Extended Stakeholder Responsibility as a Public Policy for E-waste Management in India

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Traditionally waste management in India is the responsibility of municipalities, later has been shared by corporate partially as a legal compliance and as part of social responsibility. Recent Waste handling laws in India also tried to keep consumers in comfort zone while the counterpart consumers in European countries are being charged Advanced Recycling Fee. Though NGO's are trying to do their bit about Consumer awareness concerning dark shades of grey market and recycling & reuse of e-Waste, efforts in isolation are proving to be futile. The paper tries to project the need for a public policy holding all the stakeholders responsible for the Greener Environment, not placing the onus selectively on few.

Keywords: e-Waste, Extended Producer Responsibility, Environmental Policy, Public Policy

1. Introduction

Electronic waste or e-waste or Waste Electrical and Electronic Equipment (WEEE) is a waste consisting of any broken or unwanted electrical or electronic appliance. This definition includes used electronics which are destined for reuse, resale, salvage, recycling, or disposal. WEEE / E-waste have been defined as "any appliance using an electric power supply that has reached its end-of-life" [1]. Sources of E-waste include IT & telecom equipments, large

household appliances, small household appliances, electrical & electronic tools, toys, leisure & sports equipment, and monitoring & control instruments. E-Waste contains both hazardous and non-hazardous components within. Waste is regarded as a resource which should and could be reclaimed [2]. Gadgets becoming body accessories of people in modern lifestyle, are used, abused and discarded when become obsolete with innovations. They occupy the space in offices and homes and finally thrown out for garbage thoughtlessly without realizing the harm it causes to the environment. Only 9 % of people actually recycle their mobile phones [3]. Majority of the consumers are completely ignorant of the negative environmental impacts of gadgets and also about the recycling programs [4].

Innovation and development in the field of science and technology and an open global market resulted in availability of a range of products at affordable prices, changing the very lifestyle of societies. The comforts, security, information access in an easy and faster way adding to daily life has boosted the electronic appliances market leading to massive production. But the disposal of consumption discards is a growing challenge. India with population of over 1 billion, a growing economy and increasing consumption is estimated to be generating approximately 3,50,000 tonnes of waste annually and is expected to grow at a much higher rate of 10-15% [5]. The main sources of electrical and electronic waste generation in India are government institutions and business houses, accounting for around 70% of the total waste, while contribution of individual household is relatively small. India has been one of the few developing countries to come up with exclusive e-Waste management & handling rules in 2012 with a draft proposed a year back. E-wastes contain over 1000 different substances many of which are toxic and potentially hazardous to environment and human health, if these are not handled in an environmentally sound manner. In India the bulk of the e-waste comes from computer, mobile phone and related devices. Alongside, other goods include television sets, washing machines, refrigerators, etc, besides florescent tubes, which contain mercury. The e-waste products range from those, which have high hazard and a high resource value (like computers, mobiles, TV sets, etc) to those, which have high hazards but low recoverable value – such as refrigerators (containing CFC gases) and mercury-based lamps. While the recycling market is keen to corner the first type, since they have a These electronic and electrical equipment contain valuable materials like copper, gold, silver, platinum palladium, plastics and glass. They also harbor over 50 toxic elements. If released, these can cause long-term health problems.

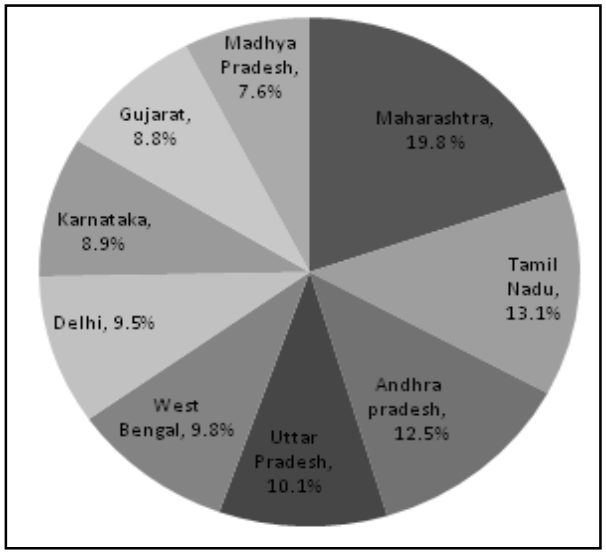
2. Objectives of the Study

The study attempts to examine the gravity of e-Waste accumulation menace in India and the existing infrastructure to address the e-Waste management. It also studies the accountability of all stakeholders in the wake of new e-Waste handling rules effective from 1st May 2012.

3. E-Waste in India, the darker side of Innovation

India generates about 350,000 tonnes of electronic waste every year and imports another 50,000 tonnes. With the annual growth rate of e-Waste generation of ten to fifteen percent, government Institutions & Businesses account for seventy percent of e-waste. Of the e-Waste generated in India internally and through imports, only three percent of the e-Waste is captured by authorized e-waste recycling facilities. The amount of e-waste being produced - including mobile phones and computers - could rise by as much as 500 percent over the next decade in some countries, such as India [7]. Maharashtra leads in e-waste generation in India with Mumbai as leading city for e-waste generation (See Figure1 & Figure 2)

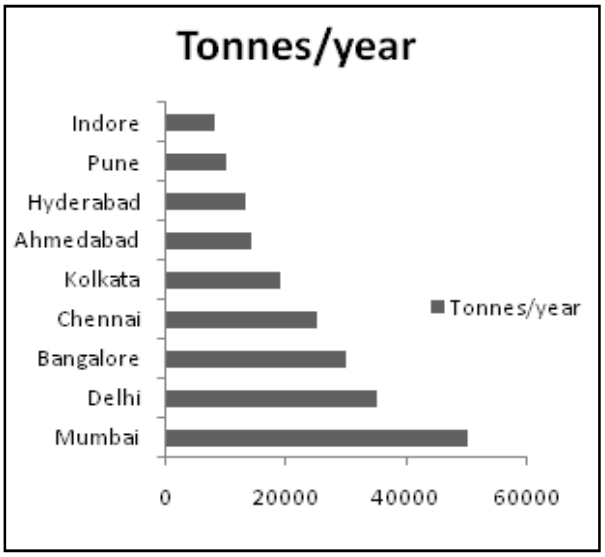
Figure 1 showing state-wise e-waste generation in India



Source: Department of Information Technology, India accessed at greenarth.com

In the corporate sector, which generates 60% of India's e-waste, less than 5% of e-waste is processed through registered recyclers. The Western region contributes maximum to e-waste generation – up to 35%. The major constraint towards growth of e-waste recycling with eco-friendly means is lack of education among individuals related to hazardousness of e-waste recycling via non eco-friendly methods.

Figure 2 showing City-wise e-waste generation in India



Source: Department of Information Technology, India

4. E-Waste Management Infrastructure

E waste management consists of both less production of e waste and the recycling of the produced ones. Careful disposal of these items is important because many electronic products contain hazardous components as well as valuable components. Computer monitors and televisions can contain leaded glass. Materials such as beryllium, mercury, cadmium, nickel, zinc, silver and gold can be found in printed circuit boards. Cadmium can also be found in batteries and mercury can be present in relays and switches. Infrastructure as a service helps in reducing the use of hardware involved in both the front and back end of the industries, considerably. By using Infrastructure as a service, the e-waste can be managed by the reduction of hardware produced. When data can be handled without the actual introduction of devices, the need for more data centres also reduces. The cloud service, infrastructure as a service will give a more efficient way to manage e waste for both consumers and producers [8].

Technical solutions are available, but in most cases a legal framework, a collection system, logistics, and other services need to be implemented before a technical solution can be applied. Display units (CRT, LCD, LED monitors), Processors (CPU chips, RAM), and audio components have different useful lives. Processors are most frequently out-dated (by software) and are more likely to become "e-waste".

E-Waste management infrastructure contains stakeholders who have gains and pains from it, the processes being applied with labour and tools and the legal framework.

4.1.Stakeholders

Producers:

Consumers:

Waste Managers: Collection Centers, Dismantler & Recycler

Municipality Governance System: Which is instrumental in collecting municipal waste from households and offices.

International/National Bodies: global organizations focused on improving WEEE handling. Key examples are the UN Solving the E-waste Problem (StEP) program and the Global e-Sustainability Initiative (GeSI) working group on waste handling. Central and State Pollution Boards, Ministry of Environment & Forests etc.

The informal sector: The informal sector is compromised of people (men, women and children) who collect, refurbish, dismantle and even recycle the metals found in e-waste. The informal sector recyclers are unregistered entrepreneurs who see e-waste as a new form of livelihood in a changing society. In fact, they are the ones who handle over 95% of all e-waste generated in India today. A recent study suggests that Delhi is the site of work for 25,000 workers in the industry. In all, they handle 10,000-20,000 tons of e-waste annually. This waste is recycled by some of the poorest people in Delhi [9]. It is a well known fact that India produces as well as imports thousands of tonnes of electronic waste every year. Almost all of this waste is recycled or scrapped by the unorganized sector, using the most rudimentary methods that pollute.

Everyone & Everything on the earth:

Attracted by the seemingly higher profitability of e-waste, over 90 recyclers have already received authorization from the government for handling e-waste.

4.2.The Process - 3Rs of e-Waste Handling System (Recycle, Reuse, Reduce)

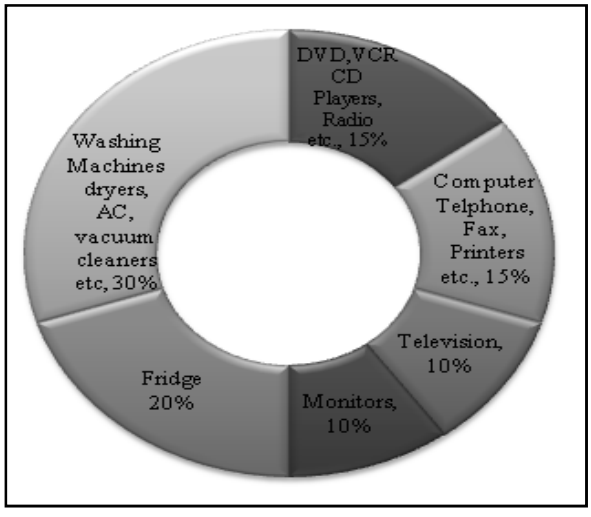
Collection of e-waste:
Many have their own vehicles for collection from the generators of e-waste as well as tie ups with logistic companies for collection across India.

Data Destruction:
Information-containing devices such as hard disks, compact disks, etc. are collected and destroyed at client's location through mobile shredding facilities. Then it is moved for recycling

Recycling:

Recycling activities commence with the receipt of e-waste material from various clients' locations. The material is initially weighed, and is separated product-wise (monitors, CPUs, printers, keyboards, etc.) for easy retrieval. The material is then checked by qualified technicians to ascertain whether the equipments are working or non-working. In developed countries, electronic waste processing usually first involves dismantling the equipment into various parts (metal frames, power supplies, circuit boards, plastics), often by hand, but increasingly by automated shredding equipment. The advantages of this process are the human's ability to recognize and save working and repairable parts, including chips, transistors, RAM, etc. The disadvantage is that the labor is cheapest in countries with the lowest health and safety standards. Today the electronic waste recycling business is in all areas of the developed world a large and rapidly consolidating business which eliminates the need to revert e-Waste to a raw material form through recovery and reuse. The environmental and social benefits of reuse include diminished demand for new products and virgin raw materials, larger quantities of pure water and electricity for associated manufacturing; less packaging per unit; affordable pricing for reusable products by economically weaker sections, and reduced use of landfills. Recycling activities commences with the receipt of e-waste material from various clients' locations. The material is initially weighed, and is separated product-wise (monitors, CPUs, printers, keyboards, etc.) for easy retrieval. The material is then checked by qualified technicians to ascertain whether the equipments are working or non-working. Cathode ray tubes (CRT) are considered one of the hardest types to recycle. The United States Environmental Protection Agency (EPA) includes discarded CRT monitors in its category of "hazardous household waste". One of the major challenges is recycling the printed circuit boards from the electronic wastes. The circuit boards contain such precious metals as gold, silver, platinum, etc. and such base metals as copper, iron, aluminum, etc. Conventional method employed is mechanical shredding and separation but the recycling efficiency is low. Alternative methods such as cryogenic decomposition have been studied for printed circuit board recycling. An automated shredder equipment is used in general for recycling. In an alternative bulk system, a hopper conveys material for shredding into an unsophisticated mechanical separator, with screening and granulating machines to separate constituent metal and plastic fractions, which are sold to smelters or plastics recyclers. Such recycling machinery is enclosed and employs a dust collection system. Some of the emissions are caught by scrubbers and screens. Magnets, eddy currents, and trammel screens are employed to separate glass, plastic, and ferrous and nonferrous metals, which can then be further separated at a smelter. Hazardous smoke and gases are captured, contained and treated to mitigate environmental threat. These methods allow for safe reclamation of all valuable computer construction materials. Recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem.

Figure 3 showing e-Waste generation from different electrical & electronic appliances



Source:
http://ewasteblog.wordpress.com/category/statistics/

Reuse by reselling/lease:

The equipments which are recovered for recycling, if they are in working/ near-working condition, then the technicians attempt to repair/ upgrade the equipments to ensure that they become re-marketable and can be resold. Reselling can happen through retailing or auctions or given for lease. Manufacturing of one desktop computer required 240 kilograms of fossil fuels, 22 kilograms of chemicals and at least 1,500 litres of water [10].With reuse new product requirements come down considerably.

4.3. Legal Framework:

e-Waste management in India is governed by many national and international rules for waste handling in general and specific to e-waste too (See Table)

The text of the Basel Convention on the Control of Tran boundary movements of hazardous wastes and their disposal was adopted on 22nd March 1989 and entered into force on the nineteenth day after the date of deposit of the twentieth instrument of ratification, acceptance, formal conformation, approval or accession by a country to the Convention, 5 May 1992. 162 countries party to the Convention commit to reduce the generation of hazardous waste to a minimum, ensure that it is managed in a manner that will protect human health and the environment from its adverse impacts and reduce the transboundary movement of such wastes, making their illegal traffic a criminal offence.

Basel Convention covers all discarded/disposed materials that possess hazardous characteristics as well as all wastes considered hazardous on a national basis. The e-waste rules mandate Extended Producer Responsibility (EPR), under which manufacturers must collect e-waste generated from their products and recycle them. According to rules, collection centres are required to get authorisation from the State Pollution Control Board (SPCB) within three months from the date of commencement of the rules. Similarly, recycling plant operators must get authorisation as well as register with SPCB for better disposal practices. For most practical purposes, any kind of WEEE would fall under the Basel Convention, given the hundred of parts and materials that most electronics are made of. An Amendment to the Convention, commonly known as the Basel Ban, calls for prohibiting the export of hazardous waste, which includes e-waste, from OECD countries to non-OECD countries, for any purpose. However, the Ban Amendment is still to come into force, as it has not been ratified by a majority of the signatories to the Convention.

Table 1 showing national & international rules for waste management in India

S.No.	Rules
1	Hazardous Wastes (Management and Handling) Rules, 1989, 2003
2	The Municipal Solid Wastes (Management and Handling) Rules, 2000
3	Basel Convention 1989
4	Lead Acid Battery Rules (MoEF 2002)
5	Environmental Protection Act, 1986
6	ISO 14001.

Basel Action Network (BAN.org) is uniquely focused on addressing global environmental injustices and economic inefficiency of global "toxic trade". It works for human rights and the environment by preventing disproportionate dumping on a large scale. It promotes sustainable solutions and attempts to ban waste trade. It requires companies to be either ISO 14001 or R2 certified.

The E-waste Management and Handling Rules in India were notified in May 2011 and the government gave states one year to set up a collection and disposal mechanism in place. Those caught violating the rules are punishable under the Environment Protection Act with a maximum sentence of seven years and/or a fine of Rs one lakh.

5. Present Public Policy in India: e-Waste (Management & Handling) Rules 2011

1 May 2012 the new e-waste rules notified by the Ministry of Environment and Forests [16]. Government of India came into force. They mandate requirements for e-waste disposal by all consumers, producers, importers and traders of electrical and electronic equipment (except those in the micro- and small-scale sector) in India. By doing so, India became one of the few select developing countries, which have such a law in place. The rules aim to manage over 8 lakh tones of toxic [11]. This is expected to double in the coming decade. Considering that over 95% of the e-waste is currently recycled in small, informal, diverse and distributed operations (almost always with detrimental impacts on human health and the

environment),forcing this economy to shift to a safer and more accountable system is in itself a daunting task. The rules notified in May 2011, provided a window of one year to enable the stakeholders to prepare. However, despite the grace period, little has been done, especially by the main stakeholder – the producer. Developed countries are using free trade agreements (FTAs) to export their waste to the developing world. Japan and the EU, for instance, are currently negotiating with India and a deal is likely to be signed this year. The commerce ministry has not made public details of about 30 such deals that India is negotiating.

5.1.Extended producers responsibility (EPR) & reverse supply chain

EPR as an environmental protection strategy to reach an environmental objective of a decreased total impact from a product, by making the manufacturer of the product responsible for the entire life cycle of the product and specially for the take back, recycling and final disposal of the product. The EPR is implemented through administrative, economics and informative instruments. The composition of these instruments determines the precise forms of the EPR Nokia has large office sites under one internally verified environmental management system, which follows the rules of ISO 14001[12]. Service providers, manufacturers, dealers, assemblers, distributors and importers are encouraged to establish procedures (for example, collection centres and storage facilities) for the voluntary take back of electrical and electronic equipment as per UNEP resolution. It implies that the responsibility of the producer extends beyond the post consumer stage of the product. The producer through a series of actions will aim to set up a reverse logistical process for the products and ensure its environmentally safe recycling and disposal. Many countries have adopted this framework in their policy and regulation to manage E-waste. It will be prudent and appropriate to incorporate EPR framework for any regulation on E-waste in India. Both individual and collective responsibility of the producers is viable and workable.

Responsibility of the producer to the end-of-life management brings in more commitment and responsibility on part of producers for cleaner materials and production processes. The E- waste Management and Handling Rules put the onus of e-waste management on Manufacturers or the brands through the principle of Extended Producer Responsibility (EPR). Companies like Samsung, LG, Nokia, HCL, HP, Videocon and many more have to ensure that they have a proper take back system and provide the opportunity to consumers to recycle E-waste. The new Rules also look at the life cycle approach, and restrict the use of hazardous substance in Electronics, though mechanism for effective implementation and monitoring of such substances in EEE has not been clearly articulated and informed.

Acer India's e-Waste program, Ericsson's Ecology Management Program, Dell, Hewlette Packard etc have e-Waste management support system for consumers on communication.

The four principal goals of EPR, as stated by the OECD (2001) are: (i) Source reduction (natural resource conservation/ materials conservation) (ii) Waste prevention (iii) Design of more environmentally compatible products (iv) Closure of material loops to promote sustainable development.

Manufacturers are also involved in the situation, as they determine what materials go into the electronics. In many instances, objectionable materials are used in response to consumer demand for cheaper computers and phones. So, there's a cycle at work that implicates virtually everyone. It really boils down to this: parties who make, use, sell or purchase electronics have a responsibility to participate in some form of e-waste management program.

Larger firms and firms with higher R&D are more likely to undertake voluntary corporate action [13]. Past environmental performance, external pressure from governments, NGOs, communities and investors may trigger voluntary initiatives at firms [14]. Since the time that IT major Wipro introduced the take-back program in 2007, it has improved and matured its process for take-back and safe processing. In FY 2010-11, a total of 260.43 tons of e-waste — more than 150 percent compared to the previous year — was collected from its 17 collection centers across India and disposed through its network of certified partners [6].

5.2.Extended Stakeholder responsibility

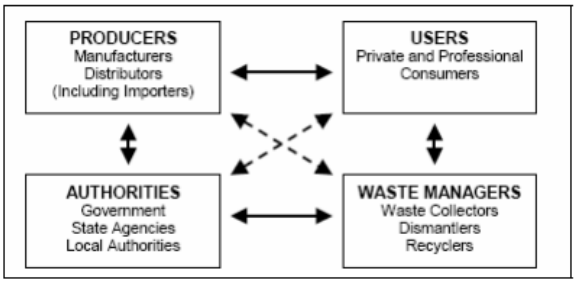
The present Waste handling rules though have been landmark development in the initiatives for environmental well being, it puts the onus on producer to take care of the e-Waste management frame work and few directives are given to other components.

A. Consumers (Individual & Institutional): e-Waste handling & management rules have directives to institutional consumers to maintain the accounts of electronic goods and disposal.

Green Buying Behaviour: When it comes time to replace your old electronics, do a little research and see which product is safest for the environment. Some manufacturers are beginning to use less toxic materials in their products, integrate recycling, and reduce their impacts on the environment by changing their manufacturing operations and policies. As consumers in developing and transition countries, like India, increase their use of electrical and electronic products, larger volumes of such products are finding their way into the waste stream. Managing this would be a challenge not only for municipal governments, but producers and consumers as well Consumer Responsibility to buy "Greener" Electronics

Proper Disposal: consumers to dispose properly of end-of-life electronics through its recycling locator at www.GreenerGadgets.org. This list only includes manufacturer and retailer programs that use the strictest standards and third-party certified recycling locations, to provide consumers assurance that their products will be recycled safely and responsibly.

Figure 4 showing stakeholders in Waste management



Source: Lindhqvist(2000)

Most of the cell phone companies & computer systems have the like Apple, HP, IBM, Gateway & Dell have some kind of " product take back program" Other retailers, like Office Depot, Big Bazaar may offer free electronics recycling on designated dates. There are also a number of charitable, non-profit and for-profit organizations that accept old computers for recycling. In some cases, giving away old electronics may even be characterized as a charitable donation with positive tax consequences for the donor.

Data destruction: Removing data & even SIM card from mobile.

B. NGOs: NGO's like Toxic Link are spreading awareness among consumers and equipment manufacturers and even trigger the government bodies to come up with appropriate mechanisms.

C. Municipality Government

D.Recyclers

6. E-Waste Management Issues in India

Increasing Consumerism:

Rapid changes in technology, changes in media (tapes, software, MP3), falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste around the globe,

Producer's perspective, The Finances:
One of the key provisions in the rules is the incorporation of producers (manufacturers) as those who have the main responsibility through EPR. Producers now are required to set up, directly or indirectly, the e-waste collection infrastructure (including setting up collection bins in each area), finance it and ensure its operations. in India consumers currently expect to be paid (even if nominally) for giving away old computers, while in Europe they are willing to be charged an Advanced Recycling Fee (ARF), which has a direct impact on cost structures.

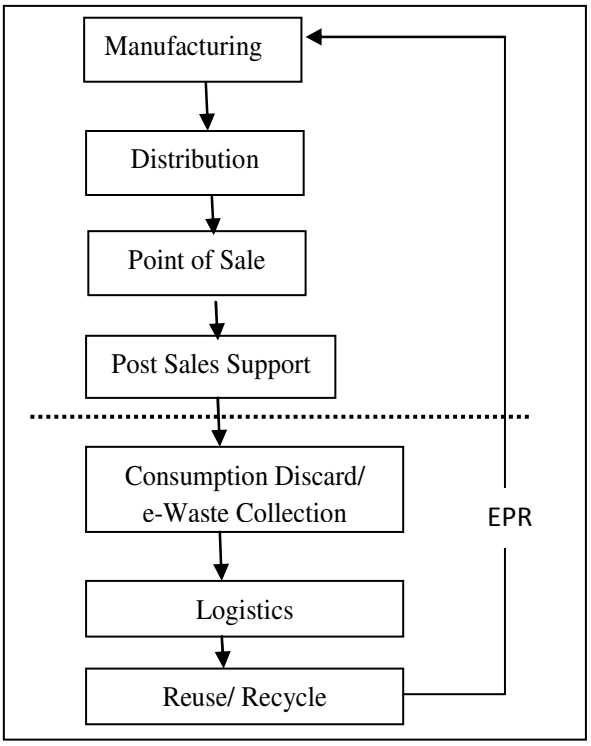
Citizen Perspective, it's the duty of governance and Municipality Systems

Occupational Hazards: Occupation exposures from e-waste processing are high, especially in the informal sector, which employs underpaid men, women and children and does not follow any environmental standards even though profits can exceed 150% of the price of e-waste. The impact on workers is high as they handle strong acids (finally thrown into gutters) to strip circuit boards of copper, use mercury for recovering gold from microprocessors, or burn PVC plastic wires to recover aluminum and copper, etc. Responsible recycling and disposal of e-waste can help prevent exploitation of people in lesser developed countries where much of the e-waste from the U.S. has

historically been disposed. Media exposés of companies that sent e-waste overseas where unprotected workers rummage through vast mountains of smoldering electronics to recover bits of recyclable metals served to shed light on the problem that our e-waste was causing elsewhere.

Consumer Bottlenecks: Lack of information, Purchasing from grey market for lesser price

Figure 5 showing Extended Producer Responsibility (EPR)



Source: Author

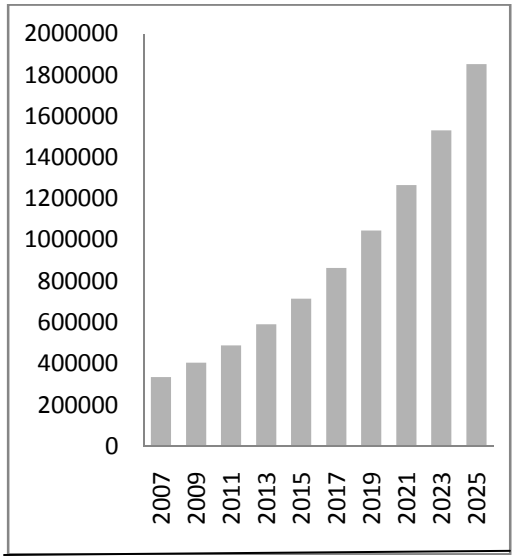
Global Supply chain in MNCs: Computers, mobiles and related devices in particular, have global supply chains, controlled by large multinational brands.However, when it comes to waste disposal they often avoid taking initiatives in developing countries. Managing e-waste in developing economies need specifi c approaches owing to the involvement of the urban poor in recycling, the existence of a large grey market for products, fl exible labour costs, weak labour and environmental regulations, low consumer awareness and poor infrastructure.

Large grey markets for some electronic products, and illegal imports of WEEE

Mobile device sales in India are forecast to reach 231 million units in 2012, an increase of 8.5 percent over 2011 sales of 213 million units, according toGartner, Inc. The mobile handset market is expected to show steady growth through 2015 when end user sales will surpass 322 million units.The Indian mobile device market has more than 150 manufacturers selling devices to consumers, which are dominated by the local Indian and Chinese manufacturers

WEEE can contain more than 1000 different substances, and is a valuable commodity in developing nations – e.g. one tonne of used mobile phones, contains about 3.5 kilograms of silver, 340 grams of gold, 140 grams of palladium, and 130 kg of copper which by 2009 rates would be valued at US $15,000 [15].

Figure 6 showing projections for e-Waste generation in India



Source: Dept of Information Technology, India accessed at Greenearth.com

e-Waste Imports

Sources of e-waste not just that being generated in India, but also through imports.Imports are the result of pressures from high e-waste generation countries (in Europe, the United States, Japan) to export their e-waste to developing countries.Since the cost of waste disposal and treatment there is high, it has provided an incentive to export to countries like India, China and to Africa with lower labour costs and weak environmental standards. A computer, for

example, which could cost up to $20 to recycle in the US, is sold for $15 to Indian traders, marking an inflow of over $35. By estimates, India imports more than 50,000 tonnes of e-waste annually, and traders make the most profi t. An estimated 50 – 80% of the e-waste is exported from US to countries like India, China and Pakistan where labour is cheap to be engaged in recycling process.

India generates close to 500000 tonnes of e-waste per annum and it is expected to touch by 1.6 million by 2012. In 2007, only 19,000 tonnes were processed using environmentally safe recyclers (organized). Unorganized recyclers took care of the rest volumes of e-waste.

7. Conclusions

The IT industry has been an important driver in the growth of Indian economy and will continue to be a very significant player. The Indian economy is expected to be one of the fastest growing economies of the world. The sheer size of the market and large consumer base is expected to boost consumption patterns and result in generation of huge quantities of waste. While this throws up a serious new challenge it also brings in new set of opportunities not only to manage this waste but also for innovation of cleaner and more sustainable products. Waste minimization is a cardinal principle to be researched, experimented and adopted for sustainability. These are possibilities not only for a solution to local problems, but are also applicable to global issues on E-waste. New revenue models in the business of E-waste appear as interesting possibilities in the Indian context and could perhaps be used as one of the many working solutions. The ideal mix of skilled labour from the informal sector coupled with appropriate technology, perhaps can provide solutions for sustainable E-waste practices.It is also important to create mass awareness and make it easier for the consumer to dispose e-waste. It is not just a producer but consumer's responsibility too. It is just human to be reactive to urgencies and it's a necessity to behave above human by being proactive to natural environment's grievance calls. Producer has the key role to play. in this regard has been by waste-picker cooperatives or nongovernmental organizations (NGOs) on their own. Recycling targets are essential for monitoring progress and improving compliance. **It should be context based.** Also to deepen the messages in both rural and urban areas, schools and universities should be drawn in, and the state can help by involving education and consumer affairs sectors. An attempt has been made to share the responsibility of implementation with the private sector across all stakeholders. Partitioned bins at collection points by municipalities

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