Guidelines for E-waste Management in Bangladesh

Prepared by

Environment and Social Development Organization-ESDO

Supported by

Swedish Society for Nature Conservation-SSNC

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DEFINITION OF TERMS

Basel convention is recommend that signatories ensure that the generation of hazardous waste and other waste within a country are reduced to a minimum, taking into account social, technological and economic aspects. Secondly, where a country exporting hazardous waste does not have the technical capacity, necessary facilities or suitable disposal sites to dispose of the waste in question in an environmentally sound and efficient manner, steps must be taken to minimize pollution and its consequences for health.

Chlorofluorocarbon (CFC) is a compound consisting of chlorine, fluorine, and carbon. CFCs are commonly used as refrigerants, solvents, and foam blowing agents.

Collector means a person who receives e-waste directly from a residence for recycling or processing for reuse. "Collector" includes, but is not limited to, manufacturers, recyclers, and refurbishers who receive e-waste directly from the public.

Electrical equipment includes any machine powered by electricity. They usually consist of an enclosure, a variety of electrical components, and often a power switch. Examples of these include: major appliance, microcontroller, power tool and small appliances. It also often refers only to the components part of the electrical distribution system such as: Electric switchboards, distribution boards, circuit breakers and disconnects, electricity meter and transformers.

Electronic Equipment is equipment that involves the controlled conduction of electrons (especially in a gas or vacuum or semiconductor) e.g. amplifier, audio and sound system, cassette player, CD player, Cathode Ray Oscilloscope, detector, equalizer, mixer, modem, telephone etc.

Environmental Audit (EA) is a systematic evaluation of activities and processes of an ongoing project to determine how far these activities conform to the Environmental Management Plan of that specific project and sound environmental management practices.

Environment Impact Assessment (EIA) is a systematic examination conducted to determine whether or not an activity or project will have any significant impacts on the environment, provide mitigation for the adverse impacts and optimize the positive impacts.

Extended Producer Responsibility (EPR) is an environment protection strategy that makes the producer responsible for the entire life cycle of the product, especially for take back, recycle and final disposal of the product.

E-waste is a term encompassing various forms of electrical and electronic equipment that are old, end-of-life electronic appliances that have ceased to be of any value to their owners (Definition by UNEP).

Hydrochlorofluorocarbon (HCFC) is a compound consisting of hydrogen, chlorine, fluorine, and carbon. The HCFCs are one class of chemicals being used to replace the CFCs.

Polychlorinated biphenyls (PCBs) are a class of organic compounds with 1 to 10 chlorine atoms attached to a molecule composed of two benzene rings. They are widely used for many applications, especially as dielectric fluids in transformers, capacitors, and coolants. They are toxic and are classified as Persistent Organic Pollutants (POPs).

Producer Responsibility Organization (PRO) is a delegated extended producer responsibility (EPR) by the producer to a third party, which is paid by the producer for spent-product management.

Recycler is a person who engages in treating or processing (of used or waste materials) to make them suitable for reuse.

Recycling is the processing of used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution and water pollution by reducing the need for "conventional" waste disposal or producing a new product from a recyclable material.

Refurbisher means a person who renovates or processes e-waste for reuse, but does not include telecommunications carriers, telecommunications manufacturers, or commercial mobile service providers with an existing recycling programme.

Strategic Environmental Assessment (SEA) is a system of incorporating environmental considerations into policies, plans and programmes. It is sometimes referred to as Strategic Environmental Impact Assessment.

ACRONYMS

ARF	Advanced Recycling Fee
BAT	Best Available Technologies
CD	Compact Disc
CDM	Clean Development Mechanism
CFCs	Chlorofluorocarbons
CFL	Compact Fluorescent Lamp
CoP	Conference of Parties
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CSR	Corporate Social Responsibility
DoE	Department of Environment
EC	European Commission
ECA	Environmental Conservation Act
ECR	Environment Conservation Rules
EEE	Electrical and Electronic Equipment
EIA	Environment Impact Assessment
EMS	Environmental Management System
EPC	Environment Pollution Control
EPR	Extended Producer Responsibility
EU	European Union
GoB	Government of Bangladesh
HCFCs	Hydrochlorofluorocarbons
ICT	Information and Communication Technologies
ILO	International Labor Organization
ISP	Internet Service Providers
LCD	Liquid Crystal Display
LCF	Licensed collection facility
MoEF	Ministry of Environment and Forest
MoICT	Ministry of Information and Communication Technology
MoST	Ministry of Science and Technology
MOU	Memorandum of Understanding
NBR	National Board of Revenue
NGO	Non Governmental Organization
NEMAP	National Environment Management Action Plan
NEP	National Environmental Policy
OECD	Organization for Economic Co-operation and Development
PC	Personal Computer
PCBs	Polychlorinated biphenyls
POPs	Persistent Organic Pollutants
PVC	Polyvinyl chloride
PRO	Producer Responsibility Organizations
PRSP	Poverty Reduction Strategy Paper
SAARC	South Asian Association for Regional Cooperation
SEMP	Sustainable Environment Management Programme
SSNC	Swedish Society for Nature Conservation
UNEP	United Nations Environmental Programme
UPSs	Uninterrupted Powers Supplies
USA	United States of America
VSAT	Very Small Aperture Terminal
WEEE	Waste Electrical and Electronic Equipment

EXECUTIVE SUMMARY

Recognizing the rapidly emerging and serious issue of Waste Electrical and Electronic Equipment (WEEE) or E-waste management, this guideline on WEEE/ E-waste has been prepared as a guidance document to support WEEE/ E-waste inventorisation and assessment of risks involved. The guideline has been prepared based on data from both primary and secondary sources including field survey, expert opinion, publications from scientific journals, reports, and web sites.

E-waste is a term that is used loosely to refer to obsolete, broken, or irreparable electronic devices like televisions, computer central processing units (CPUs), computer monitors (flat screen and cathode ray tubes), laptops, printers, scanners, and associated wiring. E-waste has become a concern in Bangladesh due to the high volumes in which it is generated, the hazardous constituents it often contains (such as lead, mercury, and chromium), and the lack of regulations applicable to its disposal or recycling. Rapid industrialization and lack of proper implementation of anti-pollution laws and regulations have had a detrimental effect on Bangladesh's natural environment. The high rate of accumulation of e-waste stems not only from the rapid pace of emerging technologies but also from e-waste disposal by developed countries in the form of used electronic equipment with short life-spans. The growth of e-waste has significant economic and social impacts. The increase of electrical and electronic products, consumption rates and higher obsolescence rate leads to higher generation of e-waste. Hazardous and toxic materials from e-wastes and scrap recycling business are polluting the air, soils and water ways. The ineffective management of the country's e-waste has recently gained significant attention.

Like other countries in the Asian region, Bangladesh has adopted information and communications technologies (ICTs) as tools for development. The government of Bangladesh currently has a declaration on building a "Digital Bangladesh" by 2021. In recent years the use of mobile phones, PCs, laptops, printers, scanners, etc. have witnessed tremendous growth. Recent data show that Bangladesh now has 59.98 million mobile subscribers (as of June 2010), and 1.02 million fixed phone subscribers (as of May 2010). Bangladesh has generated 6233.04 metric tons of toxics e-waste in cell phones alone in the last 10 years. Every year approximately 181,896 metric tons of e-waste generated from TV. Every year Bangladesh generates roughly 2.7 million metric tons of e-waste of which ship breaking yards alone accounts for more than 2.5 million metric tons of toxic e-waste each year. This electronic waste is disposed without understanding the harmful effects of dumping this waste in to open landfills, farming land and open bodies of water which are causing serious environmental pollution and health hazards. 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 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.

Concern is growing over the large quantities of used and end-of-life electrical and electronic equipment (e-waste) being exported to developing countries for the purpose of re-use, repair, refurbishment, recycling and recovery at facilities that may not meet the Basel Convention standards of environmentally sound management (ESM). The key international conventions that are regulating waste management are the Basel Convention. The Convention recommend that signatories ensure that the generation of hazardous wastes, and other wastes within a country, are reduced to a minimum, taking into account social, technological and economic aspects. Secondly, a country can export hazardous waste if it does not have the technical capacity, necessary facilities or suitable disposal sites to handle the waste in question in an environmentally sound and efficient manner. Steps must be taken to minimize pollution and its consequences for health as far as possible. It should, however, be noted that most developing countries are yet to legislate law and guidelines on e-waste and continue to act as dumping sites from developed countries. Bangladesh is a signatory to

Basel convention prohibiting trans-boundary movement to hazardous waste. Bangladesh adopted its National Environment Policy in the year of 1992 highlighting the regulating all activities that pollute and destroy the environment. There are Environment Conservation Act, 1995, The Environmental Court Act, 2000, and The Environmental Conservation Rules, 1997 in Bangladesh. The Environment conservation act, 1995 authorize the Director General of DoE to undertake any activity necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. Medical Waste Management Rules, 2008 addresses the waste management issues in the medical sector including some provision for E-waste. Bangladesh government already adopted National 3R (Reduce, Reuse and Recycle) Strategy and Hazardous Waste Management Rules where some e-waste issues were addressed. But there are still lacks of the addressed issues for proper handling and management of e-waste. So far there are no specific laws or ordinance that will guide e-waste handling, management and recycling. The Department of Environment prepared a draft Electrical and Electronic Waste (Management and Handling) Rules (2011) which is now in consultation stage. ESDO has prepared a guideline and updated through obtaining experts opinion,

The purpose of these guidelines is to assist the government, private sector, learning institutions and stakeholders to handle and manage electrical and electronic waste effectively to enhance environmental conservation. The guidelines have been developed through a consultative process involving various stakeholders in the relevant sectors. The guidelines have been developed with the strategic objective of providing a complete framework for the management of e-waste generating every year in Bangladesh. Specific objectives of the guidelines are to provide a complete guideline for handling and management of e-waste in an environmentally sound manner. The guidelines are applicable to all those who handle e-waste including the generators, collectors, transporters, dismantlers, recyclers and relevant stakeholders of e-wastes. The guidelines are approached to raise environmental awareness; environmental protection; policy and regulatory frameworks; categories of e-waste and relevant stakeholders; e-waste treatment technologies; and environmentally sound disposal procedures. It is thus pertinent that the guidelines are not a cure for e-waste problems in Bangladesh but will provide a basis for the development of e-waste regulations and an e-waste management policy.

A proper guideline is necessary for complement of a rule, because without a guideline it is hard to properly implement a rule. This guideline will complement the e-waste management rules that will help to enforce the e-waste management in Bangladesh.
E-waste management is necessary because it has numerous impacts on environment and human health. Occupational health hazards will be increased if proper management does not take place, subsequently environmental degradation will be accelerated. Pollutants from e-waste create environmental burden as every year 2.7 million metric tons of e-waste generate in our country. Ultimate disposal of these wastes is air, water and soil. Eventually, these wastes create health hazards. Therefore, it is inevitable to take necessary initiatives to e-waste management in Bangladesh through formulation of an e-waste rule and its proper implementation.

Best management practice of e-waste in developing countries in the world includes Collection and Segregation, Product Reuse and Disposal, while, in developed countries it covers remarketing, reuse and recycling of e-waste. This guideline focuses the best management practice through the amalgamation of both developed and developing countries management practices. This is because Bangladesh is one of the hubs of e-waste generation countries. Bangladesh generates (2.7 MMT) approximately one tenth of total (20-30 MMT) waste generation in the world. Therefore, best practice management will be helpful to proper management of e-waste in Bangladesh.

Environmentally sound E-waste treatment technology was identified at three levels. The first level included decontamination, dismantling and segregation. The second level included shredding and four special treatment processes like electromagnetic separation, eddy current separation, CRT breaking

and treatment and density separation using water. The third level treatment included recovery of metals and disposal of hazardous E-waste fractions including plastics with flame retardants, CFCs, capacitors, Mercury, lead and other items. The establishment of E-waste Recycling & Treatment Facility shall be in line with the Guidelines in for establishing and operating “Recycling and Treatment and Disposal Facilities” for hazardous wastes. Such facilities shall be set up by the organized formal sector. However, the activities presently operating in the informal sector need to be upgraded to provide a support system for the integrated facility. This would enable to bring the non-formal sector in the main stream of the activity and facilitate to ensure environmental compliances. The procedures for setting up & management of e-waste facility shall include licenses from all appropriate governing authorities such as environmental clearance, recycler registration from Department of Environment under Electrical and Electronic Waste (Management and Handling) Rules, obtaining of consents under relevant act and authorization from the government authority.

The guidelines for e-waste management in Bangladesh have been divided into nine chapters. The background of the development of the guidelines is presented in Chapter 1. Chapter 2 presents the objectives, scope and rationale of the development of guidelines. Chapter 3 deals with global and national situation of e-waste generation and consequences of poor e-waste management. Chapter 4 detailed on national laws related to environmental management the legal and institutional framework on e-waste management. The different categories of e-waste have been included in Chapter 5. General guidelines for specific target groups are outlined in Chapter 6. Rest of the chapters 7, 8 and 9 of the document deals with guidelines for collection and disposal systems, treatment technology for e-waste and the establishment of integrated e-waste recycling and treatment respectively.

CHAPTER 1

INTRODUCTION

1.1 Background

Waste Electrical and Electronic Equipment (WEEE) or E-waste is one of the fastest growing waste streams in the world. In developed countries, it equals 1% of total solid waste on an average. It is expected to grow to 6% by 2020. In USA, it accounts for 1% to 3% of the total municipal waste generation. In EU, historically, WEEE increases by 16-28% every five years, which is three times faster than average annual municipal solid waste generation. A recent source estimates that total amount of WEEE generation in EU ranges from 5 to 7 million tonnes per annum or about 14 to 15 kg per capita and is expected to grow at a rate of 3% to 5% per year. In developing countries, it ranges from 0.01% to 1% of the total municipal solid waste generation. In countries like China, Bangladesh and India, though annual generation per capita is less than 1 kg, it is growing at an exponential pace. The increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate" make E-waste one of the fastest waste streams. The composition of E-waste is very diverse and differs in products across different categories. It contains more than a 1000 different substances, which fall under "hazardous" and "non-hazardous" categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the WEEE followed by plastics (21%), non ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver, gold, platinum, palladium etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in E-waste classifies them as hazardous waste. E-waste dismantling or incineration is considered toxic. Therefore, they are targeted for reuse, recovery or hazardous waste disposal. The recovery of metals is a profitable business, which results in local, trans-boundary and global trade. Environmental issues and trade associated with E-waste has driven the definition of E-waste both at national and international level. In this context, it is important to understand the existing E-waste definition and its evolution, its drivers and guidance notes for its assessment and formulation as described in following sections.

1.2 E-waste concept

The term e-waste is a popular, informal name for electronic products nearing the end of their "useful life. It is a generic term encompassing various forms of electrical and electronic equipment that are old, end-of-life electronic appliances, or have ceased to be of any value to their owners. E-waste comprises of wastes generated from used electronic devices and house hold appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompasses wide range of electrical and electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc.

1.3 E-waste components

Components, which are assembled to produce "Electrical and Electronic Equipment" are metal, motor/ compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, FR/ BFR-containing plastic, batteries, CFC/HCFC/HFC/HC, external electric cables, refractory ceramic fibers, radioactive substances and electrolyte capacitors (over L/D 25 mm).

1.4 Environmentally sound management of e-waste

Like other countries in the Asian region, Bangladesh has adopted information and communications technologies (ICTs) as tools for development. The government of Bangladesh currently has a

declaration on building a “Digital Bangladesh” by 2021. Although Bangladesh got its first mainframe computer in 1963, mobile phones and PCs only started to penetrate the market in large quantities after 1997. Two things happened in that year: Bangladesh liberalized its telecom policy by allowing multiple private telecom operators to operate, and withdrew all import duties from computers and their peripherals. At the same time, operators, especially internet service providers (ISPs) were also allowed to use VSAT (very small aperture terminal) satellite systems for overseas communication, resulting in internet connectivity being opened up in the country. In recent years the use of mobile phones, PCs, laptops, printers, scanners, etc. have witnessed tremendous growth. Recent data show that Bangladesh now has 59.98 million mobile subscribers (as of June 2010), and 1.02 million fixed phone subscribers (as of May 2010).

The e-Waste is disposed of in one of the four ways land filling, incineration, recycling or exportation. Each process has an environmental impact as well as affects the health and safety of the worker. Disposal in landfills is a common practice but eventually it results in leaching of toxic metals in soil and subsoil aquifers thus many countries (especially European countries) have undertaken legal measures to check the disposal in municipal landfills. The incineration process releases heavy metals and other toxicants contained in electronic subassemblies and components as air emissions. Recycling process is considered the best way for disposing of electronic components only if the process employs environmentally sound recycling. It is considered that the developed nations usually have technological resources and infrastructure for environmentally sound recycling whereas developing nations lack the regulations as well infrastructure for proper recycling. The obsolete electronics are exported to developing countries like Bangladesh, India, China, Pakistan and Africa due to cost benefits. This exportation is creating ecological footprints in developing and underdeveloped countries of the technological advancements in industrialized nations. It is cheap to export the obsolete electronics in developing nations rather than recycling these products in developed nations. The imported obsolete electronics in developing nations creates e-Waste trade chain employing several informal workers, collectors, segregators, middlemen, scrap dealers and recyclers who manage to take components apart, reuse the functional components and recycle the non-functional components by burning, acid dipping and other unprofessional techniques. The spent acids and other chemicals, solid wastes after burning and other wastes are disposed of in open drains which eventually end up in rivers.

1.5 Management at End of Life

Collection: The proper collection of wastes is the prerequisite for management of e-Waste. The source of e-Waste varies from household to offices and businesses and the waste composition differs depending on its source of generation. The e-Waste collection is usually done by the informal sector in developing nations due to lack of legislation and take-back policies.

Dismantling: The segregation and dismantling of e-Wastes is also performed by the informal sector in countries like Bangladesh, India, Pakistan, Afghanistan, China, Thailand and Vietnam for commercial as well as residential e-wastes. In Malaysia currently the commercial e-Wastes is dismantled and separated into various parts and components for resale/recycle/recovery locally while the residential e-Wastes is discarded as garbage and disposed off in landfill.

Reuse & Recovery: Reuse and refurbishment of the components or equipments forms a common practice in the developing regions as it extends the useful life thus minimizing the generation of waste. The process like reuse, reassembling and repair of components is more valuable than using the precious metals as secondary raw materials. The obsolete electrical and electronic devices are repaired until they get totally broken.

Disposal: The recycling processes usually have low recycling rates as for the informal sector the major thrust for recycling is precious material extraction due to which the other hazardous components are usually dumped in landfill and for the formal recycling units the efficiency is less as the collections targets are not met and lack of efficient technologies.

1.6 Conceptual Life Cycle of Electrical and Electronic Equipment

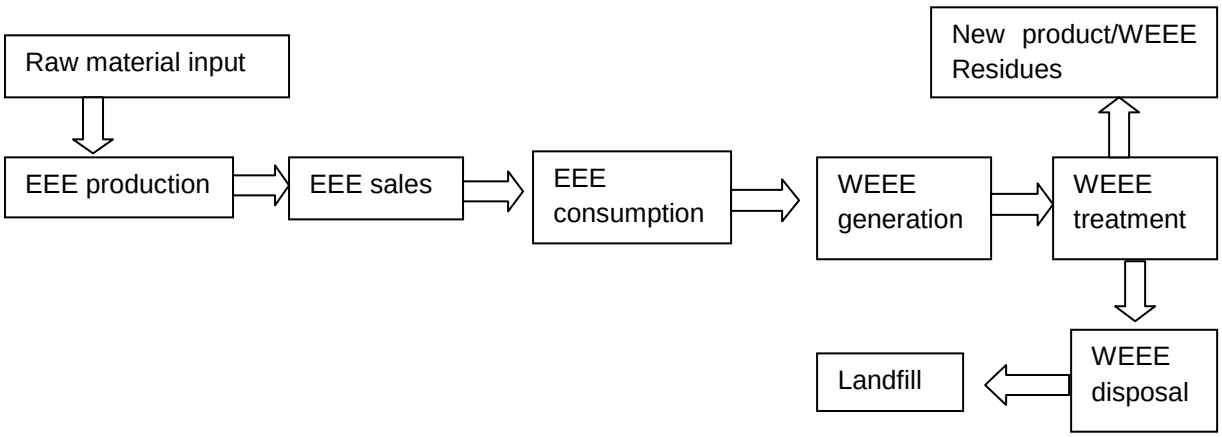

Figure-1: Conceptual Life Cycle of Electrical and Electronic Equipment

1.7 E-Waste Management Requirements

Broadly speaking, discarded e-waste has two potential fates—it may be disposed of (most likely in a landfill) or it may be recycled. Once the device is in the hands of the recycler, it may be resold and reused "as is" or it may undergo some degree of refurbishing. Products that cannot be reused or refurbished are either dismantled or shredded, with the resulting material separated into secondary material streams and at least partially recovered. The resale of electronic devices for reuse or material recovery may occur domestically or abroad. Regardless of whether an electronic device is disposed of or recycled, there are virtually no environmental regulatory requirements applicable to its management. Factors specific to e-waste that affect the lack of regulation are useful in understanding the challenges associated with addressing e-waste management issues.

CHAPTER 2

OBJECTIVE, SCOPE & JUSTIFICATION OF THE GUIDELINES

2.1 Objectives

To develop a framework for the evolution of rules and policies with the participation of key stakeholders in the sustainable e-waste management in Bangladesh

The specific objectives are

- To provide guidelines for handling and management of e-waste in an environmentally sound manner.
- To establish a base for a policy and regulatory frameworks on e-waste management in Bangladesh.
- To raise public awareness on sustainable management of e-waste in Bangladesh.

2.2 Scope

These guidelines apply to the collection, sorting, segregation, management and scientific disposal of the various categories and elements of e-waste in Bangladesh. The guidelines provide a clear mechanism for the management of e-waste at various stages in the supply chain, the objective being to ensure the integrity of the environment is assured against the potential adverse impacts of e-waste and its elements. These are intended to provide guidance and broad outline, however, the specific methods of treatment and disposal for specific wastes needs to be worked out according to the hazard/risk potential of the waste under question. These Guidelines provide the minimum practice required to be followed in the management of e-wastes and the Department of Environment may prescribe more stringent norms as deemed necessary.

2.3 Rationale

The guidelines will provide a regulatory framework to enable proper collection, recycling and to set the required standards for e-waste management. These guidelines will provide vital information to aid the development of a management framework. They will also ensure that health and safety aspects of the people involved in the operations are protected, along with issues of emissions and waste emerging from such operations. The existing informal e-waste management systems from different stakeholders will be streamlined and attract recyclers who make the recycling process safe and efficient manner. The guidelines will further enhance the development of economic instruments such as land, financial subsidies etc. to ensure an efficient collection and recycling system.

2.4 Need for the guidelines for environmental protection

Environment and Social Development Organization-ESDO in association with Swedish Society for Nature Conservation (SSNC) has conducted research for current situation analysis and to review and compare the existing practices for dealing with e-waste at the national and regional level in Bangladesh, and collect information regarding the situation of e-waste in the country. Based on the outcome of the research carried out and the consensus arrived at the reports on electronic waste a guideline for the environmentally sound management of e-waste has proposed. The specific needs for the guidelines for e-waste management are due to:

(a) Increasing amount of e- waste:

Product obsolescence is becoming more rapid since the speed of innovation and the dynamism of product manufacturing/ marketing has resulted in a short life span (less than two years) for many computer products. Short product life span coupled with exponential

increase at an average 15% per year will result in doubling of the volume of e-waste over the next five to six years.

(b) Toxic components:

E-waste is known to contain certain toxic constituents in their components such as lead, cadmium, mercury, polychlorinated bi-phenyls (PCBs), etched chemicals, brominated flame retardants etc., which are required to be handled safely. The recycling practices were found mostly in informal sectors leading to uncontrolled release of toxic materials into the environment as a result of improper handling of such materials.

c) Lack of environmentally sound recycling infrastructure:

It has been established that e-waste, in the absence of proper disposal, find their way to scrap dealers, which are further pushed into dismantler's, supply chain. Existing recycling infrastructure in Bangladesh is not equipped to handle the increasing amounts of e-waste. The major dismantling operations are occurring by the informal sector in hazardous manner.

CHAPTER 3

E-WASTE GENERATION AND MANAGEMENT: GLOBAL Vs NATIONAL

Increased economic growth has been facilitated by technology which has become an integral part of our daily life. Its use has generated opportunities, as well as challenges in the form of electrical and electronic waste and its disposal. E-waste contains toxic and hazardous substances that pose a threat to human health and the environment. Different treatment and disposal systems have been used in various parts of the world.

3.1 The e-waste scenario

3.1.1 The global situation

Globally, WEEE/ E-waste are most commonly used terms for electronic waste. At UNEP web site, it is cited that "e-waste is a generic term encompassing various forms of electrical and electronic equipment (EEE) that are old, end-of-life electronic appliances and have ceased to be of any value to their owners". There is no standard definition of WEEE/E-waste. A number of countries have come out with their own definitions, interpretation and usage of the term "E-waste/WEEE". The most widely accepted definition of WEEE/ E-waste is as per EU directive, which is followed in member countries of European Union and other countries of Europe. At first WEEE/E-waste definition as per EU directive has been described followed by description of definitions in Canada, Japan, USA, Basel Convention and OECD.

It is stated in the report "From E-waste to Resource" that in the world volume of e-waste generated per year is 20 million metric tons. However, according to UNEP projections, an estimated 20-50 million tons of E-Waste is being generated annually in the world. Developed countries have various legislations and guidelines on e-waste. In developed country the generated e-waste currently accounts for1% of total solid waste generation and is expected to grow to 2% by 2010. In the USA it accounts for 1% to 3% of total municipal waste generation. According to the European Community directive 2002/96/EC on Waste Electrical and Electronic Equipment (European Commission, 2010), e-waste is growing three times faster than average annual municipal solid waste generation. It is estimated that the total amount of e-waste generated in the EU ranges from 5 to 7 million tonnes per annum or about 14 to 15 kg per capita and is expected to grow at a rate of 3% to 5% per year. In developing countries, it ranges from 0.01% to 1% of the total municipal solid waste generation. In China and India however where annual generation per capita is less than 1 kg, it is growing at an exponential pace.

3.1.2 The Bangladesh situation

The information high technology boom in Bangladesh has brought with it a new type of waste; e-waste - a category that barely existed15 years ago. This represents the biggest and fastest growing manufacturing waste. Bangladesh is experiencing increased economic activity that has negative impacts on the environment. Economic activities associated with industry, health services, and other service sectors generate electronic wastes which are causing serious environmental problems that threaten public health and endanger economic sustainability of the country. In order to enhance the cooperation between Governmental and Non-Governmental organizations, between public and private parties and regional cooperation; facilitate a common approach on the e-wastes management; Environment and Social Development Organization (ESDO) in association with Swedish Society for Nature Conservation (SSNC) has conducted research for current situation analysis and to review and compare the existing practices for dealing with e-waste at the national and regional level, and collect information regarding the situation of e-waste in the country.

E-waste problems related to trade off and trans-boundary movement in the developing countries address environmental, social, and economic effects. E-waste has become the fastest growing waste stream in Bangladesh and has emerged as a lucrative business. Every year Bangladesh generates roughly 2.7 million metric tons of e-waste. Out of these 2.7 million metric tons, ship breaking industry alone generates 2.5 million metric tons. Bangladesh import scrap ships from developed countries as it has no/inadequate legal rules and regulations to import such highly polluted scrap products and equipments. According to the UNEP study, the developed nations dump e-waste in "developing" Asian countries (India, Bangladesh, China and Pakistan) through illegal trade routes.

Bangladesh is developing with the increasing of technology usage. Sustainable and safe use of technology can drive an economically developed country. But the wastes from these electronic goods come to us as curse. In Bangladesh, electrical and electronic equipments are consumed and dumped the useless products without any consideration of environmental damages and sustainability. Some of the electronic waste is reused, broken down for parts or thrown out completely. Currently this informal practice is not being carried out safely and has become a hazard to human health and the surrounding environment. At present there is a lack of awareness about the e-waste issue within the general population, government and also in private sector.

Moreover, every year significant no. of scrap ships is imported to Bangladesh by importer legally. These ships are broken in ship breaking yard. During ship breaking, a large number of heavy metals and toxic pollutants release to the environment including oil spills to land and water bodies. As Bangladesh has legal binding to import scrap ships, thus illegal import and trade off of e-waste is happening by importer to make profit and therefore, e-waste vulnerability of Bangladesh is increasing. The scrap ships are carrying large volume of toxics products and electrical & electronic waste that includes: antiques, barometers, clothes irons, electronics, lamps/light bulbs, light switches, paint (Latex), pesticides, television sets, thermometers, mirrors, washing machines, calculators, laptop, LCD monitors, neon lights, sewer pipes, etc.

Table 1: E-waste generation in Bangladesh

Sources of e-waste	Estimated e-waste
Ship Breaking Yards	2.5 million metric ton/yr (2500000 metric ton/yr)
Television Sets	0.182 million metric ton/yr (181896 metric ton/yr)
Computers	0.0084 million metric ton/yr (25244.24 metric ton/30yrs)
Mobile Phones	0.0006 million metric ton/yr (6233.04 metric ton/10yrs)
CFL Bulbs	0.0001 million metric ton/yr (566.90 metric ton/6yrs)
Mercury Bulbs	0.0018 million metric ton/yr (1861.32 metric ton/10yrs)
Thermometers	0.0002 million metric ton/yr (8513.59 metric ton/50yrs)
Other Medical & Dental Waste	0.009 million metric ton/yr (93478.25 metric ton/10yrs)
Total	**2.702 million metric tons/yr**

Bangladesh is one of the highly e-waste generating countries in the world. Of the approximate 45,000 ocean-going ships in the world about 700 (1.55%) are taken out of service every year. The harbors of Bangladesh are the second largest ship breaking industries in the world.

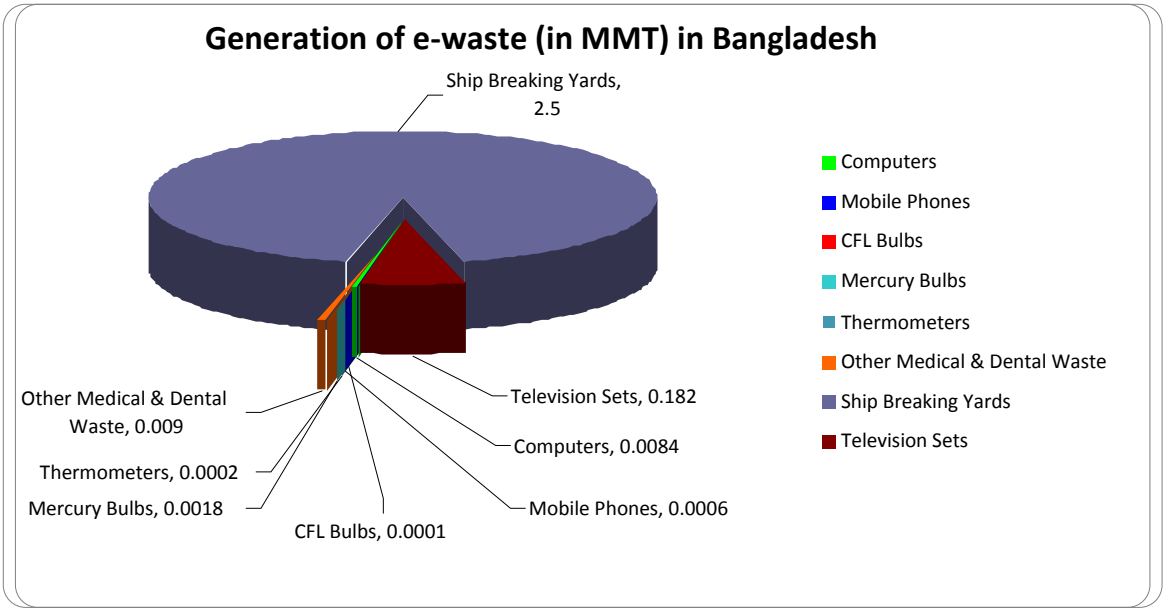

Figure-2: Graphical presentation of E-waste scenario (MMT/ year) of Bangladesh

3.2 Consequences of poor e-waste handling

The ecological, economic and social consequences resulting from poor handling and management of e-waste include:

Health consequences

- Breathing cadmium can severely damage the lungs and cause death.
- Lead attacks the nervous system in both adults and children.
- Inhaling the hexavalent form of chromium can damage the liver, kidneys, cause lung cancer and asthmatic bronchitis.
- Chromium easily passes through cell membranes and can cause damage to DNA,
- Mercury can cause brain and kidney damage and is also harmful to the developing fetus because it can pass through breast milk
- Cadmium causes cancer and can damage the bones and kidneys, where it accumulates

Environmental consequences

- Air pollution from burning of e-waste
- Management problem of non-biodegradable equipment
- Toxic and radioactive nature of e-waste to the human, plants and animals
- Blockage of water runoff channels
- Increased amount of waste
- Waste disposal problem

Economic consequences

- Substantial public expenditure on health care
- Investments in complex and expensive environment remediation technologies
- Misuse of resources that can be recycled for re-use
- Opportunities for recycling industries and employment
- Ozone layer depletion which led to unpredictable weather conditions i.e. Prolonged droughts and floods demand the use of resources which should be deployed for growth and development in other sectors

Social consequences

- E-waste affects human health (e.g. lead poisoning and cancerous mercury)
- Growth of informal waste disposal centers in the locality

- Illegal trade and informal management of e-waste
- Loss of appreciation for ICT

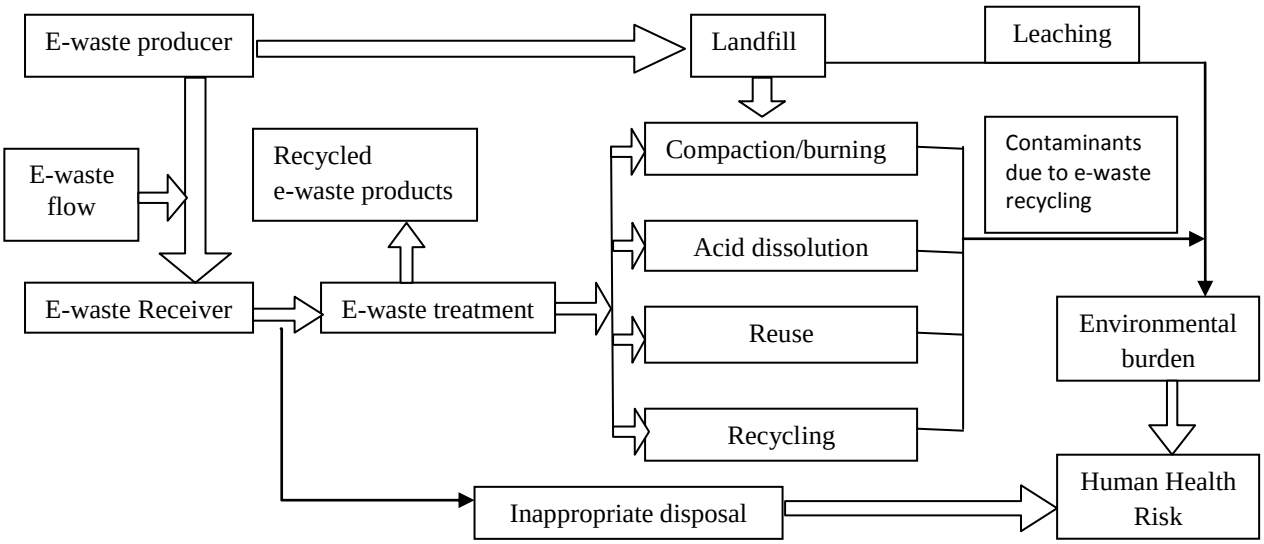

Figure-2: E-waste routes

3.3 Converting the challenges into opportunities

Despite of the problem with e-waste, its proper management using environmentally sound systems has numerous socio-economic opportunities that can stimulate entrepreneurship, employment and enhancement of livelihoods.

a. **Recycling level.** Organizations and individuals that will be licensed to recycle will either create job opportunities or self-employ themselves. Experiences across the world indicate that the scale of operation for recycling e-waste is growing at viable and potentially profitable rates.
b. **Dismantling and refurbishing level.** The refurbisher extends the functional life of electronic or electrical equipment by breaking apart the end of use equipment and selling the parts that can still be used. This process, besides creating job opportunities, saves the environment by diverting large volumes of e-waste from energy-intensive down cycling processes where the equipment is reverted to raw materials for use in manufacturing. The environmental and social benefits of refurbishing and reuse include diminished demand for new products and virgin raw materials and diminished use of landfills.
c. **Collection level.** Through the Producer Responsibility Organization (PRO) and take back systems those who collect e-waste and hand it over to recyclers, refurbishers and treatment plants are paid a take back fee which in away provides for livelihoods.
d. **Creation of artificial mines.** It is a fact that e-waste contains hundreds of tonnes of various metals. These metals can be isolated, treated and made available for use in new forms. This is done by establishing metal separation facilities at landfills or e-waste deposits. This process not only creates employment but also reduces metal loading on e-waste deposit sites and hence reduces the risk of soil contamination, besides making available new metals for use.

CHAPTER 4

LEGAL AND INSTITUTIONAL FRAMEWORK FOR E-WASTE MANAGEMENT

There is no specific national Policy, Rules or Guidelines for e-waste. None of the existing environmental laws make any direct and detail reference to the handling of electronic and electrical waste. However, preparation of Electrical and Electronic Waste (Management and Handling) Rules is the priority of the Government of Bangladesh.

4.1 Existing legislation in national and international context

4.1.1 International

Bangladesh is a signatory to many agreements and conventions on environmental management. These include support for the provisions of Agenda 21 amongst other declarations and statements of principle, such as the Rio Declaration in 1992 on Environment and Development. Bangladesh is also party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and signatory to the Stockholm convention of Persistent Organic Pollutants (POP's). Bangladesh has international obligations to effectively manage the hazardous waste within its geographical boundaries.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, usually known simply as the Basel Convention, 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). The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.

The Basel Annex-VII hazardous waste, lists the following applicable entries to e-waste:

- A1010 Metal wastes and waste consisting of alloys of any of the following: antimony, arsenic, beryllium, cadmium, mercury, selenium, tellurium, thalium.
- A1020 Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following: antimony compounds, beryllium, beryllium compounds, cadmium, cadmium compound, lead, lead compounds, selenium, selenium compounds, tellurium, tellurium compound.
- A1030 Wastes having as constituents or contaminants any of the following: arsenic, Arsenic compounds, mercury, mercury compound, thallium, thallium compounds.
- A1160 Waste lead-acid batteries, whole or crushed.
- A1170 Unsorted waste batteries excluding mixtures of only list B batteries. Waste batteries not specified on list B containing Annex I constituents to an extent to render them hazardous. [Note: List B batteries include: waste batteries conforming to a specification, excluding those made with lead, cadmium or mercury].
- A1180 Waste electrical and electronic assemblies or scraps containing components such as accumulators and other batteries included in list A, mercury- switches, glass from cathode ray tubes and other activated glass and PCB- capacitors, or contaminated with.
- Annex 1 constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics contain in Annex III.
- A2010 Glass waste from cathode ray tubes and other activated glass destined for direct reuse and not for recycling or final disposal.

It is also important to note that the Basel convention's list B includes:

- B1110 Electrical and electronic assemblies (including printed circuit board, electronic components and wires) destined for direct reuse and not for recycling or final disposal.

4.1.2 National

There is no comprehensive electronic waste (e-waste) policy, strategy and rules in Bangladesh, although it is briefly mentioned just as an action item in the country's ICT policy. The government established the Department of Environment (DoE) in 1977 under the Environment Pollution Control (EPC) Ordinance, 1977. Then in 1989, as pollution and environment got more attention, the Ministry of Environment and Forest was established as the apex body. The National Environmental Policy, highlighting the regulation of all activities that pollute and destroy the environment, came into effect in 1992. The subsequent Environment Conservation Act (ECA), 1995 and Environment Conservation Rules (ECR) 1997 authorized the DoE to undertake any activity necessary to conserve and enhance the quality of the environment and to control, prevent and mitigate pollution. The DoE was also mandated to give clearance on environmental issues for any new project.

Table 2: Major Policies, Acts and Regulations that can be relate to e-waste management in Bangladesh

Date	Title
	Policy
2011	National Science and Technology Policy This policy is to promote national research activities for the development of the country. In this policy research on "waste management" are emphasized under the area of "environmental science and technology"
2009	National ICT Policy This policy create a equitable and fair dealing society
2008	National Renewable Energy Policy This policy is promoting production of biogas and other green energy from waste and also providing Incentives such CDM to promote green energy projects.
2006	National Urban Policy CDM and Recycling has been emphasized in this policy.
2005	National Industrial Policy This policy recommended use of EMS and Cleaner Production practices amongst the industries
1998	National Policy for Water Supply and Sanitation According to this policy the government shall take measures for recycling of waste as much as possible and use organic waste materials for compost and bio-gas production.
1998	Urban Management Policy Statement Recommend the municipalities for privatization of services as well as giving priority to facilities for slum dwellers including provisions of water supply, sanitation and solid waste disposal.
1992	National Environment Policy In this policy there are provision for banning the use of heavy metals in industrial production; provision for "west permit/consent order" to improve waste management; provision for reducing hazards form the consumer products; provision for banning the import of hazardous substances that are hazards for human health.
	Act
2010	The Environment Court Act
2006	National ICT Act
1995	The Bangladesh Environment Conservation Act
	Rules
2008	Biomedical Waste Management Rules This rule recommends source separation of hospital waste as well as separate collection, transportation and treatment and disposal of all kinds of hospital and clinical waste.
2006	Lead Acid Battery Recycling and Management Rules

	Under this rules collection and recycling has been improved.
2005	National Solid Waste Management Handling Rule
	3R principle has been used.
1997	The Environment Conservation Rules
	These are rules set by the government of Bangladesh for the protection of environment
	Strategy
2009	National 3R Strategy for Waste Management
	Emphasized on the 3R principles for the management of wastes
2009	Bangladesh Climate Change Strategy and Action Plan
	This strategy are emphasized on the priority areas of action that will be taken by the government to combat climate change
2005	National CDM Strategy
	This strategy is promoting pro-poor CDM projects on waste sector by harnessing carbon financing
2005	Poverty Reduction Strategy Paper (PRSP)
	Here EMS has been promoted. To improve the solid waste management situation, special focus is given to segregation of waste at source along with the promotion of recycle, reduce and reuse of industrial and other solid waste etc.
	Action Plan
2005	Dhaka Environment Management Plan
	Waste recycling has been promoted, less land filling encouraged, EMS promoted among industries.
2005	Solid Waste Management Action Plan for Eight Secondary Towns in Bangladesh
	Under the Secondary Towns Integrated Flood Protection (Phase-2) Project of Local Government Engineering Department, GoB. This action plan is based on 4 R principle i.e. reduce, reuse, recycle and recover of the waste.
1995	National Environmental Management Action Plan (NEMAP)
	This is a plan of the Government of Bangladesh (GoB), prepared by the Ministry of Environment and Forest (MoEF) in consultation with people from all walks of life. 3R is being promoted under the Sustainable Environment Management Programme (SEMP) of NEMAP.
	Other
2004	Dhaka Declaration on Waste Management by SAARC countries during 10–12 October 2004
	SAARC countries agree to encourage NGOs and private companies to establish community based composting, segregation of waste at source, separate collection and resource recovery from wastes with particular focus on composting.

4.2 Institutional framework

The Ministry of Environment and Forest (MoEF)

The Ministry of Environment and Forest (MoEF) is responsible for the environment at policy level. To achieve this objective, the Ministry's role is to create an enabling environment through policy and regulatory reforms for environmental and natural resources management.

Department of Environment (DoE)

Department of Environment (DoE) is the principal agency of Bangladesh Government in the implementation of all policies, strategies and regulations relating to the environment. The key objectives include universal compliance and enforcement of environmental regulations, developing guidelines and standards and the prosecution of offenders failing to meet the provisions of the Environmental Conservation Act (ECA) 1995 and Environment Conservation Rules (ECR) 1997.

The lead agencies that are also pertinent to e-waste management include the Ministry of Information and Communication Technology, Ministry of Science and Technology, Ministry of Commerce, Ministry of Education, Ministry of Local Government and All City Corporations in Bangladesh, Ministry of Power, Energy and Mineral Resources, Ministry of Finance

4.3 ESDO's initiatives towards formulation of a national guidelines e-waste management

Economic activities associated with industry, health services, and other service sectors generate electronic wastes which are causing serious environmental problems that threaten public health and jeopardize economic sustainability of the country. Enhance the cooperation between Governmental and Non-Governmental organizations, between public and private parties and facilitate and regional cooperation in order to facilitate a common approach on the e-wastes management; Environment and Social Development Organization (ESDO) in association with Swedish Society for Nature Conservation (SSNC) has conducted research for current situation analysis and to review and compare the existing practices for dealing with e-waste at the national and regional level, and collect information regarding the situation of e-waste in the country. ESDO in association with Swedish Society for Nature Conservation (SSNC) is developing a National Guidelines for E-waste Management in Bangladesh. The development of these guidelines is expected to integrate the above developments to manage e-waste in the country effectively.

4.4. Current recycling method of e-waste in Bangladesh

ESDO's research finding shows that in Bangladesh recycling of e-waste is done manually without having knowledge of e-waste hazards.

CHAPTER 5

CATEGORIES OF E-WASTE

Different categories of electronic and electrical appliances and the resulting e-waste from them and their levels of toxicity are describes in this chapter. It is very important to note that these elements may be found in combination with others. This section is for understanding different types of electrical and electronic equipment so that they may be disposed of appropriately through sorting, collection, dismantling, treatment and disposal. There are two broad categories of e-waste based on mode of operation and function and based on elemental composition. The list below is not comprehensive, but a simplified guideline.

5.1 Categorization based on mode of operation and function

The classification of equipment based on the mode of operation and function reveals the composition of physical components before dismantling in order to facilitate sorting. Table 3 shows some of e waste categories.

Table 3: Categories of E-waste

Type of E-waste	Examples
ICT and Telecommunications equipment	Mainframes, Printers, Personal computers (CPU, mouse, screen and keyboard included), Laptop computer, Networking equipment, Scanners, Mobile phones, CD / DVDs / Floppy Disks, UPSs, Radio sets, Television sets, Video cameras, Video recorders, Hi-fi recorders, Audio amplifiers and Musical instruments.
Office electronics	Photocopying equipment, Electrical and electronic typewriters, Pocket and desk calculators, Facsimile and Telephones.
Large Household Appliances	Refrigerators, Freezers, Washing machines, Dish washing machines, Cooking equipment, Microwaves, Electric heating appliances, Electric hot plates, Electric radiators, Electric fans, Air conditioner appliances, exhaust ventilation and conditioning equipment, large appliances for heating beds, rooms and seating furniture.
Small Household Appliances	Vacuum cleaners, Carpet sweepers, Water dispensers, Toasters, Fryers, Appliances for hair-cutting, hair drying, brushing teeth, shaving and massage; Electric knives, Clocks, Appliances used for sewing, knitting and weaving.
Consumer Equipment.	Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, punching, folding, bending or processing wood, metal and other materials. Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses, Tools for welding, soldering or similar use. Tools for mowing or other gardening activities, Sewing machines etc.
Toys, leisure and sports equipment	Electric trains or car racing sets, Hand-held video game, Video games, Computers for biking, diving, running, rowing, etc., Sports equipment with electric or electronic components.
Lighting	Fluorescent tubes, Compact fluorescent lamps, High intensity discharge lamps, including pressure sodium lamps and metal halide lamps; Low pressure sodium lamps, Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs.
Medical equipment	Scanners, Operating equipments, Stethoscopes, Radiotherapy equipment, Cardiology, Dialysis, Pulmonary ventilators, Nuclear medicine equipment, Laboratory equipment for in-vitro diagnosis, Analysers, Freezers, Fertilization tests. Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability.

Automatic dispensers	Automatic dispensers for hot drinks, Automatic dispensers for hot or cold bottles or cans, Automatic dispensers for solid products, Automatic dispensers for money, and other appliances which deliver automatically all kind of products.
Monitoring and control instruments	Smoke detectors, Heating regulators, Thermostats, Measuring, weighing or adjusting appliances for household or as laboratory equipment and other monitoring and control instruments used in industrial installations (e.g. in control panels).
Batteries	Lead Batteries, Nickel and Cadmium batteries etc.

5.2 Categorization based on elemental composition

This category is based on the physical, chemical and gaseous components found in the electrical and electronic appliances. They include epoxy resins, fiber glass, Polychlorinated biphenlys (PCBs), (polyvinyl chlorides) (PVC), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), thermosetting plastics, lead, tin, copper, silicon, beryllium, carbon, iron and aluminium. They also vary in quantity:

5.2.1 Hazardous elements

Hazardous elements category includes elements that are harmful to the environment and human health. Table 4 below shows some hazardous elements in electrical and electronic equipment.

Table 4: Hazardous elements in electrical and electronic equipment

Element	Electrical and electronic equipments
Americium	Smoke alarms (radioactive source)
Mercury	Fluorescent tubes (numerous applications); tilt switches (pinball games, mechanical doorbells, thermostats)
Sulfur	Lead-acid batteries
PCBs	Prior to ban, almost all 1930s–1970s equipment, including capacitors, transformers, wiring insulation, paints, inks, and flexible sealants used PCBs
Cadmium	Light-sensitive resistors, corrosion-resistant alloys for marine and aviation environments and nickel-cadmium batteries
Lead	Old solder, CRT monitor glass, lead-acid batteries and formulations of PVC
Beryllium oxide	Filler in some thermal interface materials such as thermal grease used on heat sinks of CPUs and power transistors, magnetrons, X-ray-transparent ceramic windows, heat transfer fins in vacuum tubes, and gas lasers
Polyvinyl chloride	PVC contains additional chemicals to change the chemical consistency of the product. Some of these additives can leach out of vinyl products e.g. plasticizers that are added to make PVC flexible

5.2.2 Generally non hazardous elements

Non hazardous category includes elements that are not generally harmful but they can be cause toxicity at certain high level concentrations. They can be extracted from the used electrical and electronic appliances and applied elsewhere. They are listed in the following table.

Table 5: Non hazardous elements in electrical and electronic equipment

Element	Electrical and electronic equipments
Tin	Solder, coatings on component leads
Copper	Copper wire, printed circuit board tracks, component leads
Aluminium	Nearly all electronic goods using more than a few watts of power, including electrolytic capacitors
Iron	Steel chassis, cases, and fixings
Germanium	1950s–1960s transistorized electronics (bipolar junction transistors)
Silicon	Glass, transistors, ICs, printed circuit boards
Nickel	Nickel-cadmium batteries
Lithium	Lithium-ion batteries
Zinc	Plating for steel parts
Gold	Connector plating, primarily in computer equipment

5.2.3 Elements found in trace amounts

Elements that are found in trace amounts include americium, antimony, arsenic, barium, bismuth, boron, cobalt, europium, gallium, germanium, gold, indium, lithium, manganese, nickel, niobium, palladium, platinum, rhodium, ruthenium, selenium, silver, tantalum, terbium, thorium, titanium, vanadium, and yttrium etc. Almost all electronics contain lead and tin (as solder) and copper (as wire and printed circuit board tracks), though the use of lead-free solder is now being promoted all over the world. Cadmium, mercury, and thallium are also found in small amounts. These substances can be divided further based on their level of toxicity to humans and the environment.

CHAPTER 6

GUIDELINES FOR TARGET GROUPS IN E-WASTE MANAGEMENT

There is no system to manage the various groups involved in the management of e-waste in Bangladesh. E-waste has to be managed through a carefully organized system and existing actors should be part of the proposed system. The target groups do have a collective responsibility for managing the e-waste at different stages of its life-cycle.

6.1 Guidelines for producers / manufacturers

There are very few manufacturers of electronic equipment in Bangladesh. Most companies have their production plants in Asia, where they have specialized equipment and methods to recover useful raw materials from scrap.

The producer shall be responsible for;-

(1) Collecting of any e-waste generated during the manufacture of electrical and electronic equipment and channelizing the same for recycling or disposal.

(2) Ensuring that all electrical and electronic equipment are provided with a unique serial number or individual identification code for tracking their products in the e-waste management system.

(3) Collecting e-waste generated from the 'end of life' of their products in line with the principle of 'Extended Producer Responsibility' (EPR), and to ensure that such e-wastes are channelized to registered refurbishers or dismantler or recycler.

(4) Setting up collection centers or take back system either individually or collectively for all electrical and electronic equipment at the end of their life.

(5) Financing and organizing a system to meet the costs involved in the environmentally sound management of e-waste generated from the 'end of life' of its own products and historical waste available on the date from which these rules come in to force. Such financing system shall be transparent. The producer may choose to establish such financial system either individually or by joining a collective scheme.

(6) Providing contact details such as address, telephone numbers/helpline number and e-mail of dealers and authorized collection centers to consumer(s) or bulk consumer(s) so as to facilitate return of used electrical and electronic equipment.

(7) Creating awareness through publications, advertisements, posters, or by any other means of communication and information booklets accompanying the equipment, with regard to the following:

(i) Information on hazardous constituents in e-waste electrical and electronic equipment;

(ii) Information on hazards of improper handling, accidental breakage, damage and/or improper recycling of e-waste;

(iii) Instructions for handling the equipment after its use, along with the Do's and Don'ts;

(iv) Affixing the symbol given below on the products to prevent e-waste from being dropped in garbage bins containing waste destined for disposal;

6.2 Guidelines for importers

Importers of electronic and electric equipment are divided into two categories; importers of new units and importers of used units. Importers need to:

- Specify standards for products on the expected remaining lifespan of the equipments and electrical appliances.
- Notify DoE for consent to transport e-waste through Bangladesh subject to stated conditions

- State the number of years a computer has been in use before donation. The specifications should be stated according to the regulations on importation of pre-owned hand electronic equipment.
- Ensure used electrical and electronic goods reach the pre-destined end users. A record of customers should be kept to facilitate waste collection e.g. schools.
- Indicate an envisaged lifespan of used units when importing used equipment and bear responsibility for this by ensuring that take back mechanisms are in place.
- Desist from importing hazardous e-waste.

6.3 Guidelines for assemblers

Assemblers should:

- Label the constituents of products for easy identification
- Indicate Extended Producer Responsibility on electrical and electronic equipment.
- Abide by Bangladeshi standards on the assembly of electronic goods.

6.4 Guidelines for refurbishers

Every refurbisher shall ensure that the e-waste thus collected is safely transported back to authorized collection centre or registered recyclers as the case may be. The refurbishers extend the functional life of equipment and feed it into the second-hand market. Refurbishers need to:

- Ensure unusable material should go to a licensed disposer.
- Ensure waste plucked out of the equipment will go to the recycler.
- Provide incentives to the consumer to donate used devices.

6.5 Guidelines for recyclers

These are organizations and individuals who dismantle, separate fractions and recover material from e-waste after the lifespan of the equipment. Recyclers need to;

- Establish recycling infrastructure and environmentally sound technologies to manage electrical and electronic waste.
- Ensure that dismantling is done in an environmentally safe manner.
- Provide recycling processes to be approved and licensed by DoE.
- Ensure that revenue generated through sales of the materials recovered will support the administrative, plant and machinery and other overheads.

6.6 Guidelines for government organizations

These are the organizations that are involved in the formulation and enforcement of regulations regarding generation, handling and disposal of e-waste. They include DoE under MoEF. Government organization need to:

- Prepare a framework with appropriate legislation to support e-waste management.
- Monitor the processes of e-waste handling regularly
- Create a management plan with responsibilities for different target groups.
- Provide incentives to entrepreneurs to set up e-waste collection and treatment facilities
- Regulate / control the number of e-waste facilities within a geographical area
- Approve innovative e-waste management technologies that are environmentally sound
- Form multi-stakeholder monitoring committees to oversee the implementation of the e-waste management guidelines
- Create awareness among all the stakeholders through the legislative frame work of e-waste management
- Develop standards to prevent the importation and donations of useless or harmful e-waste

- Determine the impact of and come up with strategies for managing technology changes such as analogue-to-digital television equipment and deciding the procedure for Strategic Environmental Assessments

6.7 Guidelines for consumers

The consumer can either be an individual or a corporate organization that owns a device which falls into one of the e-waste categories and which is considered to have ceased to be of any value. Consumers need to:

- Separate e-waste from other wastes to facilitate collection, treatment and recycling
- Dispose e-waste generated to the e-waste collection centers
- Sell or donate e-waste to licensed refurbishers
- Take back equipment to the manufacturer, importer or assembler, if they allow it
- Dump e-waste at the licensed dumping site specified for the e-waste
- Be responsible for following recommended disposal methods or procedures especially dates of expiry or end of usage period of the product

6.8 Guidelines for educational institutions

Educational institutions can be those associated with basic education or higher education. They are recipients of electrical and electronic goods. Unfortunately, most of the second hand products are not inspected before they are donated. Coupled with poor handling and use, their lifespan becomes shorter resulting in huge amounts of e-waste in most learning institutions. In order to manage e-waste, learning institutions need to:

- Create awareness and conduct sensitization campaigns on responsible e-waste management
- Develop Memorandum of Understandings (MoUs) with PROs for take-back, recycling and refurbishing of e-waste at life-end
- Develop mechanisms to ensure that inspection certificates clearly specify end-of-life date and who bears responsibility thereafter
- Develop and mainstream e-waste education in curricula

6.9 Guidelines for transporters

Transporters need to:

- Ensure e-waste is properly stored
- Ensure vehicles transporting e-waste obtain a waste transport license from DoE.
- Ensure e-waste is disposed in licensed dumping sites

6.10 Guidelines for disposal authorities

Disposal authorities (Local Governments and City Corporations) need to:

- Develop disposal standards for each type of toxic waste, including procedures for disassembling and recycling
- Provide efficient transport for e-waste
- Develop proper infrastructure for e-waste collection and disposal
- Set manageable fees to sustain e-waste management

6.11 Guidelines for informal sector e-waste collectors

Informal sector e-waste collectors will only need to acquire a license if they collect e-waste from various sources

6.12 Guidelines for people living near dumpsites

People living near dumpsites need to be educated on how to detect potential health hazards, through organized community based discussion by the e-waste management stakeholders and environmental health practitioners

CHAPTER 7

GUIDELINES FOR E-WASTE COLLECTION SYSTEMS

These general guidelines seek to implement the 4Rs, (Reduce, Repair, Reuse and Recycle) to effectively minimize e-waste. The proposed recommendations are presented in figure 3.

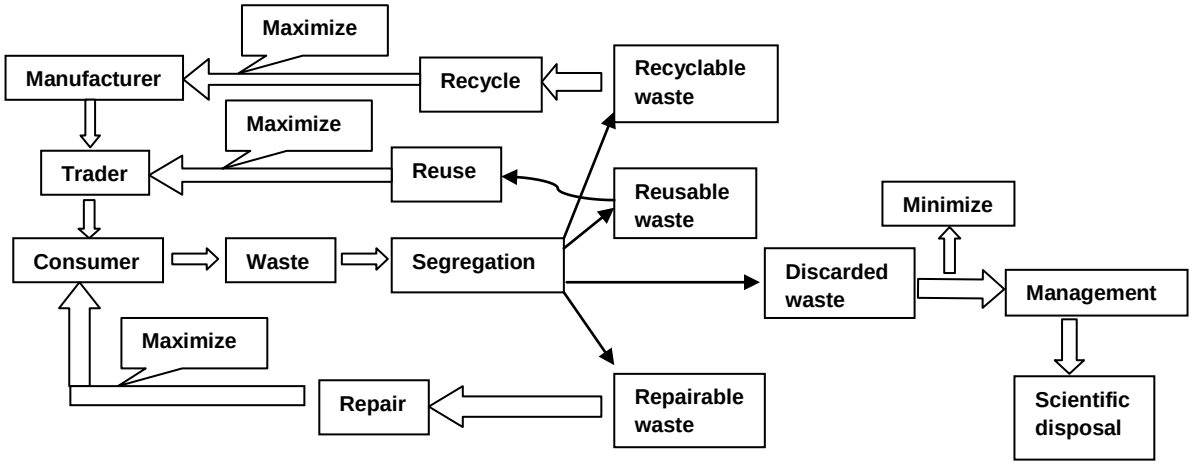

Figure 3: Electrical and electronic waste management chain

7.1 General guidelines

- Collection mechanisms for e-waste in terms of packaging, labeling and transportation shall be as per the Electrical and Electronic Waste (Management and Handling) Rules 2011
- Collection centers shall be established by producers/dealers, manufacturers, importers and distributors. They shall seek approval from DoE and Local Authorities and their details shall be publicized for public use
- Collection centers shall store the e-waste after sorting it into various categories for easier access by downstream users as well as to facilitate record keeping on the quantities of various categories of waste
- Producers / dealers, manufacturers, importers and distributors have to enroll in an e-waste collection scheme by virtue of the fact that they introduce electrical and electronic equipment into the environment
- Producers / dealers, manufacturers, importers and distributors should have the extended producer/manufacturer responsibility to ensure that at the end-of-life span of the equipment, the disposal is managed responsibly.
- Department of Environment (DoE) with other relevant key government stakeholders will regulate the collection, recycling, refurbishing and disposal of e-waste.
- Records of licensed facilities as well occupational health and safety concerns of various facilities will be monitored by DoE.
- Awareness creation on delivery mechanisms of waste to these centers shall be the responsibility of the producers, local authorities, distributors and importers.

7.2 Guidelines for selection of collection methods

These collection systems have been described in terms of the collection methods and infrastructure required to make these channels operational. The commonly used collection channels are municipal collection sites, retailer take-back, and producer take-back. The collection mechanisms are described below.

7.2.1 Retailer take back and storage

- Consumers take back e-waste to retail stores that distribute similar products
- Consumers may give back the product at the retail store depending upon purchase of a new product, or without any purchase required
- Distributors may also provide take back schemes to ensure availability and accessibility of free of charge of designated collection facilities
- Take back fees may be included in the cost of sale and refunded on delivery/return

7.2.2 Producer take back and storage

- It usually applies to larger commercial equipment and operates on the principle of "new equipment replacing the old ones"
- E-waste is taken back by producers either directly at their facilities or designated collection centers that fed into the e-waste system
- The collected waste is stored on site to be transported for treatment elsewhere or on the site

7.2.3 Municipal collection and storage

- Consumers and businesses should be able to leave e-waste at separate municipal collection bins
- Sorting containers should be provided at Municipal collection site
- The collected waste should be stored on-site or directly fed into the e-waste treatment system

7.2.4 Other collection points

- E-waste can be dropped at specially created sites or centers
- There can be specialized sorting centers controlled such as Producer Responsibility Organization (PRO) or third party sites, whose operators may be remunerated for the provision of space

7.3 Guidelines for establishing collection and storage infrastructure

The operation of a collection system described above requires storage and transportation infrastructure. Collection infrastructure requires establishment of e-waste collection points and storage areas. The following are guidelines for establishing collection points and storage areas:

- Collection points and storage areas should provide sorting infrastructure to effectively separate e-waste from other municipal waste
- Collection facilities should be available and accessible taking into account the population density
- Collection and transport of separated e-waste should be done in such a way that enables reuse and recycling of those components or whole appliances
- Sites for storage of e-waste prior to their treatment should have impermeable surface for appropriate areas with the provision of spillage collection facilities and where appropriate, decanters and cleanser-degreasers
- Sites for storage of e-waste prior to their treatment should have weatherproof covering for appropriate areas

7.4 Guidelines for design and technical specifications of e-waste collection points

A Licensed Collection Facility (LCF) should:

- Enable household e-waste to be collected from the LCF in streams of either large household appliances other than cooling appliances and display equipment containing CRTs amongst other waste
- Be accessible to the public

- Have signs to direct members of the public to deposit e-waste to the relevant container or area prevent mixing of e-waste with other waste or allow contamination with hazardous material
- State the maximum quantity that can be deposited on the site
- Have impermeable surface with a sealed drainage and impermeable drains which do not leak to ensure that all liquids are in a sealed sump except where they may be lawfully discharged
- Have a weatherproof cover
- Have a Collection Point and Storage Facility adequate to serve the geographical area and the volume of separated e-waste tonnage captured
- Have adequate collection points and storage facilities to serve the population size
- Be located where it meets the requirements of the collection option identified (i.e. retailer take back collection centre, municipal collection centre or other) and able to handle the number of trucks or trailers of different capacities required to transport the e-waste

7.5 Guidelines for operation of Producer Responsibility Organizations

Producer Responsibility Organizations are that take the responsibility for the end-of life disposal of products being manufactured or assembled. They can be established with the support of all manufacturers largely responsible for the management of e-waste in an environmentally sound manner. Manufacturers should implement take-back policies for used devices to ensure that they do not turn into waste.

7.5.1 About the PRO Structure

- The PRO will be expected to operate as a non-profit committee built on the philosophy of Corporate Social Responsibility (CSR) and be an active participant in this sector
- The cost of establishing these structures shall be supported by the manufacturers. The details on the contribution made by individual companies can be worked out through detail deliberation. A part of revenue can also be generated through the sale of the e-waste by the recycler
- The PRO should operate with all stakeholder participation (including representatives of the informal sector) and with full operational transparency to ensure efficacy in its implementation

7.5.2 Roles of Producer Responsibility Organization

- The Producer Responsibility Organization will have overall responsibility for the complete recycling process of e-waste with different levels of engagement in various processes
- The PRO will take on direct responsibility of collection and storage of all waste resulting from electrical and electronic equipments generated across the country and then passes this on to the dismantler/recycler for a price
- The nature of goods being classified as e-waste, have an intrinsic material value and this value is key to the complete financial plan of this structure. It is a globally accepted fact that e-waste has a material value assigned and all recyclers, big or small, procure electronic wastes at a price and then make profits by selling the recovered materials
- This structure suggests provision of incentives to the manufacturers to be active participants and streamline the storage and collection system to an authorized agency that will handle the e-waste
- The PRO will pay the manufacturers for the material collected and provide free collection system. The dynamic fee system for different end-of-life products will be fixed by the PRO and will be open to review at periodic intervals. This will give an option to vary the monetary value attached to it according to the prevailing market values of the materials extracted

- The revenue generated by PRO through sales of this e-waste to the recyclers will be utilized for financing the take back process from the consumers (cost paid for the e-waste) as well as the collection and storage of the waste
- Dealers selling such household products will have to take back the old products and the household manufacturers will get a discount on new purchase of electrical and electronic goods (the end-of-life cost can be fixed according to product type). These products will be then transferred back to the PRO with proper reporting

Systematic flows of e-waste management that result when most of the products reach their end of life are shown in the following figure.

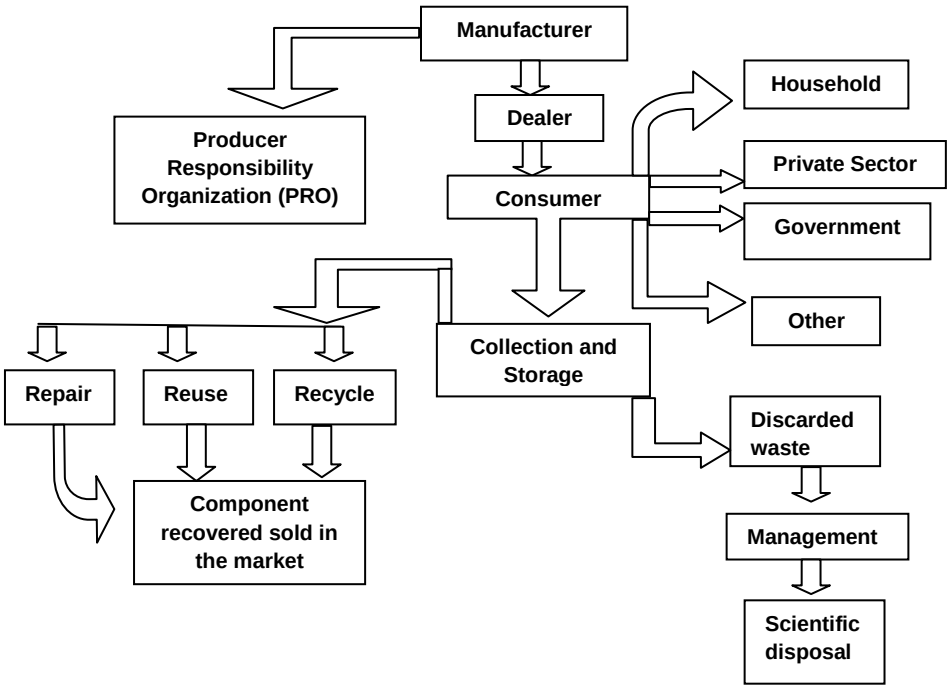

Figure 4: E-waste management (best practice management) flow chart

CHAPTER 8

GUIDELINES FOR E-WASTE TREATMENT TECHNOLOGY

The presence of hazardous elements and compounds in e-waste offers potential for increasing the intensity of their discharge in the environment due to land-filling and incineration. Therefore, a recommended approach to treating e-waste is to first reduce the concentration of these hazardous chemicals and elements and finally dispose e-waste fractions through either incineration or landfilling or a combination of both.

The e-waste treatment options should include the following unit operations:

a. ***Decontamination or Dismantling*:** This is done manually and will include;
   i. Removal of parts containing hazardous/ dangerous substances (CFCs, Mercury, switches, PCBs).
   ii. Removal of easily accessible parts containing valuable substances (cables containing copper, steel, iron, and precious metals, e.g. contacts)
   iii. Segregation of hazardous/ dangerous substance and removal of easily accessible parts
b. ***Segregation of ferrous metals, non-ferrous metals and plastics*:** This separation is generally carried out after shredding and is followed by a mechanical and magnetic separation process.
c. ***Recycling or recovery of valuable materials*:** E-waste fractions after segregation consisting of ferrous and non-ferrous metals are further treated. Ferrous metals are smelted in electrical arc furnaces whereas non-ferrous metals and precious metals are smelted in smelting plants.
d. ***Treatment or disposal of dangerous materials and waste*:** Shredded light fractions are disposed of in landfill sites or sometimes incinerated, CFCs are treated thermally, Poly Chlorinated Biphenyls (PCBs) are incinerated or disposed of in underground storages, Mercury (Hg) is often recycled or disposed of in underground landfill sites

8.1 Guidelines for development of e-waste treatment technology

An e-waste treatment process should include the following components;

- Testing of e-waste product in order to sort reusable and non-reusable e-waste separately
- Disassembling non-reusable e-waste and sorting e-waste fractions into reusable and non reusable parts
- Size reduction, separation and recovery of different materials from non-reusable e-waste
- Disposal of the remaining e-waste fractions

A detailed e-waste treatment system falls in a hierarchy of three levels:

- First level treatment
- Second level treatment and
- Third level treatment

All the three levels of e-waste treatment systems are based on material flow from first level to third level treatment. Each level treatment consists of unit operations where e-waste is treated and the output of first level treatment serves as input to second level treatment. After the third level treatment the residues are disposed off either in hazardous waste landfill or incinerated. The simplified flow diagram for e-waste treatment is given in the following figure.

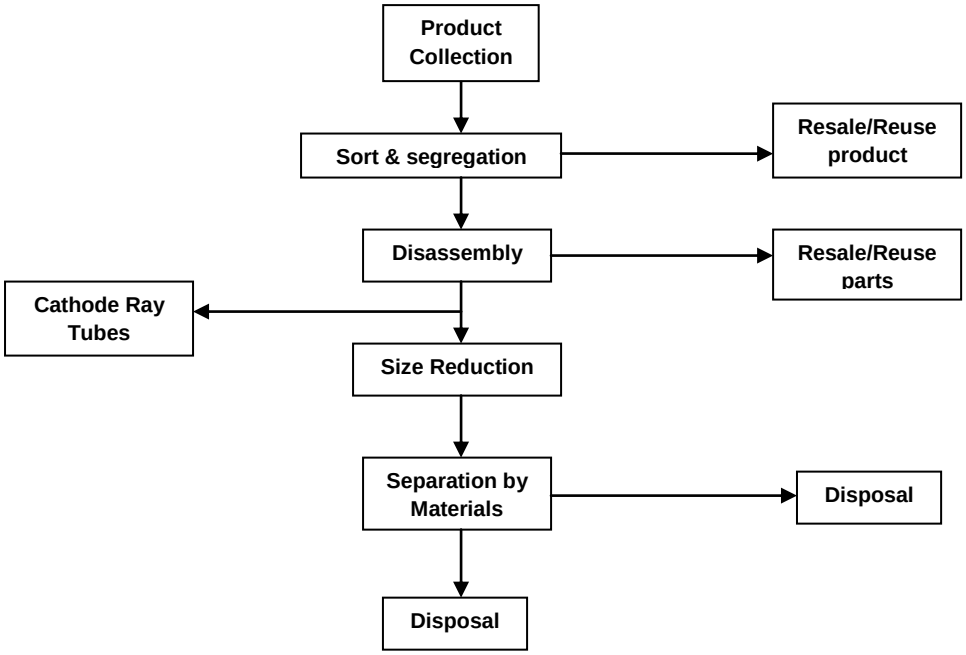

Figure 5: Generalized E-waste treatment process

8.1.1 Guidelines for development of first level e-waste treatment

Inputs: They include e-waste items like TVs, refrigerators and Personal Computers (PCs).

Unit Operations: There are three unit operations at first level of e-waste treatment. These are:

1. ***Removal of all liquids and gases:*** The first treatment step is to decontaminate e-waste and render it non hazardous. This involves removal of all types of liquids and gases under negative pressure, their recovery and storage.
2. ***Dismantling (manual or mechanized breaking):*** The decontaminated e-waste or the e-waste requiring no decontamination is dismantled to remove the components from the used equipments. The dismantling process could be manual or mechanized requiring adequate safety measures to be followed in the operations.
3. ***Segregation:*** After dismantling the components are segregated into hazardous and non hazardous components of e-waste fractions to be sent for third level treatment. All the three unit operations are dry processes, which do not require usage of water.

Outputs:

- Segregated hazardous wastes like CFCs, Hg, Switches, batteries and capacitors
- Decontaminated e-waste consisting of segregated non-hazardous e-waste like plastics, CRTs, circuit boards and cables
- Emissions that include air, water, noise

8.1.2 Guidelines for development of second level e-waste treatment

Inputs: Decontaminated e-waste consisting segregated non hazardous e-waste like plastic, circuit board and cables.

Unit Operations: There are three unit operations at second level of e-waste treatment;

1. Hammering: Size reduction
2. Shredding: Size reduction
3. Special treatment processes comprising of;
   - CRT treatment consisting of separation of funnels and screen glass
   - Electromagnetic separation
   - Eddy current separation
   - Density separation using water

Outputs: Materials from the second level treatment technology include.

- Ferrous metal scrap (secondary raw material)
- Non ferrous metal scrap mainly copper and aluminium
- Precious metal scrap mainly silver, gold and palladium
- Plastic consisting of sorted plastic, plastic with flame retardants and plastic mixture.

8.1.3 Guidelines for development of third level e-waste treatment

This is carried out mainly to recover ferrous and non-ferrous metals, plastics and other items of economic value. The major recovery operations focus on ferrous and non ferrous metal recovery, which is either geographically carried out at different places or in an integrated facility.

Plastic recycling

There are three different types of plastic recycling options i.e. mechanical recycling chemical recycling, and thermal recycling.

- In chemical recycling process, waste plastics are used as raw materials for petrochemical processes or as reductant in a metal smelter.
- In mechanical recycling process, shredding and identification process is used to make new plastic products.
- In thermal recycling process, plastics are used as alternative fuel.

The two major types of plastic resins, which are used in electronics, are “thermo sets” and “thermoplastics”. Thermo sets are shredded and recycled because they cannot be re-melted and formed into new products, while thermoplastics can be re-melted and formed into new products. Recycling options for managing plastics from end of life electronics are shown in following figure.

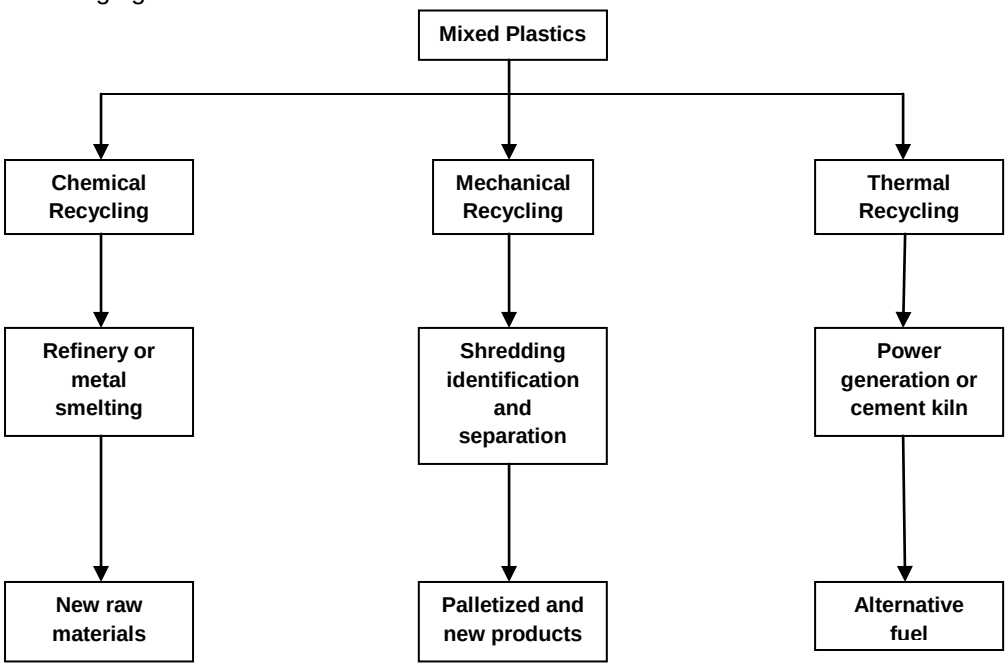

Figure 6: Recycling for managing plastics from end-of-life electronics

Mechanical recycling process

- The first step is the sorting process, where contaminated plastics such as laminated or painted plastics are removed.
- Shear-shredder and hammer mills are generally used for size reduction and liberation of metals (coarse fraction) followed by granulation and milling for further size reduction.

- Magnetic separators are used for ferrous metals separation, while eddy current separators are used for non ferrous metals separation.
- Air separation system can be used to separate light fractions such as paper, labels and films.
- Resin identification can be carried out by using a number of techniques like turboelectric separator, high speed accelerator and X-ray fluorescence spectroscopy.
- X-ray fluorescence spectroscopy is effective in identifying heavy metals as well as flame retardants.
- After identification and sorting of different resins, they are extruded and palletized.

Chemical recycling process

Mixed plastic waste is de-polymerized, de-halogenated, metals removed and hydrogenated to produce high quality products like off gas and syncrude obtained by hydrotreatment, which are sent to the petrochemical process.

Thermal recycling process

Plastics recovered in the second level treatment are used as fuel to provide energy. Since plastics have high calorific value, which is equivalent to or is greater than coal, they can be combusted to produce heat energy in cement kilns.

Metals recycling

Metal recycling includes lead recycling, copper recycling and precious metals recycling. After sorting of metal fractions at second level e-waste treatment, they are sent to metal recovery facilities.

CHAPTER 9

GUIDELINES FOR ESTABLISHMENT OF UNIT TREATMENT FACILITY, AN INTEGRATED RECYCLING TREATMENT FACILITY AND DISPOSAL SITES FOR E-WASTE

The establishment of e-waste Recycling & Treatment Facilities shall be in line with the Electrical and Electronic Waste (Management and Handling) Rules 2011 requirements applicable for establishing and operating Recycling, Treatment and Disposal Facilities. The e-waste facility should meet the following guidelines:

9.1 General Guidelines for setting-up and management of a unit treatment facility or an integrated e-waste facility

Any processing and recycling facilities that receive designated materials must ensure:

- Facility is fully licensed by all appropriate governing authorities
- An Environment Impact Assessment (EIA) is undertaken and an EIA license issued
- Facility is registered as a recycler under the Electrical and Electronic Waste (Management and Handling) Rules 2011
- Facility should have obtained approvals under the Bangladesh Environment Conservation Act 1995 and Environment Conservation Rules 1997
- Facility takes sufficient measures to safeguard occupational and environmental health and safety
- Facility has a regularly-implemented and documented monitoring and recordkeeping program that tracks key process parameters, compliance with relevant safety procedures, effluents, emissions, stored incoming and outgoing materials and waste
- Facility has an adequate plan for closure. The need for closure plans and financial guarantees is determined by applicable laws and regulations, taking into consideration the level of risk

9.2 Guidelines for facility operation requirements

The facilities can exist as a separate unit operation or as an integration of all unit operations under one roofing. The key facility operation units include;

- An effective collection channel and infrastructure
- Adequate storage area
- An elaborate dismantling and segregation section
- A recycling plant / unit
- A Treatment and Disposal unit

9.2.1 Guidelines for collection systems for e-waste

- The collection systems shall be in line with the guidelines provided in Chapter 7
- The individual producers can have direct contact with dismantlers or recyclers to get back the re-usable components from their obsolete equipments for use in production.
- The system may charge fees, provide free collection or provide discount on purchase of new.

9.2.2 Guidelines for storage areas

- The location can be within the facility (on site) or outside the facility (off site)
- It should be well covered to store waste until it is recycled or treated
- The covering should be weatherproof to minimize the contamination of clean surface and rain waters. It will also facilitate the reuse of whole appliances and components intended for recycling and to assist in the containment of hazardous materials and fluids
- The type of weatherproof covering required will depend on the types and quantities of waste and the storage and treatment activities undertaken

- E-waste items should be separated and kept in appropriate well marked containers
- The storage area should have impermeable surfaces and a sealed drainage system. This will ensure that no liquid will run off the pavement and all liquids entering the system are collected in a sealed sump
- Spillage collection facilities should be provided. They should include the impermeable pavement and sealed drainage system as the primary means of containment
- An appropriate storage site should be provided for disassembled spare parts (e.g. motors and compressors) that contain oil or other types of fluids. They should be stored in containers that are secured that will not allow oil and other fluids to escape with an impermeable surface and a sealed drainage system
- Components and residues arising from the treatment of e-waste should be contained for disposal or recovery. If they contain hazardous substances they should be stored on impermeable surfaces and in appropriate containers or bays with weatherproof covering
- Containers should be clearly labeled to identify their contents and must be secure from liquids and rainwater seepage
- Components should be segregated having regard to their eventual destinations and the compatibility of the component types
- Batteries should be handled and stored with a clear knowledge of their potential fire risk

9.2.3 Guidelines for dismantling and segregation of dismantled parts

Dismantling and segregation are the first steps towards recycling of the e-waste. These are cost effective and labor intensive activities and are mostly carried out in the informal sector which needs to be brought into mainstream recycling. E-waste segregation involves separation of equipment according to its level of difficulty to dismantle, and its hazardousness. Segregation can be done either before the equipment is dismantled or after.

- Dismantling of e-waste may be carried out manually or mechanically depending upon the scale of operations and the e-waste being handled
- Manual dismantling should only involve used electronic and electrical equipments where there is no likelihood of contact with hazardous substances
- An integrated facility should provide a mechanical dismantling facility to dismantle e-waste containing hazardous substances
- Sorting of waste is encouraged at source to enable easier identification and access to particular waste streams
- Identification will be carried out in three categories;
    1. Items in good condition that can be reused
    2. Items that can be repaired/refurbished
    3. Items for dismantling for recovery or disposal
- Dismantling shall be carried out after verification that items are no longer usable
- The electrical components are dismantled, classified and broken apart.
- Removal of parts containing dangerous substances; removal of easily accessible parts containing valuable substances (cable containing copper, steel, iron, precious metal containing parts, e.g. contacts).
- Useful parts can be recovered and sold to the second hand market for some profit (or donated) as refurbished.
- Occupational health and safety concerns of facilities for storage and dismantling of the equipment shall be as per the stipulated Occupational Safety and Health regulation set by ILO.
- DoE shall monitor the facilities through control environmental audits to determine the handling facilities in terms of physical status and mitigation measures in place to ensure safety of workers as well as protection of the environment.

9.2.4 Guidelines for recycling and recovery of e-waste

Recycling is encouraged at a formal level where all institutions shall ensure that e-waste is collected and delivered to the designated collection centers. E-waste recycling is expensive and the costs are not necessarily covered by the resale of recovered materials.

- DoE in collaboration with relevant lead agencies shall register and recognize collection schemes as well as recycling centers for regulation through licensing
- DoE in collaboration with the Bangladesh National Board of Revenue (NBR) may have to introduce an Advanced Recycling Fee (ARF) for products which will eventually become part of the e-waste stream as part of import levy
- This fee will be submitted by the supplier to NBR which will in turn dispatch to the association to run collection centers as well as partly fund end–of–life recycling. Certain items, such as CRTs, may attract a higher ARF due to greater recycling costs
- The supplier will be required to supply records of the amounts collected for this purpose to the government
- An integrated e-waste recycling facility should opt for the Best Available Technologies (BAT) and provide the state of the art facility complying with all the environmental laws in the terms of emissions, effluents, noise, waste treatment and disposal amongst others

9.2.5 Guidelines for developing a treatment and disposal unit

- Provisions should be made of equipment for the treatment of water, including rainwater, in compliance with health and environmental regulations. Operators of treatment facilities should take appropriate steps to minimize the contamination of clean waters.
- Impermeable surfaces should be provided for appropriate areas. The impermeable surface should be associated with a sealed drainage system and may be needed even where weatherproof covering is used.
- Spillage collection facilities that include the impermeable pavement and sealed drainage system as the primary means of containment should be provided. However, spill kits to deal with spillages of oils, fuel and acids should be provided and used as appropriate.
- Records should be maintained on the treated waste to inform on e-waste entering a treatment facility and components and materials leaving each site (together with their destinations).

9.3 Guidelines for e-waste disposal sites

- Disposal should be done in specialized cells or sections in a licensed landfill site
- Owners / operators of disposal sites shall be licensed by DoE and Local Authorities
- Owners / operators must demonstrate technical knowledge and understanding of the hazardous nature of e-waste
- Disposal sites shall be published after licensing for the general public is aware of the existence of the same
- Purchasing is strictly prohibited as contaminants may easily leach into the soil and pollute both soil and groundwater resources
- Disposal shall be paid for and the disposer shall be issued with a certificate of safe disposal.
- Disposers shall keep a record of the amounts and categories of waste which DoE may access upon request or during inspection of e-waste handling facilities
- Incineration of unusable disposable parts is not recommended in the country due to the unsuitability of existing incineration facilities. In future, development of incinerators will include compulsory installation of waste gas purification systems to deal with dioxins and furans in incineration flue gas.