods for recycling and recovery are to be established. Criteria are to be developed for recovery and disposal of E Wastes. Policy level interventions should include development of e-waste regulation, control of import and export of e-wastes and facilitation in development of infrastructure. An effective take-back program providing incentives for producers to design products that are less wasteful, contain fewer toxic components, and are easier to disassemble, reuse, and recycle may help in reducing the wastes. It should set targets for collection and reuse/recycling, impose reporting requirements and include enforcement mechanisms and deposit/refund schemes to encourage consumers to return electronic devices for collection and reuse/recycling. End-of life management should be made a priority in the design of new electronic products.

11. References

1. Agarwal R. India: The World's Final Dumpyard!, January, Basel Action News, 1998, 1. at www.ban.org accessed on 14th September, 2006.
2. Alastair I. Mapping Environmental Justice in Technology Flows: Computer Waste Impacts in Asia Global Environmental Politics 4:4, Massachusetts Institute of Technology, 2004.
3. Asia-Pacific Regional Scoping Workshop on Environmentally Sound Management of Electronic Wastes, 19-22 November, Tianjin, China, 2002.
4. Ammons J, Sarah B. Eliminating E-waste: Recycling through Reverse Production, 2003. at www.lionhrtpub.com accessed on 7th September 2005.
5. CII. E-waste management, Green Business Opportunities, Confederation of Indian Industry, Delhi. 2006; 12(1).
6. Devi BS, Shobha SV, Kamble RK. E-Waste: The Hidden harm of Technological Revolution, Journal IAEM. 2004; 31:196-205.
7. DIT. Environmental management for Information Technology industry in India, Department of Information Technology, Government of India, 2003, 122-124.
8. Envocare. Mobile Phone Recycling, 2001. at www.envocare.co.uk accessed on 28th August 2005.
9. Mehra HC. PC waste leaves toxic taste, The Tribune, 22nd March, 2004.
10. Radha G. A Study of the Performance of the Indian I.T, 2002. Sector at www.nautilus.org accessed on 21st June, 2005.
11. Ramachandra TV, Saira VK. Environmentally sound options for waste management, Envis Journal of Human Settlements, March, 2004.
12. Sergio J, Tohru M. Waste management of electric and electronic equipment: comparative analysis of end-of-life strategies, J Mater Cycles Waste Manag. 2005; 7:24-32.
13. Shobana Ramesh, Kurian Joseph. Electronic waste generation & management in Indian city, Journal of Indian Association for Environmental Management. 2006; 33(2):100-105.
14. Toxic links scrapping the Hi-Tech Myth Computer Waste in India, 2003. www.toxiclink.org accessed on June, 2006.
15. Toxics Link. E-Waste in Chennai Time is running out, 2004. www.toxicslink.org accessed on 14th June, 2006.
16. Trick J. A mobile is not just for Christmas, Tuesday, 2002. 24th December 2002, http://news.bbc.co.uk accessed on 19th August, 2005.
17. Widmer R, Heidi Oswald-Krapf, Deepali Sinha-Khetriwal, Max Schnellmann, Heinz Bo¨ni. Global perspectives on e-waste, Environmental Impact Assessment Review. 2005; 25:436-458.