Electronic Waste (E-waste) Management Plan -January 2022

Electronic Waste (E-waste) Management Plan (E-Waste Management Plan/EWMP)

1. Considerations on Waste Management

The African Union Commission (AUC) will manage environmental and social risks and impacts of the project throughout the project life cycle in a systematic manner, proportionate to the nature and scale of the project and to the potential risks and impacts. The generation of waste is one of those risks that must be considered during the preplanning and implementation phases of the project. Waste management planning for the project should be conducted early as possible to identify sound management practices and procedures within legal and environmental frameworks. Possible waste streams that may be generated during project implementation may include papers and electronic wastes. However, the focus of this plan is on Electronic waste or E-waste. An E-Waste Management Plan (EWMP) is used to describe the waste management related issues within the Electrical and Electronic Equipment (EEE) industry sector and specify the best way to address these issues, giving specific actions, targets, and timeframes. This E-waste management plan should be implemented throughout the project's lifecycle to protect the environment, biodiversity, and habitats, safeguard the health of the local communities, and comply with The World Bank Environment, Safety and Health Guidelines (ESHG) Environmental and Social Standards (ESS), Tunisian legislations and regulations, and Good International Industry Practice (GIIP).

1.1. E-waste definition and general considerations

Waste electric and electronic equipment (WEEE) is referred to as e-waste or electronic waste and it is defined as any end-of-life or end-of-use piece of "equipment which is dependent on electrical currents or electromagnetic fields in order to work properly". It covers a broad range of electronic devices, ranging from large household appliances, information technology and telecommunications equipment, lighting equipment, medical devices, monitoring and control instruments, automatic dispensers, and consumer electronics, such as electrical and electronic tools, toys, leisure and sports equipment, and mobile phones to computers. Components of electric and electronic equipment (EEE), such as batteries, electric cables from end-of-life vehicles (ELVs), printed circuit boards (PCBs), plastic casings, cathode-ray tubes (CRTs), activated glass, and lead capacitors are also classified as e-waste. Possible WEEE to be covered by this project may include computers, scanners, printers, servers, copiers, electric cables, cell phones, backup generators, etc. E-waste contains materials that, if mishandled, can be hazardous to human health and the environment, but, most importantly, also materials that are valuable and scarce.

E-waste is one of the fastest growing waste streams worldwide, growing at a rate of 3–5% per year simply because of the market demand. The market demand for production of EEE is continuously increasing, but the life span/replacement interval of such products continues to decline in the course of technological evolution. The proper treatment of e-waste avoids negative impacts and yields many benefits. E-waste, if not properly treated, can have negative impacts, both on human health and on the environment. However, sustainable treatment of e-waste avoids these negative impacts.

The appropriate handling of e-waste can both prevent serious health and environmental damage and recover valuable materials, especially for common metals and precious metals. The recycling chain for e-waste is classified into three main subsequent steps: i) collection; ii) sorting/dismantling and pre-processing (including sorting, dismantling and mechanical treatment); and iii) end processing. All three steps should operate and interact in a holistic manner to achieve the overall recycling objectives.

The main objectives of sustainable e-waste recycling are: i) Treat the hazardous fractions in an environmentally sound manner; ii) Maximize the recovery of valuable materials; iii) Create eco-efficient and sustainable business; iv) Consider social impact and local context; and v) Capacity building through strong communication and knowledge sharing.

1.2 Toxicity and radioactive nature of E-waste to human, water, soil, and animals

Electrical and electronic equipment contain different hazardous materials, which are harmful to human health and the environment if not disposed of carefully. While some naturally occurring substances are harmless in nature, their use in the manufacture of electronic equipment often results in compounds, which are hazardous (e.g. chromium becomes chromium VI). Lead, mercury, cadmium, and polybrominated flame retardants are found in electronic equipment and are all persistent, bio-accumulative toxins (PBTs). They can create environmental and health risks when computers are manufactured, incinerated, landfilled, or melted during recycling. PBTs, in particular are a dangerous class of chemicals that have longevity in the environment and bioaccumulate in living tissues. PBTs are harmful to human health and the environment and have been associated with cancer, nerve damage and reproductive disorders. Table 1 depicts a selection of the most common toxic substances in E-waste.

Table 1. Toxic Substances in E-waste

Substance	Occurrence in E-waste
Halogenated compounds	
PCB (polychlorinated biphenyls)	Condensers, Transformers
TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation) TBBA is presently the most widely used flame retardant in printed circuit boards
Chlorofluorocarbon (CFC)	Cooling unit, Insulation foam
PVC (polyvinyl chloride)	Cable insulation
Heavy metals and other metals:	
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
Barium	Getters in cathode ray tubes (CRTs)
Beryllium	Power supply boxes which contain silicon-controlled rectifiers and x-ray lenses
Cadmium	Rechargeable computer batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)

Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards, television sets, PC monitors, light bulbs, lamps
Lithium	Li-batteries
Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
Selenium	Older photocopying-machines (photo drums)
Zinc sulphide	Interior of CRT screens, mixed with rare earth metals

Arsenic

Arsenic is a poisonous semi-metallic element, which is present in dust and soluble substances. Chronic exposure to arsenic can lead to various diseases of the skin and decrease nerve conduction velocity. Chronic exposure to arsenic can also cause lung cancer and can often be fatal.

Barium

Barium is a metallic element that is used in sparkplugs, fluorescent lamps, and "getters" in vacuum tubes. Being highly unstable in the pure form, it forms poisonous oxides when in contact with air. Short-term exposure to barium could lead to brain swelling, muscle weakness, damage to the heart, low blood potassium, cardiac arrhythmias, respiratory failure, gastrointestinal dysfunction, paralysis, muscle twitching, and elevated blood pressure, liver, and spleen. Animal studies reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time.

Beryllium

Beryllium has recently been classified as a human carcinogen because exposure to it can cause lung cancer. The primary health concern is inhalation of beryllium dust, fume, or mist. Workers who are constantly exposed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (beryllicosis), a disease that primarily affects the lungs. Beryllium can also affect organs such as the liver, kidneys, heart, nervous system, and the lymphatic system, may develop beryllium sensitization or chronic beryllium disease. Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps. Studies have shown that people can still develop beryllium diseases even many years following the last exposure.

Brominated flame retardants (BFRs)

The 3 main types of BFRs used in electronic and electrical appliances are Polybrominated biphenyl (PBB), Polybrominated diphenyl ether (PBDE), and Tetrabromobisphenol - A (TBBPA). Flame-retardants make materials, especially plastics and textiles, more flame resistant. They have been found in indoor dust and air through migration and evaporation from plastics. Combustion of halogenated case material and printed wiring boards at lower temperatures releases toxic emissions including dioxins, which can lead to severe hormonal disorders. Major electronics manufacturers have begun to phase out brominated flame-retardants because of their toxicity.

Cadmium

Cadmium components may have serious impacts on the kidneys. Cadmium is adsorbed through respiration but is also taken up with food. Due to the long half-life in the body, cadmium can easily be accumulated in amounts that cause symptoms of poisoning. Cadmium shows a danger of cumulative effects in the environment due to its acute and chronic toxicity. Acute exposure to cadmium fumes causes flu-like symptoms of weakness, fever, headache, chills, sweating and muscular pain. The primary health risks of long-term exposure are lung cancer and kidney damage. Cadmium also is believed to cause pulmonary emphysema, possibly reproductive damage, and bone disease (osteomalacia and osteoporosis).

CFCs (Chlorofluorocarbons)

Chlorofluorocarbons are compounds composed of carbon, fluorine, chlorine, and sometimes hydrogen. Used mainly in cooling units and insulation foam, they have been phased out because when released into the atmosphere, they accumulate in the stratosphere and have a deleterious effect on the ozone layer. This results in increased incidence of skin cancer in humans and in genetic damage in many organisms.

Chromium

Chromium and its oxides are widely used because of their high conductivity and anti-corrosive properties. While some forms of chromium are nontoxic, Chromium (VI) is easily absorbed in the human body and can produce various toxic effects within cells. Most chromium (VI) compounds are irritating to eyes, skin, and mucous membranes. Chronic exposure to chromium (VI) compounds can cause permanent eye injury, unless properly treated, human carcinogens, impacts on neonates, reproductive and endocrine functions. Chromium VI may also cause DNA damage.

Dioxins

Dioxins and furans are a family of chemicals comprising 75 different types of dioxin compounds and 135 related compounds known as furans. Dioxins is taken to mean the family of compounds comprising polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Dioxins have never been intentionally manufactured but form as unwanted by-products in the manufacture of substances like some pesticides as well as during combustion. Dioxins are known to be highly toxic to animals and humans because they bio-accumulate in the body and can lead to malformations of the foetus, decreased reproduction and growth rates and cause impairment of the immune system among other things. The best-known and most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

Lead

Lead is the fifth most widely used metal after iron, aluminium, copper, and zinc. It is commonly used in the electrical and electronics industry in solder, lead-acid batteries, electronic components, cable sheathing, in the glass of CRTs etc. Short-term exposure to high levels of lead can cause vomiting, diarrhoea, convulsions, coma or even death. Other symptoms are appetite loss, abdominal pain, constipation, fatigue, sleeplessness, irritability, and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys. It is particularly dangerous for young children because it can damage nervous connections and cause blood and brain disorders.

Mercury

Mercury is one of the most toxic yet widely used metals in the production of electrical and electronic applications. It is a toxic heavy metal that bio-accumulates causing brain and liver damage if ingested or inhaled. In electronics and electrical appliances, mercury is highly concentrated in batteries, some switches and thermostats, and fluorescent lamps.

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a class of organic compounds use in a variety of applications, including dielectric fluids for capacitors and transformers, heat transfer fluids and as additives in adhesives and plastics. PCBs have been shown to cause cancer in animals. PCBs have also been shown to cause a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system, and other health effects. PCBs are persistent contaminants in the environment. Due to the high lipid solubility and slow metabolism rate of these chemicals, PCBs accumulate in the fat-rich tissues of almost all organisms (bioaccumulation).

Polyvinyl chloride (PVC)

Polyvinyl chloride (PVC) is the most widely used plastic, used in everyday electronics and appliances, household items, pipes, upholstery etc. PVC is hazardous because it contains up to 56 percent chlorine which when burned produces large quantities of hydrogen chloride gas, which combines with water to form hydrochloric acid and is dangerous because when inhaled, leads to respiratory problems.

Selenium

Exposure to high concentrations of selenium compounds cause selenosis. The major signs of selenosis are hair loss; nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).

1.3. Benefits from Sustainable E-Waste Management Practices

Sustainable management practices, i.e., recycling operations, also considerably contribute to reducing greenhouse gas emissions. Primary production of some metals that are constituent of E-waste usually contributes largely to greenhouse gas emissions, i.e., mining, concentrating, smelting, and refining, especially of precious and special metals have a significant carbon dioxide (CO_2) impact due to the low concentration of these metals in the ores and often difficult mining conditions. But, "mining" of old phones, servers, or old computers to recover the contained metals – if done in an environmentally sound or correct manner – needs only a fraction of energy compared to mining ores in nature. Recycling of E-Waste equipment reduces the amount of land that has to be set aside specifically as landfill sites which in turn can be used for far more productive and socially beneficial purposes such as low-income housing, farming, or renewable energy power supplies. Recycling means that less money and energy has to be expended for the mining of the various minerals, which are consumed during the manufacturing process to produce E-Waste equipment. The environmental footprint of a phone, computer, or any other electronic device can be significantly reduced if treated in an environmentally sound managed recycling operations, which prevent hazardous emissions and ensure that a large part of the contained metal(s) is finally recovered for a new life. This E-Waste Management plan does not include or mandates for the establishment of an E-Waste recycling infrastructure, but points in the direction that building a sustainable recycling infrastructure creates jobs and contributes to capacity building. The sustainable collection, sorting, manual dismantling, and pre-processing of e-waste could create a significant number of jobs in the country(ies) that would develop this activity.

2. E-Waste Management Plan (EWMP)

2.1. E-Waste management during the implementation phase

This Electrical Waste Management Plan (EWMP) will be implemented throughout the project's lifecycle and will follow and comply with the ESS1 and ESS3 of the Environmental and Social Framework of the World Bank. The plan is required to be adopted during the project implementation period when project financed electrical equipment (computers, printers, servers, cables, etc), backup generators, among others, are replaced, irreparable or at their end of life. This plan must also comply with existing Tunisian legislation and regulations, WB ESHG, and Good International Industrial Practice (GIIP).

2.1.1. Material recycling process

The material recycling processes of waste computer can be split into three steps: 1) dismantling or disassembling process; 2) preprocessing (mechanical process); and 3) recovery and refining process. Although this plan illustrates the resourceful recycling process of waste computers, the methodology of recycling for other electronic equipment of information and communication technology is almost similar.

2.1.1.1. Dismantling process

Dismantling is the systematic removal of components, parts, a group of parts or a sub-assembly from waste electronic equipment. The dismantling process itself is performed with simple tools such as screwdrivers, air drivers, hammers, tongs, and conveyor, in order to separate the materials and components into different categories (i.e., plastics, iron, steel, copper, printed circuit boards, etc.). Disassembling of waste computers makes the recycling process easy and efficient. Disassembling process breakdowns the computers into small components and materials, which make the packing, shipping, preprocessing and refining process easy and efficient. Although the manual disassembling process is not economically feasible in the developed countries because of the unavailability of workers and high wages, it is still viable in the developing countries and many parts in the world.

Computer case

Generally, the computer cases are disassembled manually to separate the main body (iron, aluminium, or plastic), power supplies, copper wires, cooling fans, CD drives, floppy disk drives, hard drives, memory modules, PCI cards, motherboards (PCBs), CPUs, etc.

Cathode ray tube (CRT) monitors

The CRT unit is mainly composed of different kinds of glass: panel glass, made of strontium/barium oxides in front of the monitor; funnel glass, leaded glass that covers the CRT unit; neck glass, highly leaded glass that covers the electron gun; and front glass, highly leaded glass that results from welding the funnel glass to the panel glass. Aside from the glass, the CRT unit contains a ferrous shadow mask and an electron gun. Waste CRT monitors cause a substantial portion of the regional and global electronic waste stream. CRT monitors possess nominal or negative scrap value as they contain leaded glass; therefore, CRT monitors are difficult and expensive to recycle. As a result, CRT monitors are usually transferred to be dismantled manually and discarded in safety regions of environmental protection.

Liquid crystal display (LCD) monitors

Disassembled components of LCD monitors of waste computers are classified in printed circuit boards (PCBs), cold cathode fluorescent (CCFL) tubes, LCD panel glasses, metals, speakers, plastics, and others. The plastics and metals can be recycled by existing technology transferring them to plastic recovery facility. CCFL tubes usually contain small quantities of mercury, and hence require special treatment. Therefore, CCFL tubes must be disassembled from the LCD module. This type of tube should be transferred to heavy metal (i.e., mercury) recovery facility after disassembling, yields no scrap value. The LCD panel glasses consist of a number of layers, which typically consist of 25 or more components. These include glass, foil, and liquid crystal compounds. The LCD panel glasses denote an environmental risk, and it is necessary to be disassembled from waste LCD monitors.

PCBs

PCB is an essential constituent of all electronic and electrical equipment that contains various metals such as copper (Cu), iron (Fe), lead (Pb), zinc (Zn), gold (Au), silver (Ag), palladium (Pd), platinum (Pt). The substrate of the PCBs is a thermoplastic material and epoxy resin with contents of flame retardants, which are not so easy to recycle. Most of the disassembled PCBs excluding power boards contain gold coatings, gold plated connectors, pins, small, medium, and large size IC chips, capacitors, slots, resistance, solder, Integrated Graphics Processor (IGP), Ball Grid Array (BGA) IC chips, and metal films. Typically, six types of PCBs can be categorized after dismantling waste computers and monitors. Type 1 is a PCB of HDD drive, Type 2 is a memory module, Type 3 is a PCI card, Type 4 is a PCB of LCD monitor, Type 5 is the motherboard and Type 6 is a lower grade PCBs or power board. The value of each scrap PCB is different and depends on the size and number of IC chips, small capacitors, gold pins, gold plated connectors, area of gold plates.

Identification of scrap metals

Different types of scrap metal are extracted from waste computers such as copper, aluminium, copper, magnesium, zinc, etc. Since the market value of these scrap metals is different, they should be separated at the time of the dismantling process. The scrap metals mined from waste computers can be separated into two categories by magnet test: ferrous and non-ferrous metals. Non-ferrous metals are typically more valuable than ferrous metals. Once the magnet test is finished, there are additional scratch tests that could be executed to distinguish the non-ferrous metal (i.e., aluminium, copper, stainless steel, etc.).

2.1.1.2. Preprocessing

Preprocessing or mechanical processing is an integrated part of e-waste recycling by shredding into small pieces using crusher and grinders. However, incineration and pyrolysis process of e-wastes are also considered mechanical processing. Metals and non-metals are separated during this stage using separation techniques such as screening, magnetic, eddy current and density separation techniques. Although this type of mechanical process makes the e-waste recycling faster and reduce the demand of workers, the unselective blending of plastic materials and different types of metal may reduce the recovery rate of metals especially the precious metals and rare metals. Various preprocessing techniques include: shredding and separation process, thermal treatment, pyrolysis, incineration, pulverizing, compressing, etc.

Although preprocessing is essential for disassembled scrap materials from waste computers, all the process (i.e., shredding, incineration, pulverizing, compressing, etc.) are not obligatory for each and every type of scrap material. Actual process selection of a preprocessing technique usually depends on material characteristics, scrap value, transportation, recovery, and refinery facilities. It is still a big challenge to select actual preprocessing for each and every material to enhance the value of e-waste scraps.

2.1.1.3. Recovery and refining process

Selection of further recovery and refinery process of disassembled scraps is also a big task in recycling business. Each type of scrap should be sent to a specialized recovery facility to yield maximum recovery efficiency. The final destination (recovery facility) should be selected on the basis of the metal composition of the scraps. The concentration of precious metals and base metals should be measured for each type of PCB. The higher-grade PCBs (contain a comparatively higher amount precious metals) should be shipped to a recovery facility, which specialized in the hydrometallurgical recovery of precious metals. Meanwhile, the lower grade PCBs (contain a very lower amount precious metals) should be transferred to a pyrometallurgical recovery facility.

2.2. Aim and objectives of the EWMP

The main aim is to achieve and maintain a sustainable and integrated E-Waste management plan that is effective and efficient to serve the sub projects within Tunisia funded through the proposed African Union Commission (AUC) Statistics Development and Harmonization Regional Project.

The overall objectives of the waste management plan are summarised below: (i) to assess the activities involved for the proposed project and determine the type, nature, and estimated volumes of waste to be generated; (ii) to identify any potential environmental impacts from the generation of waste at the project sites; (iii) to recommend appropriate waste handling and disposal measures in accordance with the current legislative requirements, WB ESHG, and GIIP; (iv) to strengthen capacity building and raise awareness to communities and firms on e-waste management risks and impacts.

2.3. E-Waste management legal framework, ESS, ESHG, and GIIP

2.3.1. Tunisian law

Since the IT equipment to be procured for this project are for use in the project offices and by project staff only, and the project offices will be at the StatAFRIC Headquarter based in Tunis, Tunisia, hence the EWMP is specifically for Tunisia. National policies and regulation regarding E-waste in Tunisia are still needed as current regulations target waste in general, especially in terms of encouraging the involvement of private operators. The general framework of environmental protection in Tunisia pertaining to waste, its management and disposal is governed by the general legislation: Law 1996-41 of 10.06.1996 on waste control, use and disposal which complies with the Basel International Treaty on transboundary movement and disposal of hazardous wastes.

Law 96-41 has three main objectives:

- Prevention and reduction of waste and its hazards, in particular at the level of production and distribution of products.
- Valorization of waste via reutilization, recycling and other actions aiming at recovery of reusable materials and their utilization as energy resources; and
- Resort to controlled landfills for discharge of residual waste, following exhaustion of all other possibilities of valorization.

Any contractor that is contracted to treat, handle, transport, store, dispose of, transit, trade in shall hold a Tunisian National Agency for Waste Management (ANGed) hazardous waste license/permit. Project related E-waste could end up in licensed disposal facilities for hazardous wastes or landfill site. However, any hazardous waste disposal using this method, the landfill must be managed in accordance with Environmental Management Regulations and the guidelines prescribed by the National or Local Authorities. There will be no transboundary movement of project related hazardous waste.

2.3.2. Environmental Social Standards (ESS)

The project will follow national legislation, WB ESHG, and GIIP for the management of E-waste. The project will avoid the disposal of E-waste by reuse, recycle, and recover. Where E-waste cannot be reused, recycled, or recovered then the project will treat, destroy, or dispose of E-waste in accordance with ESS 1 and ESS 3, and the guidelines prescribed by the National or Local Authorities. That is, when hazardous waste management is conducted by third parties, the project will use ANGed license hazardous waste contractors and all E-waste will be disposed of in hazardous waste landfill or licensed disposal facilities in accordance with the Environmental Management Regulations.

2.3.3. WB ESHG

The WB ESHG promotes waste prevention, reuse and recycling, good housekeeping, inventory control, avoidance of damage and instituting procurement measures that allow the return of reusable material. It requires the segregation of hazardous waste type from other waste, its appropriate storage (labelled containers) and record keeping. It allows collection, transport, and disposal in accordance with the Environmental Management Regulations. The WB ESHG also requires monitoring records for hazardous waste collected, stored, or shipped.

2.3.4. GIIP

GIIP promotes the use of an obligation on distributors to offer to consumers a take-back system where E-waste items can be disposed of free of charge. There are two types of take-back systems, and distributors of EEE items must offer one of these schemes to their customers. Examples include free in-store take-back scheme where distributors accept E-waste items from customers purchasing equivalent new items. Distributors take-back scheme where consumers can dispose of WEEE items free of charge at designated collection facilities. E-waste generators should manage and dispose of E-waste responsibly in ways already mentioned in the preceding paragraphs. In addition, when purchasing a new electrical item arrange with the retailer to collect the old one. Businesses and other users (i.e. schools, hospitals, and government agencies) of electrical and electronic goods (EEE) must ensure that all separately collected E-waste is treated and recycled.

2.4. E-Waste Mitigation Measure and Management/Disposal Plan

This E-waste management plan contains proposed mitigation measures through which all E-waste can be managed in accordance with national legislations, WB ESF, WB ESHG, and GIIP. The mitigation measures or guidelines have been designed in order to avoid, minimize, and reduce negative environmental and social impacts at the project level. The mitigation measures are presented in Table 3 in a descriptive format.

2.4.1. Procurement of electronic items of a high quality and from reputable retailers/sources

The first mitigation measure is to ensure that all electronic devices are procured from retailers and sources that are credible, that all devices will have a clear date of manufacture and warranty and the item is of a high quality. This will avoid procurement of poor quality, refurbished, or used second hand electronic devices with a shorter life cycle that leads to a rapid generation of E-waste. All items should be purchased where applicable, with protective covers and insurance. If possible, retailers or source of electronic items should be engaged where a repair, renewal, recycling or take back scheme option is offered. If the retailer or source does not offer some or all of these options, then the project is to locate legally licensed facilities that do repair or recycle electronic items. If such options do not exist, then disposal in licensed disposal facilities for hazardous wastes should follow the Environmental Management Regulations as prescribed by the National or Local Authorities.

2.4.2. Awareness and Sensitization

Awareness and sensitization of project staff who will use the electronic devices on the proper disposal once they become damaged, irreparable or at their end of life is vital. The project office should include in the sensitization the usefulness and significance of E-waste recycling, and the need for returning back all electronic items procured by the project to a collection centre that should be established. Also, project staff should be aware and sensitize on the fact that cell phones and computers do hold sensitive data/information, which present security risks if not properly disposed, and this can lead to lawsuits.

2.5. E-Waste Environmental Health and Safety Guidelines

2.5.1. Recommended Procedures for E-wastes Management Plan (EWMP)

2.5.1 General E-Waste Management

The following guidance applies to the management of non-hazardous and hazardous e-waste. Additional guidance specifically applicable to hazardous e-wastes is presented below. E-waste management should be addressed through an e-waste management system that addresses issues linked to e-waste, which include generation, waste management (reduction, reuse, recycling), transportation, disposal, and monitoring.

As part of the E-waste Management Plan, e-waste should be characterized according to composition, sources, types of e-waste, generation rates, and local legislation. Effective planning and implementation of e-waste management strategies should include: i) Revision of new e-waste sources during all project phases including planning, siting, and equipment upgrades, in order to identify e-waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure; ii) Collection of data and information about the process and e-waste streams in existing facilities, including characterization of e-waste streams by type, quantity, and potential use/disposition; iii) Establishment of priorities based on a risk analysis that takes into account the potential Environmental Health and Safety (EHS) risks during the e-waste cycle and the availability of the infrastructure to manage the e-waste in an environmentally sound manner; iv) Definition of opportunities for source reduction, as well as for reuse and recycling; v) Definition of procedures and operational controls for onsite storage; and, vi) Definition of options/procedures/operational controls for treatment and final disposal.

2.5.2. E-Waste Prevention Processes

This should be designed and operated to prevent, reduce, or minimize, the quantity of e-waste generated and hazards associated with the e-waste generated in accordance with the following strategy: i) Substituting raw materials or parts with less hazardous or toxic materials, or with those where processing generates a lower e-waste volume; ii) Adopting and implementing good housekeeping and operating practices, including inventory control to reduce the amount of e-waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or are an excess to operational needs; and iii) Reducing/minimizing hazardous e-waste generation by implementing stringent e-waste segregation to prevent the commingling of non-hazardous and hazardous e-waste from been managed.

2.5.3. Recycling and Reuse

In addition to the implementation of e-waste prevention strategies, the total amount of e-waste may be significantly reduced through the implementation of reuse and recycling plans, which should consider the following elements: i) Identification and reuse/recycling of products that can be reintroduced into the operational processes ii) Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., e-waste exchange); iii) Establishing reuse/recycling objectives and formal tracking of e-waste generation and recycling rates; and iv) Providing training and incentives to employees in order to meet objectives.

2.5.4. Treatment and Disposal

If e-waste materials are still generated after the implementation of feasible e-waste prevention, reduction, reuse, recovery, and recycling measures; then, e-waste materials should be treated and disposed of following all measures to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the specifications of e-waste characteristics and local regulations, and may include one or more of the following: i) On-site or off-site chemical, or physical treatment of the e-waste material to render it non-hazardous prior to final disposal; ii) Treatment or disposal at permitted facilities specially designed to receive the e-waste; iii) Permitted and operated landfills or disposal facilities designed for the respective type of e-waste or other methods known to be effective in the safe, final disposal of e-waste materials.

2.5.5 Hazardous E-Waste Management

Hazardous e-waste should always be segregated from non-hazardous e-wastes. If the generation of hazardous e-waste cannot be prevented through the implementation of the above general e-waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles: i) Understanding potential risks and impacts associated with the management of any generated hazardous e-waste during its complete life cycle; ii) Ensuring that contractors handling, treating, and disposing of hazardous e-waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the e-waste being handled; iii) Ensuring compliance with applicable local and international regulations, WB ESHG, and GIIP.

2.5.6. Hazardous E-Waste Storage

Hazardous e-waste should be properly stored to prevent or control accidental releases to air, soil, and water resources in areas where: i) E-waste is stored in a manner that prevents the commingling or contact between incompatible e-waste and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatible or physical separation such as walls or containment curbs; ii) Store in closed containers (some could be radioactive proofed), away from direct sunlight, wind and rain; iii) Secondary containment systems should be constructed with materials appropriate for the e-waste being contained and adequate to prevent loss to the environment; iv) Provision of readily available information on compatibility to employees, including labelling each container to identify its contents; v) Limiting access to hazardous e-waste storage areas to only employees who have received proper training; vi) Clearly identifying (labelling) and demarcating the area, including documentation of its location on a facility map or site plan; and, vii) Conducting periodic inspections of e-waste storage areas and documenting the findings.

2.5.7. Transportation of E-Waste

All e-waste containers designated for off-site shipment should be secured and labelled with the contents and associated hazards. This must be properly loaded and secured into transportation vehicles before leaving the site and must be accompanied by a shipping paper (i.e., manifest, record, etc.) that describes the load and its associated hazards, and which is consistent with the Transport of Hazardous Materials good practices and guidance.

2.6. Monitoring Plans and Activities

2.6.1. Special considerations for Monitoring Activities

Monitoring activities associated with the management of hazardous and non-hazardous e-waste should include: i) Regular visual inspection of all e-waste storage, collection and storage areas for evidence of accidental releases and to verify that e-waste is properly labelled, and stored; ii) Inspection of loss or identification of cracks, corrosion, or damage to protective equipment, or floors; iii) Verification of locks, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied); iv) Checking the operability of emergency systems; v) Documenting results of testing for integrity, emissions; vi) Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage; vii) Regular audits of e-waste segregation and collection practices, viii) Tracking of e-waste generation trends by type and amount of e-waste generated, preferably by facility departments, ix) Characterizing e-waste at the beginning of generation of a new e-waste stream, and periodically documenting the characteristics and proper management of the e-waste, especially hazardous e-wastes; x) Keeping manifests or other records that document the amount of e-waste generated and its destination; xi) Periodic auditing of third-party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous e-wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location. In the event that e-waste (on-site storage and/or pre-treatment and disposal) is in direct contact with soil, additional procedures must be performed to ensure regular monitoring of soil quality.

Monitoring records for hazardous e-waste collected, stored, or shipped should include the following:

- Name and identification number of the material(s) composing the E-waste.
- Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these).
- Quantity (e.g., kilograms or liters, number of containers).
- Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported, and date received, record of the originator, the receiver, and the transporter.
- Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the E-waste.
- Location of each E-waste within the facility, and the quantity at each location.

2.7. Monitoring Roles and Responsibilities

The goal of monitoring is to measure the success rate of the project, determine whether interventions have resulted in dealing with negative impacts, whether further interventions are needed, or monitoring is to be extended in some areas.

2.7.1. The African Union Commission (AUC)

The African Union Commission (AUC) implementing this project will be responsible for overall monitoring and evaluation of this E-waste management plan. Monitoring must be performed throughout the project life cycle. The results of the monitoring reports will be submitted to the Bank. The African Union Commission should also provide training and capacity building on e-waste management.

2.7.2. Project offices

The project offices that will be provided electronic items (computers, printers, servers, cables, etc) financed by this project will be responsible for ensuring that the mitigation measures outlined in the E-waste management plans are followed and will provide quarterly reports to the PIU on the status of implementation of the plans.

2.7.3. Bank's Monitoring Support

The Bank will provide second line of monitoring compliance and commitments made in the E-Waste Management Plan through supervision. The bank will further undertake monitoring during its scheduled project supervision missions. Specifically, for each year that the agreement is in effect, the AUC will be required to submit all the monitoring reports to the Bank as part of its reporting and the Bank supervision missions will review these reports and provide feedback.

2.8. Public Consultation Mechanism

The information provided to the project staff and contractors (as applicable), as well as to the communities and all other relevant stakeholders, must be early and appropriate. Procedures must be established for solicitation, convened, and training to workers and affected communities. Amongst the potential topics to be covered are labor ethics, responsibilities and rights, sustainable daily issues and behavior, care for nature and biodiversity, environmental management. For information mechanisms to communities and workers the following must be considered: written information (press), radio, internet, social media, workshops, etc. The public consultation of project activities must be performed before project implementation, at the design phase. This activity is a mandate of ESS10 and demands the local stakeholder's active participation which shall be continuous throughout all the project phases. The result of the public consultations shall be included in the EWMP for all project activities.

2.9. Budget and Costs

Each phase of the project requires a budget with associated costs of the development and implementation of the EWMP. Table 2 summarizes the estimated costs for the items associated with the implementation of the EWMP. These will be updated by the African Union Commission and subject to clearance by the World Bank.

Table 2. EWMP Estimated Costs

SN	Description	Cost/annual ($)
1	Collection	10,500
2	Transportation	5,000
3	Sorting	5,000
4	Dismantling	5,000
5	Disposal	20,000
6	Training and capacity building of project staff and contractors	4,950
7	Consultancy for valuation and verification of the fixed assets	20,000
	Total	**70,450**

Table 3. E-Waste Management/Disposal Plan

Issue: Procurement and Provision of Electronic Devices (computers, printers, servers, cables etc)			
Impact	**Mitigation**	**Monitoring**	**Responsibility**
Air Pollution through improper disposal Which leads to release of toxic, hazardous, and carcinogenic gaseous. **Human Health** Electrical and electronic equipment contain different hazardous materials, which are harmful to human health. For instance, bio-accumulative toxins (PBTs) are harmful to human health and have been associated with cancer, nerve damage and reproductive disorders. Chronic exposure to arsenic can cause lung cancer and can often be fatal. Also, exposure to barium can lead to brain swelling, muscle weakness, damage to the heart, liver, and spleen. **Pollution of water bodies** Electrical and electronic equipment contain different hazardous materials, which are harmful to human health and the environment including ground and surface	Procure Electronic devices from credible manufactures to avoid purchasing second hand, refurbished or obsolete devices with a short shelf life or already categorized as E-Waste. If possible, select sources offering repair and take back schemes. Ensure insurance coverage and electronic physical protective devices are fitted. Reuse and recycle all E-waste where applicable and possible. Establish E-Waste collection points in all project sites, including collection bins/receptacles. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Warranty and take back schemes for Electronic Devices purchased. Credibility of manufacturers supplying the electronic devices Availability of E-waste receptacles in each project site. Number of awareness and training conducted for users of electronic devices on E-waste. E-waste certificates of disposal using licensed hazardous waste contractors and licensed hazardous waste landfills/disposal facilities.	AUC

water if not disposed of carefully.			
Pollution of land resources including landfills Electrical and electronic equipment contain different hazardous materials, which are harmful to human health and the environment including soil if not disposed of carefully.	Procure Electronic devices from credible manufactures to avoid purchasing second hand, refurbished or obsolete devices with a short shelf life or already categorized as E-Waste. If possible, select sources offering repair and take back schemes. Ensure insurance coverage and electronic physical protective devices are fitted. Reuse or Recycle all E-waste. Establish E-Waste Collection Centres in all project sites, including collection bins/receptacles. Use licensed hazardous waste contractors and licensed hazardous waste landfill sites/disposal facilities. Create and maintain records of all E-waste items for disposal, securely store and prepare for shipment correctly. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Warranty and take back schemes for Electronic Devices purchased. Credibility of manufacturers supplying the electronic devices. Availability of E-waste receptacles in each project site. Number of awareness and training conducted for users of electronic devices on E-waste E-waste certificates of disposal using licensed hazardous waste contractors and licensed hazardous waste landfills/disposal facilities.	AUC

Growth of informal E-waste disposal centres. Improper and indiscriminate disposal of E-waste is likely to lead to the exponential increase of informal waste disposal centers in communities near project sites which may further exacerbates the problem of E-waste.	Procure Electronic devices from credible manufactures to avoid purchasing second hand, refurbished or obsolete devices with a short shelf life or already categorized as E-Waste. If possible, select sources offering repair and take back schemes. Ensure insurance coverage and electronic physical protective devices are fitted. Reuse or Recycle all E-waste. Establish E-Waste Collection Centres in all project sites, including collection bins/receptacles. Use licensed hazardous waste contractors and licensed hazardous landfill sites/disposal facilities. Create and maintain records of all E-waste items for disposal, securely store and prepare for shipment correctly. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Warranty and take back schemes for Electronic Devices purchased. Credibility of manufacturers supplying the electronic devices. Availability of E-waste receptacles in each project site. Number of awareness and training conducted for users of electronic devices on E-waste. E-waste certificates of disposal using licensed hazardous waste contractors and licensed hazardous waste landfills/disposal facilities.	AUC

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