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**Title**

# CURRENT STATUS AND STRATEGIES OF ELECTRONIC WASTE MANAGEMENT IN BANGLADESH

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## Abstract:

The production of electric and electronic equipment (EEE) is one of the fastest growing areas. This development has resulted in an increase of waste electric and electronic equipment (WEEE). Recycling of WEEE is an important subject not only from the point of waste treatment but also from the recovery of valuable materials The current practices of e-waste management in Bangladesh suffer from a number of drawbacks like the difficulty in inventorisation, unhealthy conditions of informal recycling, inadequate legislation, poor awareness and reluctance on part of the corporate to address the critical issues. The consequences are that (i) toxic materials enter the waste stream with no special precautions to avoid the known adverse effects on the environment and human health and (ii) resources are wasted when economically valuable materials are dumped or unhealthy conditions are developed during the informal recycling. This paper gives readers an overview on the e-waste topic—how e-waste is defined, what it is composed of.  The paper highlights current status and strategies to address this emerging problem, in the light of initiatives in Bangladesh. The paper presents a waste management system with shared responsibility for the collection and recycling of electronic wastes amongst the manufacturers / assemblers, importers, recyclers, regulatory bodies and the consumers.


**Keywords:** e-waste, EEE, WEEE, Extended producer responsibility,

## 1.0: Introduction:

Electronic waste, e-waste, e-scrap, or Waste Electrical and Electronic Equipment (WEEE) describe loosely discarded, surplus, obsolete, or broken electrical or electronic devices. Informal processing of electronic waste in developing countries causes serious health and pollution problems. Some electronic scrap components, such as CRTs, contain contaminants such as lead, cadmium, beryllium, mercury, and brominated flame retardants. Even in developed countries recycling and disposal of e-waste may involve significant risk to workers and communities and great care must be taken to avoid unsafe exposure in recycling operations and leaching of material such as heavy metals from landfills and incinerator ashes. Scrap industry and USA EPA

officials agree that materials should be managed with caution, and environmental dangers of unused electronics have not been exaggerated.

 "Electronic waste (E-waste)" may be defined as all secondary computers, entertainment device electronics, mobile phones, and other items such as television sets and refrigerators, whether sold, donated, or discarded by their original owners. E-waste is a popular, informal name for electronic products nearing the end of their "useful life." Computers, televisions, VCRs, stereos, copiers, and fax machines are common electronic products. Many of these products can be reused, refurbished, or recycled. Unfortunately, electronic discards are one of the growing segments of our nation's waste stream."(ESDO,2010)

Rapid urbanization has made electronic waste management a serious problem today. The perception of the people has always been that it is a responsibility of the local government bodies.During the last decade, it has assumed the role of providing a forceful leverage to the socio - economic and technological growth of a developing society. The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronics Waste" or "e waste" that consists of obsolete electronic devices. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them. The fraction including iron, copper, aluminium, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70% (Widmer et al., 2005). Solid waste management, which is already a mammoth task in Bangladesh, is becoming more complicated by the invasion of e-waste, particularly computer waste. E-waste from developed countries find an easy way into developing countries in the name of free trade (Toxics Link, 2009) is further complicating the problems associated with waste management.

## 2.0: Literature review:

Electronic waste" may be defined as all secondary computers, entertainment device electronics, mobile phones, and other items such as television sets and refrigerators, whether sold, donated, or discarded by their original owners. This definition includes used electronics which are

destined for reuse, resale, salvage, recycling, or disposal. Others define the re-usable (working and repairable electronics) and secondary scrap (copper, steel, plastic, etc.) to be "commodities", and reserve the term "waste" for residue or material which was represented as working or repairable but which is dumped or disposed or discarded by the buyer rather than recycled, including residue from reuse and recycling operations. Because loads of surplus electronics are frequently commingled (good, recyclable, and non-recyclable), several public policy advocates apply the term "e-waste" broadly to all surplus electronics. The United States Environmental Protection Agency (EPA) includes discarded CRT monitors in its category of "hazardous household waste" but considers CRTs set aside for testing to be commodities if they are not discarded, speculatively accumulated, or left unprotected from weather and other damage.. Protectionists may broaden the definition of "waste" electronics. The high value of the computer recycling subset of electronic waste (working and reusable laptops, computers, and components like RAM) can help pay the cost of transportation for a large number of worthless. Electrical or electronic equipment which is waste including all components, sub-assemblies and consumables, which are part of the product at the time of discarding Directive 75/442/EEC, Article 1(a)defines e waste as bany substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force  (EU WEEE Directive ,EU, 2002a).E-waste encompasses a broad and growing range of electronic devices ranging from large household devices such as refrigerators, air conditioners, cell phones, personal stereos, and consumer electronics to computers which have been discarded by their users (Basel Action Network, Puckett and Smith, 2002). Any appliance using an electric power supply that has reached its end of- life (OECD 2001) An electrically powered appliance that no longer satisfies the current owner for its original purpose (SINHA2004).E-waste refers to the reverse supply chain which collects products no longer desired by a given consumer and refurbishes for other consumers, recycles or otherwise process waste (STEP 2005)

According to the definitions in the Directive 2002/96/EC of the European Parliament and of the Council (January 2003) on Waste Electrical and Electronic Equipment (EU, 2002a), WEEE consists of the ten categories listed below. No. Category Label

1. Large household appliances Large HH

2. Small household appliances Small HH

3.　IT and telecommunications equipment ICT

4.　Consumer equipment CE

5.　Lighting equipment Lighting

6.　Electrical and electronic tools (with the exception of large-scale

7.　stationary industrial tools)

8.　E & E tools

9.　Toys, leisure and sports equipment Toys

10.　Medical devices (with the exception of all implanted and infected products) Medical equipment

11.　Monitoring and control instruments M & C

12. 0 Automatic dispensers Dispense

This categorization seems to be in the process of becoming a widely accepted standard. The Swiss Ordinance on the Return, the Taking Back and the Disposal of Electrical and Electronic Equipment (ORDEE) of 1998 differentiates between the following categories of WEEE:

- electronic appliances for entertainment;

- appliances forming part of office, communication and information technology;

- household appliances

- electronic components of the (above) appliances.

In Bangladesh every year more than 15% of child workers die as a result of e-waste recycling and more than 83% are exposed by toxics substances and become sick and are forced to live with long term illness. According to ESDOs recent study and available information, approximately (50,000) fifty thousand children are involved in the informal e-waste collection and recycling process, amongst them about 40% are involved in ship breaking yards. E-waste generated from ship breaking yards alone accounts for more than 2.5 million metric tons of toxics e-waste each

year. Bangladesh has generated 10,504 metric tons of toxics e-waste in cell phones alone in the last 21 years. Every year around 296,302 TV sets are scrapped and generate approximately 0.17 million metric tons of e-waste.(ESDO,2010)

## 3.0: Objective of the study:

The main objective of the study is to identify the current status of e-waste management in Bangladesh and specific objectives are

- ➢ to identify the current practice of e-waste management in Bangladesh

- ➢ to identify the  problems of e waste management in Bangladesh

- ➢ to develop some strategies for e-waste management in Bangladesh.

## 4.0: Methodology of the study:

Research methodology of the study focused on qualitative research. Research on e-waste management is usually done on the basis of secondary data published by the concerned local and international authority and institutions. This study also made on the basis of data mainly published by department of Environment in Bangladesh and some local newspaper news. In addition, interviews with the some concerned official of department of Environment were also made to know the present condition of e-waste management. Apart from these data, extensive study of the report of e-waste management has been made to apprehend the critical issues of e-waste management in Bangladesh.

## 5.0: Status of E-waste management in Bangladesh

As there is no separate collection of e-waste in Bangladesh, there is no clear data on the quantity generated and disposed of each year and the resulting extent of environmental risk. The preferred practice to get rid of obsolete electronic items in Bangladesh is to get them in exchange from retailers when purchasing a new item. The business sector is estimated to account for 78% of all installed computers in Bangladesh is obsolete. (Toxics Link, 2009).Obsolete computers from the

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business sector are sold by auctions. Sometimes educational institutes or charitable institutions receive old computers for reuse. It is estimated that the total number of obsolete personal computers, Tv and refrigerators emanating each year from business and individual households in Bangladesh will be around 1 million, 1.5 million and 2.5 million respectively. The total number of Mobile Phone active subscribers in Bangladesh was 58.36 million at the end of May 2010 According to a report of Confederation of Bangladeshi Industries, the total waste generated by obsolete or broken down electronic and electrical equipment in Bangladesh has been estimated to be 1,46,000 tons per year (CII, 2006). The results of a field survey conducted in the Dhaka, a metropolitan city of Bangladesh to assess the average usage and life of the personal computers (PCs), television (TV) and mobile phone showed that the average household usage of the PC ranges from 0.39 to 1.70 depending on the income class (Shobbana &Kurian 2009)..In the case of TV it varied from .07 to 1.78 and for mobile phones it varied from 0.88 to 1.70. The low-income households use the PC for 5.94 years, TV for 8.16 years and the mobile phones for 2.34 years while, the upper income class uses the PC for 3.21 years, TV for 5.13 years and mobile phones for 1.63 years. Although the per-capita waste production in Bangladesh is still relatively small, the total absolute volume of wastes generated will be huge. Further, it is growing at a faster rate. The growth rate of the mobile phones (80%) is very high compared to that of PC (20%) and TV (18%). The public awareness on e-wastes and the willingness of the public to pay for e-waste management as assessed during the study based on an organized questionnaire revealed that about 50% of the public are aware of environmental and health impacts of the electronic items. The willingness of public to pay for e-waste management ranges from 3.57% to 5.92% of the product cost for PC, 3.94 % to 5.95 % for TV and 3.4 % to 5 % for the mobile phones.

However, no confirmed figures available on how substantial are these transboundary e-waste streams, as most of such trade in e-waste is camouflaged and conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations. The government trade data does not distinguish between imports of new and old computers and peripheral parts and so it is difficult to track what share of imports are used electronic goods.

Deriving date from all sources, we estimate that e-waste generated in Bangladesh each year

Can be summarized like this;

Ship Breaking Yards = 2.4 million metric ton

Television Sets = 0.17 million metric ton

Computer s = 0.035 million metric ton

Mobile Phones = 0.005 million metric ton

CFL Bulbs = 0.0005 million metric ton

Mercury Bulbs = 0.001 million metric ton

Thermometers = 0.009 million metric ton

Other Medical & Dental Waste = 0.09 million metric ton

_____

Total = 2.80 million metric tons/
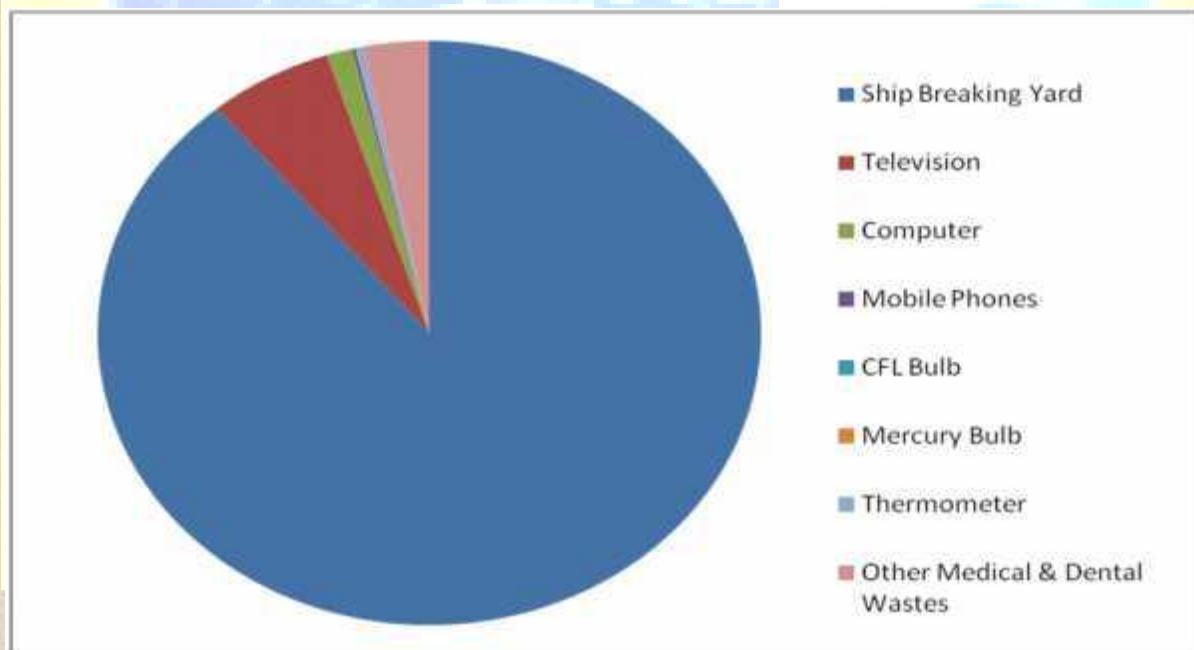


No inventory has been made to assess the extent of the e-waste problem in Bangladesh. The

goods below all contribute to the volume of e-waste in Bangladesh.

➢ The total number of PCs, TVs and refrigerators purchased in the year 2006 was 600,000, 1,252,000 and 2,200,000 respectively.

➢ At year end 2008, the total number of TVs in use in Bangladesh was roughly 10.3 million.

➢ Every year around 5,985,000 TV sets become scrap and this equates to approximately 88,357 metric tons of e-waste.

➢ The total number of active mobile phone subscribers in Bangladesh was 58,360,000 at the end of May 2010.

➢ Each year more than 2.8 million tons of electronic waste (including e-waste from 'ship breaking yards') is generated in Bangladesh.

➢ E-waste generated from ship breaking yards is equivalent to approximately 2.5 million metric tons per year.

➢ Persistent Organic Pollutant (POPs) that are generated from ship breaking sites: PCB, Dioxin, Furan.

➢ 10,504 metric tons of e-waste has been generated from mobile phones within the last 21 years.

➢ Within the last 10 years, the IT sector has generated approximately 35,000 metric tons of e-waste in Bangladesh.

We can presume on the basis of the number of subscribers in Bangladesh that there are more than 30 million mobile phone handsets in use in our country. The average longevity of a non branded handset is about one year, whereas a branded mobile handset is expected to last from 2 – 3 years. If non-branded mobile phones account for 60% of the market, therefore every year we can assume we are disposing of over 10 million mobile phones. The mobile service providers in Bangladesh expect to have 50 million subscribers by the end of this decade. Thus very soon

we could expect to be disposing of approximately 25 million mobile phones annually Despite a wide range of environmental legislation in Bangladesh there are no specific laws or guidelines for electronic waste or computer waste (Rabbi., 2006). As per the Hazardous Waste Rules (1989), e-waste is not treated as hazardous unless proved to have higher concentration of certain substances. Though PCBs and CRTs would always exceed these parameters, there are several grey areas that need to be addressed. Basel Convention has Waste electronic assemblies in A1180 and mirror entry in B1110, mainly on concerns of mercury, lead and cadmium. Electronic waste is included under List-A and List-B of Schedule-3 of the Hazardous Wastes (Management & Handling) Rules, 1989 as amended in 2000 & 2003. The import of this waste therefore requires specific permission of the Ministry of Environment and Forests. As the collection and re-cycling of electronic wastes is being done by the informal sector in the country at present, the Government has taken the following action/steps to enhance awareness about environmentally sound management of electronic waste Government already prepared draft National 3R (Reduce, Reuse & Recycle) Strategy and in that drafte-waste issues were addressed.

- Hazardous Waste Management Rules is under preparation and still time to incorporate E-waste management issues for proper management of E-waste among others.

- The Department of Environment have prepared draft solid waste management rules which is now in consultation stage and still time to include E-waste management issues in that rule.

- Bangladesh is a signatory to Basel convention prohibiting trans-boundary movement of hazardous waste.

- Import of any kind of waste requires Government permission.

- Several Workshops on Electronic Waste Management was organized by Department of Environment, Government of Bangladesh

- Action has been initiated by Department of Environment for rapid assessment of the E-Waste generated in major cities of the country.

- A National Working Group has been constituted for formulating a strategy for E-Waste management.

- Demonstration projects has also been set up by the Ministry of Telecommunication

Inventory of E-waste in large cities of Bangladesh.

- Develop E-waste policy & guideline with consultation with the relevant stakeholders.

- Establish efficient collection system at least for selected electronic waste.

- Registration and capacity development of E-waste recyclers.

- Introduction of Environmental Management System in E-waste sector.

- Establish E-waste tracking mechanism in order to update the inventory.

- Awareness raising.

Although awareness and readiness for implementing improvements is increasing rapidly, the major obstacles to manage the e wastes safely and effectively remain. These include:

- The lack of reliable data that poses a challenge to policy makers wishing to design an e-waste management strategy and to an industry wishing to make rational investment decisions.

- Only a fraction of the e waste (estimated 10%) finds its way to recyclers due to absence of an efficient take back scheme for consumers,

- The lack of a safe e waste recycling infrastructure in the formal sector and thus reliance on the capacities of the informal sector pose severe risks to the environment and human health.

- The existing e waste recycling systems are purely business-driven that have come about without any government intervention. Any development in these e waste sectors will have to be built on the existing set-up as the waste collection and pre-processing can be handled efficiently by the informal sector, at the same time offer numerous job opportunities.

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The Swiss State Secretariat for Economic Affairs mandated the Swiss Federal Laboratories for Materials Testing and Research (EMPA) to implement the program "Knowledge Partnerships in e-Waste Recycling" and Bangladesh is one of the partner countries. The program aims at improving e-waste management systems through Knowledge Management and Capacity Building. It has analyzed e-waste recycling frameworks and processes in different parts of the world (Switzerland, Bangladesh, China, South Africa) in its first phase (2003-04).

## 6.0: Recommended strategies for e-waste management in Bangladesh.

The best option for dealing with E wastes is to reduce the volume. Designers should ensure that the product is built for re-use, repair and/or upgradeability. Stress should be laid on use of less toxic, easily recoverable and recyclable materials which can be taken back for refurbishment, remanufacturing, disassembly and reuse. Recycling and reuse of material are the next level of potential options to reduce e-waste (Rabbi, 2006). Recovery of metals, plastic, glass and other materials reduces the magnitude of e-waste. These options have a potential to conserve the energy and keep the environment free of toxic material that would otherwise have been released.

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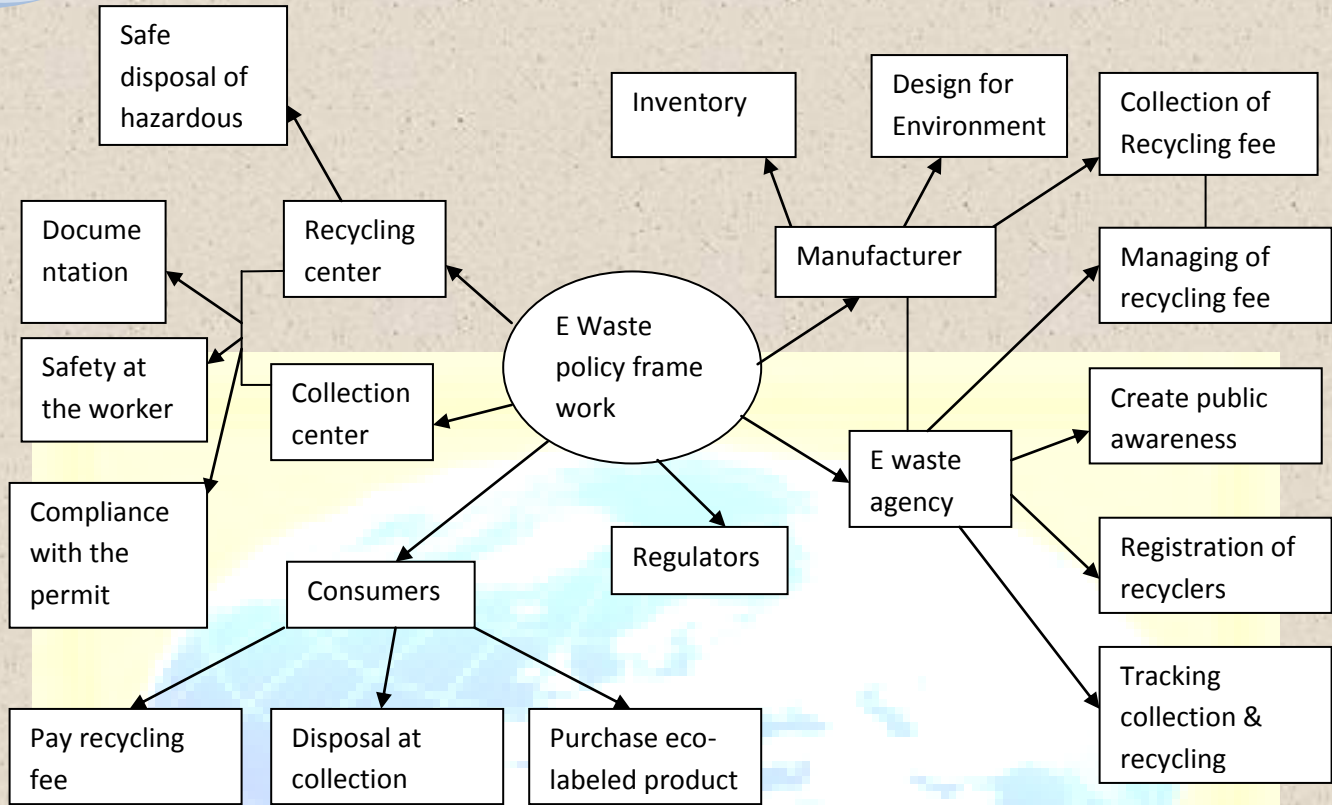
Figure 1. Elements of e-waste management system for Bangladesh

### 6.1: E-waste policy and regulation

Bangladesh is a signatory to the Basel Convention prohibiting trans-boundary movement of hazardous waste. The Medical Waste Management Rules of 2008 address the waste management issues for the medical sector, including e-waste . There are no specific laws or ordinances for e-waste management and recycling. But we have the Bangladesh Environment Conservation Act of 1995, the Environmental Court Act of 2000, and The Environmental Conservation Rules of 1997. The Environment Conservation Act of 1995 authorizes the Director General to undertake any activity necessary to conserve and enhance the quality of the environment and to control, prevent and mitigate pollution. The Government of Bangladesh has prepared the draft National 3R (Reduce Reuse and Recycle) Strategy and in that draft e-waste issues were addressed. That Policy shall address all issues ranging from production and trade to final disposal, including

technology transfers for the recycling of electronic waste. Clear regulatory instruments, adequate to control both legal and illegal exports and imports of e-wastes and ensuring their environmentally sound management should be in place. There is also a need to address the loop holes in the prevailing legal frame work to ensure that e – wastes from developed countries are not reaching the country for disposal. The Port and the Custom authorities need to monitor these aspects. The regulations should prohibit the disposal of e-wastes in municipal landfills and encourage owners and generators of e-wastes to properly recycle the wastes. Manufactures of products must be made financially, physically and legally responsible for their products. Policies and regulations that cover Design for Environment (DfE) and better management of restricted substances may be implemented through measures such as

- specific product take-back obligations for industry

- financial responsibility for actions and schemes

- greater attention to the role of new product design

- material and/or substance bans including stringent restrictions on certain substances

- greater scrutiny of cross-border movements of Electrical and Electronic Products and e-waste

- Increasing public awareness by labeling products as 'environmental hazard'

- arantee recycling firms a reliable and adequate flow of secondary material?

A complete national level inventory, covering all the cities and all the sectors must be initiated. A public-private participatory forum (E Waste Agency) of decision making and problem resolution in E-waste management must be developed. This could be a Working Group comprising Regulatory Agencies, NGOs, Industry Associations, experts etc. to keep pace with the temporal and spatial changes in structure and content of E-waste. This Working Group can be the feedback providing mechanism to the Government that will periodically review the existing rules, plans and strategies for E-waste management. Mandatory labeling of all computer monitors, television sets and other household/industrial electronic devices may be implemented

for declaration of hazardous material contents with a view to identifying environmental hazards and ensuring proper material management and E-waste disposal.

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

**6.2: Extended producer responsibility**

Extended producer responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post consumer stage of the product's life cycle, including its final disposal. In principle, all the actors along the product chain share responsibility for the lifecycle environmental impacts of the whole product system. The greater the ability of the actor to influence the environmental impacts of the product system, the greater the share of responsibility for addressing those impacts should be. These actors are the consumers, the suppliers, and the product manufacturers**.** *Consumers* can affect the environmental impacts of products in a number of ways: via purchase choices (choosing environmentally friendly products), via maintenance and the environmentally conscious operation of products, and via careful disposal (e.g., separated disposal of appliances for recycling). *Suppliers* may have a significant influence by providing manufacturers with environmentally friendly materials and components. *Manufacturers* can reduce the life-cycle environmental impacts of their products through their influence on product design, material choices, manufacturing processes, product delivery, and product system support (Sergio and Tohru, 2005). The system design needs to be such that there are checks and balances, especially to prevent free riders. The goals of the product designer could include reducing toxicity, reducing energy use, streamlining product weight and materials, identifying opportunities for easier reuse, and more. Manufacturers have to improve the design by: (i) the substitution of hazardous substances such as lead, mercury, cadmium, hexavalent chromium and certain brominated flame retardants;(ii) measures to facilitate identification and re-use of components and materials, particularly plastics; and (iii) measures to promote the use of recycled plastics in new products.

Manufacturers should give incentives to their customers for product return through a "buy back approach" whereby old electronic goods are collected and a discount could be given on new products purchased by the consumer. All vendors of electronic devices shall provide take-back and management services for their products at the end of life of those products. The old electronic product should then be sent back to be carefully dismantled for its parts to be either recycled or re-used, either in a separate recycling division at the manufacturing unit or in a common facility. Collection systems are to be established so that e-waste is collected from the right places ensuring that this directly comes to the recycling unit. Collection can be accomplished through collection centres. Each electronic equipment manufacturer shall work cooperatively with collection centres to ensure implementation of a practical and feasible financing system. Collection Centres may only ship wastes to dismantlers and recyclers that are having authorization for handling, processing, refurbishment, and recycling meeting environmentally sound management guidelines.

### 6.3: E-waste recycling

Many discarded machines contain usable parts which could be salvaged and combined with other used equipment to create a working unit. It is labor intensive to remove, inspect and test components and then reassemble them into complete working machines. Institutional infrastructures, including e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and or regional levels for the environmentally sound management of e-wastes. These facilities should be approved by the regulatory authorities and if required provided with appropriate incentives. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with governments, NGOs and manufacturers. Environmentally sound recycling of e-waste requires sophisticated technology and processes, which are not only very expensive, but also need specific skills and training for the operation. Proper recycling of complex materials requires the expertise to recognize or determine the presence of hazardous or potentially hazardous constituents as well as desirable constituents (i.e. those with recoverable value), and then be able to apply the company's capabilities and process systems to properly recycle both of these streams. Appropriate air pollution control devices for the fugitive and point source emissions are required. Guidelines are

to be developed for environmentally sound recycling of E-Wastes. Private Sector are coming forward to invest in the e-waste projects once they are sure of the returns.

### 6.4: Capacity building, training and awareness programmes

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

## 7.0: Conclusion

The recycling of e-waste is required to be regulated due to presence of hazardous constituents in the components of waste electrical and electronic assemblies. Governments should encourage e-waste recycling projects under public-private partnership mode. Solid waste management, which is already a mammoth task in Bangladesh, is becoming more complicated by the invasion of e-waste, particularly computer waste. There exists an urgent need for a detailed assessment of the current and future scenario including quantification, characteristics, existing disposal practices, environmental impacts etc. Institutional infrastructures, including e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and regional levels for the environmentally sound management of e-wastes. Establishment of e-waste collection, exchange and recycling centers should be encouraged in public private partnership

Model facilities employing environmentally sound technologies and methods for recycling and recovery are to be established. Criteria are to be developed for recovery and disposal of E Wastes. Policy level interventions should include development of e-waste regulation, control of import and export of e-wastes and facilitation in development of infrastructure. An effective take-back program providing incentives for producers to design products that are less wasteful, contain fewer toxic components, and are easier to disassemble, reuse, and recycle may help in reducing the wastes. It should set targets for collection and reuse/recycling, impose reporting requirements and include enforcement mechanisms and deposit/refund schemes to encourage consumers to return electronic devices for collection and reuse/recycling. The government should establish an e-waste tracking mechanism in order to maintain this inventory.

raise awareness of the issue in the general population and within public and private sectors is necessary. End-of life management should be made a priority in the design of new electronic products.

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