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# Handling and Management of Electronic Waste: Review of Global Legislations

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**Abstract--** The global demand for electronic products and equipments has been phenomenal in the last few decades. This paper aims to examine the existing national legislations in India and their implementation framework. It also reviews the legislations in other countries to have a comparative analysis in terms of effectiveness of implementation and role of stakeholders involved in E-waste management. On comparison with other countries, Indian legal framework appeared to be reasonably relaxed and less stringent. The paper also recommends reasons for non-compliance and suggestive measures to improve the existing scenario of E-waste in the country.

**Keywords--** E-waste scenario, Legislative framework, Management & Handling, Non-compliance

## I. INTRODUCTION

Rapid innovation and advancement in the information and technology sector and the competition amongst users of electronics to acquire the most recent gadget has led to quick obsolescence of electronic goods where products are replaced before their end-of-life and not repaired for inconsequential reasons. Globally the consumption of electronics is increasing and every year we create more E-waste than before. The demand is irresistible so the need for a solution becomes ever more urgent. As the quantity of E-waste in the country is increasing at an alarming rate, a parliamentary panel has recommended creation of a legislative and enforcement mechanism to prevent India from becoming a dumping ground of E-waste for developed nations (Hindu, 2015).

Also, The National Green Tribunal has directed the Ministry of Environment and Forests (MoEF) to convene a meeting of various stakeholders and propose a scheme for environment-friendly disposal of E-waste (Economic Times, 2015). A 2009 report from the United Nations Environment Programme, Recycling from E-waste to Resources, offers several considerations of the hidden environmental impact of electronic devices such as the cooling and freezing equipment for example, employ ozone depleting substances (ODS) in the refrigeration system. These substances, such as CFCs and HCFCs, have a huge global warming potential.

It is estimated that the total amount E-waste generated in 2014 was 41.8 million metric tonnes (Mt). It is forecasted to increase to 50 Mt of E-waste in 2018 (Baldé, et.al., 2015).

In this context, it is important to understand the existing E-waste scenario with respect to legislative framework and its evolution. Over the last decades the electronics industry has revolutionized the world. Electrical and electronic products have become ubiquitous of today's life around the planet. Without these products, modern life would not be possible in (post) industrialized and industrializing countries. These products serve in such areas as medicine, mobility, education, health, food supply, communication, security, environmental protection and culture. Such appliances include many domestic devices like refrigerators, washing machines, mobile phones, personal computers, printers, toys and TVs (UNEP, 2009).

A wide range of literature is available on the generation and management of E-waste, especially in the developed countries. For instance, Nnorom and Osibanjo (2010) stated that most developed countries have in place legislation mandating electronic manufacturers and importers to take-back used electronic products at their end-of-life (EoL) based on the principle of extended producer responsibility (EPR) but developing countries lack such legislation. However, the work done on the Indian scenario of E-waste management is comparatively less. Sepúlveda, A. , et al (2010) said that with the increasing global legal and illegal trade of waste electrical and electronic equipment (WEEE) comes an equally increasing concern of poor WEEE recycling techniques.

According to Borthakur, A. et al (2013) actual and reliable data on the generation of E-waste, both domestic and import of E-waste, is currently unavailable in India. Moreover, there is lack of authentic data on global scenario of E-waste production. Another research by Wath, et al (2010) points out E-waste recycling and recovery options practiced in India are very outdated and hazardous, causing severe environmental and occupational hazards. There is a fundamental difference between the current European models of E-waste management and the reality of E-waste recycling in India.

Hence, more research work is required which can focus on gaps in legislative framework and policy level initiatives in developing countries with respect to E-waste. Internationally, various legal frameworks have been enacted and enforced to regulate E-waste. The Basel Convention on the control of transboundary movements of hazardous waste and its disposal plays a significant role in curbing the E-waste trade from OECD countries to non-OECD countries. The EU has taken a lead to protect the environment from hazards of E-waste in Europe by framing two important directives, WEEE directive and Restriction of use of certain Hazardous Substances (RoHS) in electrical and electronic equipment regulations directives.

## II. OBJECTIVES

The main purpose of this study was to investigate the magnitude of E-waste problem and the legislations pertaining E-waste management in India and other countries. More specifically, the study aims to achieve the following specific research objectives:

- ❖ To study regulatory measures concerning E-waste management at national and international levels

- ❖ To examine the reasons for non-compliance of rules and regulations
- ❖ To explore international initiatives for management of E-waste
- ❖ To provide recommendations to manage E-waste

## III. RESEARCH APPROACH

The paper reviews legislations, policies and guidelines for E-waste management in India and other countries. To understand the existing legislative scenario of various countries information was collected from various secondary sources like journal articles, government reports, newspaper articles and websites like Delhi Pollution Control Board, Ministry of Environment & Forest and Climate Change, Central Pollution Control Board, Toxics Link, Centre for Science & Environment and GIZ etc and many more. To do comparative analysis of effectiveness of legislations some developing countries like India, China & Nepal etc and developed countries like Finland, Switzerland and UK etc have been selected randomly depending on availability of information regarding legislations and policies for E-waste management.

**Table 1:**  
**Regulatory legislative measures in India regarding E-waste**

Country	Year	Regulation/ E-waste Definition
India	2011	<ul style="list-style-type: none"> <li>▪ E-waste (Management and Handling) Rules, 2011 were enforced on 1<sup>st</sup> May, 2012</li> <li>▪ The rules are comprised of six chapters (Definitions of various terms, Responsibilities of stakeholders, Procedure for seeking authorization &amp; registration, Storage of E-waste, RoHS and Miscellaneous) three schedules and five forms</li> <li>▪ Responsibilities prescribe the duties to be performed by Producer, consumer, bulk consumer, collection center, dismantler, recycler and regulatory authority</li> <li>▪ The following activities are excluded from the ambit of this act, <ul style="list-style-type: none"> <li>✓ Batteries as covered in the Batteries (Manufacture and Handling) Rules 2001</li> <li>✓ Micro as well as small enterprises as defined in the Micro, Small and Medium enterprises Development Act 2006</li> <li>✓ Radioactive waste as defined in the Atomic Energy Waste</li> </ul> </li> <li>▪ Draft of E-waste (Management) Rules, 2015 have been proposed to fill the gaps in existing rules.</li> <li>▪ Some new stakeholders have been added to the new draft rules e.g. Refurbishers, dealers and producer-responsibility organizations (PROs)</li> <li>▪ The draft rules have also incorporated the <i>Deposit Refund Scheme</i> in which a portion of the sale price shall be retained by the producers and be refundable to consumers once the end-of-life products are channelised according to the prescribed methods</li> </ul>
	2015	<ul style="list-style-type: none"> <li>▪ The new rules have simplified the formalities regarding authorisation and registration</li> <li>▪ The penal provisions are the same as the existing rules of 2011</li> </ul>

Source: deity.gov.in

**Table 2:**  
**Regulatory legislative measures in other countries regarding E-waste**

S.No.	Country	Year	Regulation/ E-waste Definition
1.	Switzerland	1998	<ul style="list-style-type: none"> <li>▪ In early 1998, Switzerland passed legislation on the Return, Take-Back and Disposal of Electrical and Electronic Equipment (ORDEE).</li> <li>▪ Under this ordinance, retailers, manufacturers and importers are required to take back, at no charge, appliances of the kind that they normally stock. Consumers, for their part, are obliged to return end-of-life appliances, and are not allowed to dispose of them via household waste or bulky item collections.</li> <li>▪ The ordinance covers all sorts of electrical/electronic devices, including IT and telecommunications equipment. Collection and disposal are managed by the Swiss Foundation for the Disposal of Wastes (SENS) and the Swiss Association for Information, Communication and Organisational Technology (SWICO).</li> <li>▪ The purchase price of all appliances covered by the ORDEE includes a prepaid disposal charge based on voluntary sectoral agreements (co-regulation). Equipment can, as a result, be returned free of charge</li> <li>▪ The definition of WEEE/E-waste is identical to EU directives. However, equipment covered by this ordinance are electrically powered and fall under one of the following categories:               <ul style="list-style-type: none"> <li>✓ Entertainment electronics</li> <li>✓ Office, information, communication appliances</li> <li>✓ Household appliances</li> <li>✓ Fluorescents with lightbulbs</li> <li>✓ Fluorescents without light-bulbs</li> <li>✓ PCB containing fluorescents</li> <li>✓ Tools (Larger industrial tools excluded)</li> <li>✓ Sport/entertainment appliances and toys</li> <li>✓ Components of the aforementioned</li> </ul> </li> </ul>
2.	Japan	2001  2003	<ul style="list-style-type: none"> <li>▪ Home Appliances Recycling Law (enacted 1998 and enforced 2001)</li> <li>▪ In Japan, the legislation is similar to that in Europe . However, unlike the EU which uses environmental legislation, the emphasis is more on using technical advancement to deal with the E-waste handling and management (Sawhney, et.al, 2008).</li> <li>▪ The Japanese Home Appliance Recycling Law (2001) is the basis of EPR programme for four large home appliances (large TV sets, washing machines, air conditioners and refrigerators). The law was later extended to cover electronic products such as personal computers and copiers on a voluntary basis (Savage, 2006). For the recycling of home appliance, the consumers pay for the collection at the time of disposal.</li> <li>▪ Japan also implemented a Computer Recycling Law in 2003, like the Home Appliance Recycling Law, the Computer Recycling Law is financed by customer fees. In the case of PCs, to recycle the old computer, manufacturer has to be contacted.</li> </ul>
3.	Finland	2004	<ul style="list-style-type: none"> <li>▪ Act 452/2004 amending the Waste Act (1072/1993) adopted on 04/06/2004 and Government Decree on Electrical and Electronic Waste 852/2004 adopted on 09/09/2004.</li> <li>▪ The scope of products includes luminaries in households, which have been excluded from the scope of products in the WEEE Directive.</li> </ul>
4.	China	2004  2011	<ul style="list-style-type: none"> <li>▪ Ordinance on the Management of Waste Household Electrical and Electronic Products Recycling and Disposal (2004)</li> <li>▪ Regulations on Recovery Processing of Waste Electrical and Electronic Products (2011)</li> <li>▪ In China, the electronic waste is regulated by the administration of</li> </ul>

			<p>control of pollution caused by electronic information products.</p> <ul style="list-style-type: none"> <li>Accordingly, the designer and manufacturer of electronic information products are required to design and manufacture electronic information products in accordance with the national industrial standards.</li> <li>The administration also provides for penalty for imports, sellers, manufactures, and designer in case of non compliance.</li> <li>The administration also has provision for penalty on importers, sellers, manufactures, and designer in case of noncompliance of the laid-down standards (Hicks et al, 2005).</li> </ul>
5.	Norway	2004	<ul style="list-style-type: none"> <li>Relating to the recycling of Waste, 1 June 2004, in Chapter-1 E-waste is defined as EE waste, where EE waste means scrap EE equipment.</li> <li>EE equipment is defined as EE equipment means products and components that depend on an electrical current or electromagnetic field in order to function correctly, as well as equipment for the generation, transfer, distribution and measurement of these currents and fields, including the components necessary for the cooling, heating, protection, etc., of the electrical or electronic components.</li> </ul>
6.	Italy	2004	<ul style="list-style-type: none"> <li>Italy Decree 25/07/2005 n.151. This Directive establishes measures and procedures with the purpose of:               <ul style="list-style-type: none"> <li>✓ Preventing the production of waste electrical and electronic equipment (WEEE);</li> <li>✓ Promoting the reuse, recycling and other forms of recovery of WEEE to reduce the quantity destined for disposal;</li> <li>✓ Improving the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment;</li> <li>✓ Reducing the use of dangerous substances in electrical and electronic equipment;</li> </ul> </li> <li>Article 3 provides definitions of various terms. It defines E-waste as 'electrical and electronic equipment' or 'EEE' means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents.</li> <li>It states 'waste electrical and electronic equipment' or 'WEEE' means electrical or electronic equipment which is waste within the meaning of Article 6, Sub- point 1, letter of Legislative Decree no. 22 of 5 February 1997.</li> </ul>
7.	Spain	2005	<ul style="list-style-type: none"> <li>Royal Decree 208/2005, which adapts EU Directive 2002/96/CE on E-waste into national law, establishes the responsibility of manufacturers and importers for E-waste management.</li> <li>A draft law on a sustainable economy, as approved by the government and submitted to debate in the Spanish parliament in the spring of 2010, mentions (in Article 3.5) the importance of promoting waste treatment. According to the bill, the government should adopt policies to combine economic development with waste minimisation.</li> <li>E-waste is handled by the Integrated Management System (SIG). However, reuse is not addressed by the system, which only deals with recycling.</li> <li>The ECOLEC Foundation has been created as a collective management system set up by the business associations that represent the manufacturing sector and importers of large and small electrical appliances</li> </ul>
8.	United Kingdom	2006	<ul style="list-style-type: none"> <li>The Waste Electrical and Electronic Equipment Regulation 2006 enforced in 2007.</li> </ul>

		2014	<ul style="list-style-type: none"> <li>▪ The Regulations require any 'producer' (manufacturer, re-brander, or importer) of EEE to finance the costs of collection and treatment of waste electrical and electronic equipment (WEEE) that arises over a calendar year, in proportion to the amount by weight they place on the market.</li> <li>▪ Producers meet their obligations by registering with an approved producer compliance scheme, who will then purchase evidence of recycling on behalf of the producers from an approved authorised treatment facility or approved exporter.</li> <li>▪ In 2009 there were several amendments made to the UK WEEE Regulations which mainly affect Producer Compliance Schemes, Approved Authorised Treatment Facilities (AATFs) and Approved Exporters (AEs).</li> <li>▪ The Waste Electric and Electronic Equipment (WEEE) Regulations, 2013 became law in the UK on the 1st of January 2014 and replaced the 2006 Regulations.</li> </ul>
9.	Kenya	-	<ul style="list-style-type: none"> <li>▪ There is also no policy or regulation on E-waste, although Kenya is a signatory of both Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and the Bamako Convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa.</li> <li>▪ At the national level we see a mix of laws and regulations addressing waste, and some recent references to E-waste, but there is no coordinating framework.</li> <li>▪ The Environmental Management Co-ordination Act (EMCA, 1999) defines hazardous waste, pollutants and pollution, but it does not address specific aspects of waste (such as E-waste).</li> <li>▪ The National Environmental Management Authority (NEMA), responsible for implementation of all policies and regulations relating to the environment, also has no specific regulations focusing on E-waste.</li> <li>▪ In contrast, the Kenya ICT policy (2006) contains a clause on E-waste, which makes the appropriate recycling and disposal facilities for E-waste part of the requirements for renewal of communications licenses.</li> <li>▪ It is clear from this that the government has recognized the challenges posed by E-waste. However, the level of preparedness from a policy and regulatory perspective is still quite low, particularly when it comes to actual waste management practices.</li> </ul>
10.	Nepal	-	<ul style="list-style-type: none"> <li>▪ Though Nepal signed the Basel Convention more than a decade ago, there is still no sign of E-waste policy in the country.</li> <li>▪ According to the officials of the Environment Standard Department of the Ministry of Environment, which is concerned with managing E-waste in Nepal, standards for E-waste management and inventory are being prepared.</li> <li>▪ Though there is no official data or research on E-waste issues in Nepal, it cannot be concluded that there is no generation of E-waste in Nepal and that it does not present a threat to add to the woes of climate change.</li> <li>▪ Going by the current rate, in ten years time it can be projected that more than two million Nepali people will be using computers and the internet. And more than 25 people per 100 or 7.5 million Nepali people will be using mobile phones by 2020. Of course, it is easier said than done. But Nepal cannot afford to squander another decade just making complacent excuses.</li> </ul>

*(Source: Country specific Environment laws)*

*The domestic E-waste generated by various countries discussed earlier is mentioned below with emphasis on population and E-waste generation in the year 2014:*

**Table 3:**  
**Domestic E-waste generated per country in 2014**

S.No.	Name of country	kg	kt	National Regulation in force till 2013	Population (1000)
1.	Switzerland	4	4	yes	1106
2.	Japan	17.3	2200	yes	127061
3.	Finland	21.4	118	yes	5476
4.	China	4.4	6033	yes	1367520
5.	Norway	28.3	146	yes	5150
6.	Italy	17.6	1077	yes	61156
7.	Spain	17.7	817	yes	45995
8.	United kingdom	23.5	1511	yes	64271
9.	Kenya	1	44	no	44572
10.	Nepal	0.5	15	no	32010
11.	India	1.3	1641	yes	1255565

*Source: The global e-waste monitor, 2014*

The table clearly shows that the waste generated by India is comparatively high than other countries reason for same includes huge population size, large production of electronics due to high consumption rate, illegal export from other countries and lastly the gaps in implementation of E-waste rules. The scenario is same for China because of similar reasons. In contrast, Switzerland is the most well managed country in terms of E-waste management because of stringent rules and less population.

#### IV. RESULTS AND DISCUSSIONS

Different countries have different terminology of electronic waste.

For instance, Norway it as 'EE waste' where EE waste means scrap EE equipment and Italy defines it as 'EEE' which means equipment which is dependent on electric currents or electromagnetic fields in order to work properly. The results and discussions are summarized as followed:

- Comparative analysis of legislations in India and other countries highlights following points (Table 5)
- International initiatives for E-waste management (below 4.1.)
- Reasons for Non-compliance of legislative polices (below 4.2.)



**Table 5:**  
**Comparative analysis of legislations in India and other countries**

S.No.	Developed countries	Developing countries (India)
1.	Developed countries hardly import E-waste from other countries unlike India	India imports E-waste from developed countries
2.	Developed countries have online centralized system for management of E-waste	Developing countries like India lacks a centralized system for management of E-waste
3.	Producers take the absolute responsibility of end of life products e.g. Switzerland, Spain and United Kingdom	Concept of EPR is still a controversial subject
4.	Penalties are stringent for violation	Rules don't specify any stringent penalty
5.	Formal Sector is more active	In India, formal sector is less active as compared to informal sector which is too large to tap
6.	For most electronic products there is a take back policy	Less or no take back schemes for electronic items e.g. old refrigerators / AC's / washing machines
7.	Advanced recycling fee (ARF) is paid by consumers for home appliances such as in Japan under Japanese Home Appliance Recycling Law (2001)	Consumers don't want to bear cost of recycling for end- of- life goods
8.	Recycling sector is highly active and well trained	Most of the recyclers in India are not even trained for recycling E-waste. They seem to have moved into this business because of profitability

#### 4.1. International initiatives for E-waste management

- *EU Directive on Waste Electrical and Electronic Equipment (WEEE) Feb 2003:* The Directive provided for the creation of collection schemes where consumers return their WEEE free of charge. These schemes aim to increase the recycling of WEEE and/or re-use.
- *Restriction of Hazardous Substances (RoHS) Directive Feb 2003:* The RoHS directive aims to restrict certain dangerous substances commonly used in electronic and electronic equipment. Any RoHS compliant component is tested for the presence of Lead (Pb), Cadmium (Cd), Mercury (Hg), Hexavalent chromium (Hex-Cr), Polybrominated biphenyls (PBB), and Polybrominated diphenyl ethers (PBDE).
- *Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS 2) July 21, 2011:* The new RoHS Directive 2011/65/EU required Member States to transpose the provisions into their respective national laws by 2 January 2013
- *EU Directive on Energy-using-Products (EuP):* The European Union has implemented an ambitious energy program (EuP) to address the security of its energy supply, as well as energy-related health and environmental issues. It is a framework directive which primarily focuses on energy in use. It does this by setting minimum requirements for certain energy consuming products.
- *EU Directive on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) June 1, 2007:* REACH makes industry responsible for assessing and managing the risks posed by chemicals and providing appropriate safety information to their users.
- *Basel convention on the control of transboundary movements of hazardous wastes and their disposal May 5, 1992:* is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste



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- *Mobile Phone Partnership Initiative (MPPI) June 30, 2010:* In 2002 the Mobile Phone Partnership Initiative (MPPI) was launched, during the sixth meeting of the Conference of the Parties to the Basel Convention, when 12 manufacturers signed a Declaration entering into sustainable partnership, with the Basel Convention and in cooperation with other stakeholders, to develop and promote the environmentally sound management of end-of-life mobile phones. In addition three telecom operators also signed a Declaration entering into sustainable partnership in July, 2005.
  - *Partnership for Action on Computing Equipment (PACE) March 4, 2009:* PACE was launched in 2008 by the ninth meeting of the Conference of the Parties to the Basel Convention. It provides a forum for representatives of personal computer manufacturers, recyclers, international organizations, associations, academia, environmental groups and governments to tackle environmentally sound refurbishment, repair, material recovery, recycling and disposal of used and end-of-life computing equipment.
  - *UN StEP Initiative 2007:* EPA collaborates with the United Nations University - Solving the E-waste Problem Initiative (StEP). is a global consortium of companies, research institutes, governmental agencies, international organisations and NGOs dedicated to advancing the management and development of environmentally, economically and ethically sound e-waste resource recovery, reuse and prevention
  - *Electronic Product Environmental Assessment Tool (EPEAT):* It is an independent rating system that identifies greener electronic products that meet multiple environmental standards. EPEAT ratings have been benefiting environments by helping companies, governments and consumers around the world compare and buy devices with comparably less environment cost.
  - *International E-Waste Management Network (IEMN):* EPA and Environmental Protection Administration Taiwan (EPAT) coordinates it and has brought together environmental officials from Asia, Latin America, the Caribbean, Africa, and North America to exchange best practices on e-waste management since 2011.
  - *United Nations-New Agreement on Electronic Waste March 12, 2012:* UN system collaborates on electronic waste disposal. A new agreement signed by the United Nations International Telecommunication Union (ITU) and the Secretariat of the Basel Convention (SBC) was announced on March 12, 2012
  - *National Strategy for Electronics Stewardship (NSES) July 20, 2011:* which details the federal government's plan to enhance the management of electronics throughout the product lifecycle. Strategy to lay the groundwork for improving the design of electronic products and enhancing our management of used or discarded electronics.
- #### 4.2. Reasons for Non-compliance of legislative policies
- After reviewing global E-waste regulations some of the reasons for non-compliance of legislative policies are discussed below.
- ✚ First and foremost, it ignores the unorganized and small and medium sectors where 90 per cent of the E-waste is generated.
  - ✚ Lack of legislation that encourages or enforces re-use of EEE
  - ✚ Some equipment manufacturers do not allow their products to be re-used, to avoid competition with new products.
  - ✚ Some of the registered companies under government for recycling and collection of E-waste illegally sell its E-waste to an unorganized sector
  - ✚ The major drawback is the heavy responsibility on the central and state pollution control boards for monitoring and supervision which may not be practical given the red tape and bureaucratic nature of the Indian political system. There needs to be a further breakdown and inclusion of more regulatory bodies in the enforcement of these policies (Kazi, S.S., et al, 2012)
  - ✚ Principles like "Polluter must pay" and "generators have responsibility" are not clear to people. "Passing the buck" attitude is also seen among many of the establishments as they feel that only the government should manage the waste and they have no role in it.
  - ✚ 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.
  - ✚ Customs officials are unable to check every container of E-goods imported from other countries because of shortage of men and machinery and resort to random checks. Most of the scanners have limitations too. This also leads to non compliance of rules.
  - ✚ Organized sector has lack of proper collection, disposal mechanisms and appropriate technologies in the face of a large informal sector. The formal sector also lack refineries for precious metals recovery.



## V. CONCLUSION

The draft of E-waste rules, 2015, has widened the scope of the existing E-waste Rules, 2011 by including several notable provisions. The former rules had several confines for stakeholders which prevented their proper implementation. The new draft rules now claim certain clarity and lay down the responsibilities of various stakeholders in clear terms. The inclusion of Producer Responsibility Organisations (PROs) is another welcome initiative in the draft rules. However, whether the inclusion of PROs will change the existing scenario is still uncertain as such models worked for developed countries where a number of organisations come together to implement take back of E-waste which is financed by producers or manufacturers.

As India is a huge country, setting up of a collection mechanism is a big challenge. If any of the producer will try independently to reach out to all parts of the country, it will not be economically sustainable. So, a collective effort is required by all stakeholders. Recovery of metals in another challenge for India and it lags behind in metal recovery processes when compared to other countries. For instance, gold recovery is a complicated process and takes time for full recovery and dismantlers or recyclers in India are only remove the visible gold which is only 20-30%. The remaining 70% is not visible and is hard to extract. This 70% is not recovered even by recyclers. 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" (*The Hindu*, 2010).

*Some of the Recommendations are discussed below:*

- ✚ *Formalization of informal sector:* such formalization would help in having a better monitoring mechanism for dismantling, recycling and trade of electronic products
- ✚ *Conducting timely inspections:* employing officials for conducting inspections at E-waste recycling sites, electronics manufacturing industries for compliance of E-waste rules
- ✚ *Take-back policy:* making it mandatory for all producers of electronic items to take back electronic products for free from the consumers
- ✚ *Stringent Policies:* developing and implementing stringent policies to deal with E-waste menace.
- ✚ *Imposing fines:* levying taxes or fines for violation of rules concerning E-waste
- ✚ *Selling to authorized dealers and collectors:* encouraging authorized dealers and collectors of E-waste to formulate attractive deals so that more no. of consumers return their non-used/old E-waste items
- ✚ *Sustainability criteria for electronic products:* Developing certain standard and criteria for E-goods so that consumers are aware of specifics like shelf life of the product and its hazards e.g.EPEAT
- ✚ *Developing global network:* for collection and recycling of E-waste to avoid CO<sub>2</sub> emissions that are the result of the long-distance transport of E-waste.
- ✚ *Focus on open-architecture:* so that upgradability of electronic products is possible
- ✚ *More repair and refurbishment:* Need of hour is to repair and refurbish E-waste. We create more E-waste than we re-use

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