

# Recycling E-Waste: A Growing Unorganized Sector

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**Abstract** - Informal processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution "E-wastes are considered dangerous, as certain components of some electronic products contain materials that are hazardous, depending on their condition and density. The hazardous content of these materials produce a threat to human health and environment. Discarded computers, televisions, VCRs, stereos, copiers, fax machines, electric lamps, cell phones, audio equipment and batteries if not disposed properly can add many toxic substances into soil and groundwater. Many of these products can be reused, refurbished, or recycled in an environment friendly manner so that they are less harmful to the ecosystem. In this paper I have discussed about the growing but unorganized growth of e-waste management sector.

**Keywords:** e-waste, hazardous substance, environment, e-waste management, electronic scrap, unorganized sector.

## I. GLOBAL TRADE IN HAZARDOUS WASTE

Among all the international agreements, the Basel Convention on the Control of the Trans-boundary Movement of Hazardous Waste and Their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. It was adopted in 1989 and came into force in 1992 for the purpose of protecting human health and the environment against the adverse effects resulting from the generation, management, trans-boundary movement and disposal of hazardous and other wastes. Originally, it did not mention e-waste, but later it addressed the issues of electronic waste along with end-of-life ships at the Conference of the Parties of the Basel Agreement in late 2006. Currently, electronic waste, mobile phones, Polychlorinated Biphenyls (PCBs) and compounds used in industry as heat exchange fluids, in electric transformers and capacitors are among the wastes regulated by the Basel Convention. Many of the global e-waste exports, therefore, are in contrary to the Basel Convention.

## II. RISING ILLEGAL E-WASTE EXPORTS

In August 2006, when the Abidjan Hazardous Wastes Crisis exposed the occurrence of illegal hazardous waste exports from Europe, the UNEP Executive Director, Achim Steiner stated: "As global trade flows expand and tough domestic controls raise the costs of hazardous wastes disposal in developed countries, the opportunities

and incentives for illegal trafficking of wastes will continue to grow." It is an affirmation of the rising trend in the export of hazardous wastes by fraudulent means in global trade. Many studies have confirmed and revealed the danger posed by many wastes, their toxicity, carcinogenicity and other characteristics harmful to the human health and environment.

This awareness has been the basis of global action leading to the tightening of laws and regulations. This has, in turn, triggered an increase in the cost of hazardous waste disposal through safer means compelling many countries to search for more economically viable ways of disposing waste abroad. As a result, many developed countries, which are able to circumvent the national legislations, export hazardous wastes including electronic wastes to the developing countries which are having neither the knowledge of the hazardous nature or having rudimentary knowledge, nor the capacity to dispose off the wastes safely. Normally, a computer recycler in the U.S., for instance, would scan the incoming electronic waste materials for its most valuable components and probably sell them in a store or to specially brokers. The rest of the material would be broken down and sorted according to the type of waste (eg. circuit boards, wires and cables, plastics, cathode ray tubes (CRTs), and non-recyclables). These are sold to the brokers who then ship them mainly to China or the South Asian countries - India, Pakistan and Bangladesh. Alternatively, the e-waste materials are sometimes simply sold off in bulk without any separation whatsoever. E-waste brokering is an aggressive and competitive business and buyers for all kinds of e-waste for the Asian market are always available.

## III. MAIN FACTORS IN GLOBAL WASTE TRADE ECONOMY

Like most waste trade, e-waste export to the developing countries is governed by brute global economics in which market forces, if left unregulated, dictates that the toxic waste will always run "downhill" on an economic path of least resistance. Illegal export becomes possible when the environment and occupational regulations are non-existent, minimal, lax or not well-enforced, as they are in some developing countries. Low labour costs in these countries also provide the impetus for the export in wastes. For instance, labour cost in

China is \$1.50 per day. In addition, exporting e-waste is more lucrative for the exporter country than recycling or disposing it within the country. For instance, waste traders in Europe or USA have to pay US \$20 to recycle a computer safely in their countries while they can sell it at half the cost to the informal traders in developing countries. Again, while it costs Rs. 12,000 to recycle a tonne of rubbish after segregation in the U.K., shipping the rubbish to India costs just about Rs. 2,800. The U.S. produced five times more hazardous waste in 2002

(265 million tonnes) than it did in 1975 (57 million tonnes). The cost of managing such waste within the country would be enormous depending on the toxicity and reactivity of the substances. Thus, it would be more economical to ship toxic wastes to the developing countries when the cost is negligible. Considering its cost effectiveness, export is a clandestine option chosen by some companies in the industrialized countries. The illegal exports are mostly justified as 'charity' or as 'recycling'. Through these methods, obsolete devices find their way from the industrialized countries to the developing countries where they can be used for a few more years. For instance, in 2005, out of nearly 5 million Personal Computers in India, 1.38 million were either model 486s (about eight years old by 2005) or even older. Reuse or recycling may prolong the life span of a product but sooner or later, it would find its way into the waste mainstream. Therefore, while the developed countries legally evade the problem of waste disposal, the developing countries are left to reckon with the ultimate problem of waste disposal.

#### IV. WASTE TRADING AS A QUINTESSENTIAL PART OF ELECTRONICS RECYCLING

Importing waste is no doubt a lucrative economy. The main objective behind the import of used electronics is the recovery of valuable metals and elements that are contained in electronic waste, including steel, aluminium, copper, tin, nickel, etc. which are in bulk; cadmium and mercury which are in smaller amounts; and barium, nickel, gold, titanium, cobalt, palladium, manganese, silver and platinum, etc. which are in traceable amounts. These various commodities provide useful raw material feedstock in the manufacture of new products. The largest market of a non-working equipment or e-waste is for the circuit boards that are rich in precious metals, *i.e.* silver, gold, palladium and platinum. Sound management practices for the recovery of these elements are debatable. However, export and import trade has become an essential aspect of the electronics recycling.

Moreover, many of the markets for processed plastics and other raw materials derived from end-of-life electronics

equipment are also outside of the U.S. In fact, there are no smelters for copper or for the recovery of precious metals from circuit boards in the U.S. The five primary copper and precious metal smelters in the world are located in Canada,

Belgium, Sweden, Germany and Japan. There are no Cathode Ray Tube (CRT) glass furnaces in North America and there are less than 20 worldwide. There are approximately 15 in Asia (*e.g.* South Korea, Malaysia, India, Thailand, Singapore and China) and one in Poland. As the demand for the CRT glass cullet remains strong, the number of glass furnaces continues to be inadequate and insufficient. The challenge is further complicated by the Government restrictions.

#### V. FREE TRADE AGREEMENTS AS A MEANS OF WASTE TRADING

A muted aspect of the global trade in waste which has raised some concerns is that developed countries like Japan are making full use of the Free Trade Agreements (FTAs) or so called "Economic Partnership Agreements" (EPAs) to export their waste to the developing world. Often involved in the EPA arrangements are unspoken *quid-pro quo* deals such as the Philippines promised access to domestic and nursing labour markets in Japan, or Thailand getting a package mass transit investment for Bangkok. Since 2004, the Governments of Japan and Thailand have been formally negotiating an FTA that seeks to eliminate tariffs on an unprecedented list of Japanese hazardous waste exports to Thailand. The latter would have to accept waste, including slag, residues from incinerated municipal waste, chemical and allied industries and hospital waste. Other industrialized countries which have been exporting waste to the South-east Asian countries including Thailand,

Philippines and Indonesia through existing loopholes that permit some forms of waste being shipped for recycling include the United States, Australia, Britain, New Zealand, Canada and South Korea. It is reported that Japan and the EU are currently negotiating a similar FTA with India which could result in enormous increase in the import of waste severely hampering environmental safeguard measures. A leaked portion of the negotiation text of the FTA between the EU and India has caused some apprehension. The leaked text of the India-EU FTA phrases a new name for waste. It mentions that "no new goods shall be understood to include notably used and remanufactured goods" and that "non-new goods" would not have any restrictions such as import or export tariffs. Thus, import of waste could be treated just like import of fresh products. The growing pressure on the developing countries to import waste through bilateral or free trade

agreements is a cause of serious concern as it encourages the business of recycling wastes. It could also override the existing national and international laws against the hazardous waste import, especially the Basel Convention and its global Ban Amendment forbidding toxic waste exports to the developing countries. For instance, despite the international ban, the U.K. could export nearly 23,000 MT of electronic waste “illegally” in 2003 to parts of South-east Asia, India and China.

#### VI. 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 tonnes annually. In 2009, India generated 5.9 million tonnes of hazardous waste domestically and imported 6.4 million tonnes. It generates about 3,50,000 tonnes of electronic waste every year and imports another 50,000 tonnes. So far, India has been the destination of the hazardous and industrial wastes like mercury, electronic and plastic wastes from the United States; asbestos from Canada; defective steel and tin plates from the E.U., Australia and the U.S.; toxic waste oil from the United Arab Emirates,

Iran and Kuwait; zinc ash, residues and skimming's, lead waste and scrap, used batteries and waste and scrap of metals such as cadmium, chromium, cobalt, antimony, hafnium and thallium from Germany, Denmark, the Netherlands, the United Kingdom, Belgium and Norway. These wastes contain toxic components which are damaging to the public health and environment. New draft rules on the import and the management of e-waste are currently being considered. Till the rules are notified, the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008 regulate the export import trade or trans-boundary movements of hazardous wastes including e-waste. According to these Rules, import of hazardous wastes for disposal is not permitted. However, import of waste is permitted only for reuse, recycling or reprocessing. Monitoring of units recycling hazardous wastes is the responsibility of the State Pollution Control Board or the Pollution Control Committee in a Union Territory. The

Rules also require all import consignments to be accompanied by a movement document and a test report from an accredited laboratory or a pre-shipment inspection certificate from a recognized agency. The proposed e-waste rules, 2011 do not address the issue of

import/export of e-waste. The trans-boundary movement of hazardous waste including e-waste is regulated by the Hazardous Waste Rules, 2008. Import of e-waste can be considered for actual users only with the permission of Ministry of Environment and Forests and license from Directorate General of Foreign Trade.

#### VII. INDIA'S STAND ON LIBERALIZING IMPORT RULES

Global trade in remanufactured products has already crossed \$100 billion. Like other Asian countries, India has also felt the pressure from the developed countries to liberalize its import rules to allow access to its markets for their re-manufactured goods. It is argued by the countries like U.S., Switzerland and Japan that promoting trade in re-manufactured goods helps both the developed and the developing countries by increasing access to low cost, superior quality products while helping solid waste management and encouraging transfer of technology and skills. But India is apprehensive that it could lead to a deluge of import of low-quality cheap goods and actually amount to transfer of waste from the developed to the developing countries. Thus, it has opposed suggestion by some developed countries for more liberal trade in remanufactured goods or refurbished old products apprehending that it could harm the country's domestic industry and also have adverse environmental ramifications. Agreeing with the Government's stand on the issue, Amit Mitra, Secretary-General of the Federation of Indian Chambers of Commerce and Industry (FICCI), has been quoted as saying, “Unrestricted imports of remanufactured goods would adversely impact our domestic manufacturing sector and also have the risk of diluting safety standards and dumping of e-waste”.

#### VIII. LOOPHOLES IN LEGISLATIONS

However, some provisions contained in some specific policies enable import of e-waste. For instance, India's EXIM (export-import) policy allows import of the secondhand computers not more than 10 years old, besides letting computers in as donations. The Foreign Trade (Development and Regulation) Act, 1992 provides for import of computers and peripherals from zones which have been set up primarily for export, *i.e.* EOU (Export Oriented Units), EPZ (Exports Processing Zones), STP (Software Technology Parks) and EHTP (Electronics Hardware Technology Parks) at a zero custom duty. These computers can be donated to the recognized non-commercial educational institutions, registered charitable hospitals, public libraries, public-funded research and development establishments and

organizations of the Government of India and State/ UT Governments.

Moreover, there is no Exim code for trade in second-hand computers for donation purpose or for resale. Both second hand and new computers are placed under the same EXIM

code in the Indian Customs Tariff Act allowing exporters to club new computers with the old ones. Besides, the

Directorate-General of Foreign Trade (DGFT) rules are flexible to interpretation enabling the Customs Authorities to take on- the- spot decisions and provide rules exemption.

Thus, if a consignment of second hand computers is found without a license, traders manage to get their shipment released by paying a penalty. Importers also escape full penalty by an under-assessment of illegally imported goods. Such provisions in the law can be misused by the developed countries to export hazardous e-waste to the country. In the

new draft rules on e-waste, Rule 16 in Chapter VI says that 'every producer, distributor collection centre, refurbisher, dismantler, recycler, consumer or bulk consumer shall not import used electrical and electronic equipment or components in India for use unless it is imported for the purpose of repair or refurbishment or to fulfill obligations under the Extended Producer Responsibility (EPR)'. The fact that e-waste could still be imported under the pretext of metal scrap and second-hand electrical appliances have been a matter of serious concern. As per the proposed e-waste rules, 2011, the clause for import of used electrical and electronic equipment in India for use has been deleted. However, as per the EXIM Policy of Ministry of Commerce import of second hand computers including personnel computers/lap tops and refurbished/ re-conditioned spares is restricted.

#### IX. POROUS PORTS AND LACK OF CHECKING FACILITIES

Among all ports, the Mumbai Port Trust and the Jawaharlal

Nehru Port Trust have been found to have the largest amount of hazardous goods lying around. Much of the global waste which is imported into India and find their way into the ports is labelled as waste or mixed waste paper consignments. Customs officials are unable to check every container because of shortage of men and machinery and resort to random checks. Of the 12 major ports and 14 intermediate ports in India, the Jawaharlal

Nehru Port at Nhava Sheva has two scanning machines. It is the largest port in India, handling close to 50 percent of the country's port traffic. More than a million containers arrive at the port and the scanners have limitations. If cobalt-60, a radioactive substance, is packed in a lead box, the scanners would detect the lead only because the metal blocks radiation from cobalt. Besides, beaches and small ports have also grown to be hubs for illegal import of the hazardous waste.

#### X. PROCEDURE OF IMPORTING E-WASTE

The standard procedure followed for importing a consignment to India involves an importer, an exporter, an agency registered and notified by the Directorate-General of Foreign Trade, a bank and the customs department at the port. First, the importer is required to get a pre-inspection certificate of the import material by a registered agency, which could be an Indian or a foreign company. After the agency issues the certificate, a bill detailing the number of containers, excise duty classification and product details is prepared. Thereafter, the consignment is shipped. When it reaches India, the customs officials at the port check the certificate, levy a customs duty on the product as specified in the Central Excise Tariff Act and release the consignment to the importer. The e-waste trade is a thriving business in India with strategic port cities like Singapore and Dubai serving as transit centres in the e-waste trade route. E-waste from Australia, North America, South Korea and Japan is received in Singapore and dispatched again to the importing Asian countries including India. Dubai also serves as a centre where scrap and wastes of all kinds from U.S.A., Europe and the West Asian countries are collected and re-exported. India is a major buyer from Dubai. The Dubai based exporters are well aware of the Indian domestic scrap market such that prices of any scrap are kept at par with the Indian market price. The transboundary movements of hazardous wastes, including e-waste are regulated under the Hazardous Wastes Rules, 2008. As per these Rules, import of e-waste is permitted to actual users in the country with permission of MoEF and license issued by Directorate General of Foreign Trade (DGFT) for recycling or reprocessing only. Import of e-waste by traders is not permitted.

#### XI. ILLEGAL WASTE IMPORTS SEIZED IN PORTS

India annually imports approximately 3.5 million metric tones of scrap metal worth Rs. 5,500 crores, entering the country at an average of 500 container loads daily. It is unloaded at any of the major and minor ports along the coast and transported to the Inland Container Depots throughout the country from where they enter a

flourishing grey market. The Custom officials at regular intervals have intervened successfully and seized hazardous goods entering the ports. In 2009, nine containers of hazardous waste imported from Malaysia, Saudi Arabia and Barcelona by three different companies in Tamil Nadu were caught at the port of Tuticorin in Tamil Nadu.

In early 2010, twenty containers of hazardous waste from

Greece and Reunion, a French colony, imported by a paper factory in Tamil Nadu were sent back from the Tuticorin Port. As recently as in August, 2010, more than 120 tonnes of e-waste in eight containers and imported from various countries by different companies were seized in Chennai. Of the total five consignments, one was from Australia, one from Canada, two from Korea and one from Brunei. Subsequent examination of the goods revealed that there were very old, used and unusable computer monitors, CPUs and processors, control panels, electrical motor parts, printers and keyboards. A large proportion of the computer monitors were found to be more than ten years old and clearly meant for recycling. These imports were found to be in direct violation of the provisions of the Customs Act, 1962 read with the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.

## XII. E-WASTE ECONOMY IN THE UNORGANIZED SECTOR

India has the label of being the second largest e-waste generator in Asia. According to a MAIT – GTZ estimate,

India generated 330,000 lakh tonnes of e-waste in 2007, which is equivalent of 110 million laptops. More than 90 percent of the e-waste generated in the country ends up in the unorganized market for recycling and disposal. The unorganized sector mainly consists of the urban slums of the metros and mini-metros, where recycling operations are carried out by the unskilled employees using the most rudimentary methods to reduce cost. A study by the Basel

Action Network (BAN) in partnership with the Toxic Link reveals that e-waste is received and processed in India in similar manner as is done in China, or the condition could be even worse. The unorganized sector consists of an assortment of small and informal businesses not governed by any stringent health and environmental regulations. Workers face dangerous working conditions as they may be without protection like gloves or masks. Released gases, acid solutions, toxic smoke and contaminated ashes are some of the most dangerous threats for the workers and for the local

environment. Many workers function from homes to reprocess waste, further exposing themselves, their families and the environment to dangerous toxins. For instance, to extract metals from circuit boards, gas torches are used to heat a board just enough to melt the solder, which separates the metal parts from the boards. Metals are also extracted by soaking the circuit boards in open acid bath followed by manual scrapping to extract copper and precious materials next to open drains. In this sector, the dismantlers extract metals on their own or work with a big trader, earning about Rs. 100/- per day. Two motherboards usually weighing one kilogram cost Rs. 230. A profit of 10 per cent is made after selling the metals. The circuit board recycling process involves either open burning of the circuit boards or using acid stripping. Both processes first involve removal of the chips, condensers and capacitors from the board. Very often child labour is employed to separate the parts from the circuit boards, utilizing wire cutters and pliers. After some pin straightening, some of the Integrated Circuits (IC) chips and components are sold for reuse. The items that are not worthy of re-use go directly to the open fires to reduce them to metals. Following the chip extraction and burning, the boards themselves are burned in an open pit to retrieve the rest of the metal solder and copper. After burning, the ashes are floated in water to remove lighter ash. Another process involves utilizing nitric acid on the circuit boards to remove gold and platinum. Both methods, open burning and acid baths, are fraught with occupational health risks as well as risks to the people living in the surrounding community. The circuit boards are sourced from the computer monitors,

CPUs, keyboards, television and remote control sets, radios, cell phones and other electrical appliances. It is estimated that about half the circuit boards used in the appliances in India end up in Moradabad (Uttar Pradesh) also called *Peetal Nagri* or the brass city.

## XIII. E-WASTE ECONOMY IN THE ORGANIZED SECTOR

In July 2009, organized recyclers formed the e-waste recycler's association but facing stiff competition from the unorganized sectors, they have been able to capture only 10 per cent of the total share of the e-waste market. A problem facing the organized sector is the lack of proper collection and disposal mechanisms and appropriate technologies in the face of a large informal sector. Due to lack of proper collection systems, households and institutions at times end up storing obsolete products in their warehouses or storerooms. Even when these are sold or exchanged, they are refurbished and then resold. Only a small proportion of obsolete electronics products actually find its way into the

e-waste processing stream. This is the dilemma facing the 10,000 sq. ft. formal e-waste dismantling unit in Noida (Uttar Pradesh) belonging to the TIC Group India Pvt. Ltd which can process up to 500 tonnes of e-waste annually. But since June 2008, when it was launched, the unit has processed only 200 tonnes. Similarly, the Attero recycling unit in Roorkee (Uttarakhand) is a 35 crore plant which can process 36,000 tonnes of waste in a year although it is getting only 600 tonnes currently. The formal sector also lack refineries for precious metals recovery. Therefore, according to the e-waste recyclers' association formed by organized recyclers in July, 2009, the only way to sustain formal business in the current scenario is the license to import. Currently, the Attero recycling unit is the only recognized recycling facility for e-waste in India which has the license to import e-waste from the developed countries. Applications from other formal agencies are pending with the Ministry of Environment and Forests, Government of India. Opinions however differ on the issue of license to import as the only way to sustain formal business in the current scenario. The Toxics Link holds that the aim of e-waste management should be safeguarding environment rather than sustaining businesses. Allowing imports would mean many non-recyclable hazardous materials dumped in our landfills, which should not be allowed. The country generates very large quantities of waste and the critical need was to establish a sound collection mechanism and not permit waste import to sustain capacity utilization of plants. Unlike the informal recyclers, the formal recyclers do not use any chemicals or incinerations and use environmentally sound processes. Clients of the formal recyclers include multinational companies which have to keep up with an environment friendly image and those which do not want their products to enter the grey market and compete with their new products. Unlike the organized sector, the informal dealers refurbish and sell a computer, even if it can be classified as e-waste, with some parts of it in working condition. Selling any part of a computer that is functional would fetch more money than selling it as metal parts. About

**XIV. PER CENT OF THE E-WASTE GENERATED EVERY YEAR IS RECYCLED AND THE REMAINING IS REFURBISHED.**

Comparison of the e-waste economy between the informal and formal sectors in the table given below provides a comprehensive insight into the methods, safeguards, capital investments and earnings involved in the e-waste business:

Informal	Formal
1. Cathode Ray Tubes' (CRTs) are broken manually to separate its components – glass, metal and copper. The glass, comprising lead, is sold to bakeries or bangle makers. Since it retains heat, the glass goes into the base of ovens. Phosphors, if inhaled, can be toxic. The CRTs are sold to non branded television makers.	Components of the CRTs are separated by heating in a closed chamber, which sucks out phosphors from the components. They are then crushed in shredder machines. Glass containing lead is sold to the companies that manufacture the CRTs.
2. Circuit boards have gold plated brass pins, microchips and condensers which are separated by heating. Fumes released during heating are toxic. Gold-plated brass pins are soaked in acid to recover the gold and brass separately. Microchips and condensers are heated in big containers filled with acid.	Circuit boards are crushed in shredder machines. They are sent to approved smelters abroad, where after smelting at 1200°C, the metals in the circuit board collect together. Since smelting is carried out in closed chambers at high temperature, it is not hazardous. The metals lead, copper, nickel, tin, gold, silver, palladium are then separated.
3. No safety precautions followed. Informal recyclers paid Rs.200-300 daily in Seelampur; Rs. 100-150 in Moradabad.	Protective equipments gloves, masks, shoes, caps are provided to employees. Rs. 5,000 per month paid to unskilled workers.
4. Minimal capital investment required. Cost includes price of e-scrap, bribes to transfer it across state borders and set up and run shops, and rent for the workspace.	Investment for a dismantler is about Rs. 30 lakh and for a recycling plant, about Rs. 25crore.

As e-waste is a cheap source of raw materials while providing employment to many, there are those who advocate recycling e-waste while stressing the need for safe recycling and for setting up of more plants. Commenting on the benefit of safe recycling, the former President of India, Dr. A.P.J. Abul Kalam also said at the inauguration of the Attero Recycling Plant in Roorkee in Delhi in January 2010: "With metal prices rising, recycling will help in sustaining our economy as it is much cheaper than extracting metals from its ore." In this

regard, the UNEP report of July 2009 titled “Recycling From E-waste to Resources” has analysed issues related to e-waste including market potential of recycling of e-waste and transfer of innovative technologies for selected 11 countries, including India.

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