E-waste Management Plan

DRAFT

Punjab Urban Land Systems Enhancement (PULSE) Project (P172945)

September 13, 2021

Board of Revenue, Government of the Punjab

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ABBREVIATION AND ACRONYMS

ARCs	Arazi Record Centers
BFR	Brominated Flame Retardant
CCP	Climate Change Policy
CNS	Central Nervous System
COVID-19	Corona Virus Disease of 2019
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DEFRA	Department for Environment, Food and Rural Affairs
DLR	Directorate of Land Records
EEE	Electrical and Electronic Equipment
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Mitigation Plan
EU	European Union
EWMP	E-waste Management Plan
GHG	Greenhouse Gas
GoP	Government of Pakistan
GoPb	Government of Punjab
IARC	International Agency for Research on Cancer
ICTs	Information and Communication Technologies
IEE	Initial Environmental Examination
LCD	Liquid Crystal Display
LDCs	Less Developed Countries
LRMIS	Land Record Management Information System
NOC	No Objection Certificate
NPHP	Naya Pakistan Housing Program
ODS	Ozone Depleting Substance
OHS	Occupational Health and Safety
PAHs	Polyaromatic Hydrocarbons
PDMA	Provincial Disaster Management Authority
PEPA	Pakistan Environmental Protection Act
PHATA	Punjab Housing and Town Planning Agency
PIU	Project Implementation Unit
PLRA	Punjab Land Records Authority
POPs	Persistent Organic Pollutants
PTS	Persistent Toxic Substance
PULSE	Punjab Urban Land Records and System Enhancement Project
PVC	Polyvinyl Chloride
WEEE	Waste Electrical and Electronic Equipment

EXECUTIVE SUMMARY

The Project

The Government of Pakistan (GoP) has initiated a number of pro-poor programs, including the Naya Pakistan Housing Program (NPHP). Launched in April 2019, NPHP seeks to build 5 million low-cost housing units in urban areas across the country within a 5-year timeframe. The program will be implemented in partnership with private developers and banks, with the aim of strengthening the construction sector, creating jobs and boosting economic growth. Although NPHP will target a mix of income groups, it will place special emphasis on the bottom 40 percent of Pakistan's population. Out of the 5 million units, between 2 and 2.5 million are expected to be constructed in Punjab Province under the purview of the Punjab Housing and Town Planning Agency (PHATA). NPHP, however, faces numerous challenges as the GoP attempts to achieve the ambitious goals set under the program, particularly targeting housing investments in urban areas where needs are most acute, as well as identifying appropriate lands for housing developments that are near jobs and basic infrastructure, and not prohibitively expensive.

Both the GoP and the Government of Punjab (GoPb) recognize that they will not be able to achieve NPHP's goal of constructing up to 2.5 million low-cost housing units in Punjab if the province's urban land record challenges are not resolved. The NPHP calls urban land records modernization to access a comprehensive data catalog of state land's location and status. Further, the GoPb plans to address the following challenges due to the absence of a standardized system of recording property rights in Punjab: (i) property tax evasion (i.e., transfer tax) and inequitable taxation; (ii) the unavailability of any formal ownership records (iii) lengthy litigation processes; (iv) overlapping records registries by multiple agencies that lack any harmonization; (v) a lack of easy access to property rights information for development authorities and agencies to fulfill their core functions; (e.g., housing, utilities); and (vi) absence of up-to-date cadastral data for the governments to incorporate climate change considerations while planning of services and infrastructure.

As such, the Board of Revenue (BoR) requested Bank assistance to support the modernization and digitization of land records throughout the province ensuring that land registration processes are efficient and transparent. Specifically, it is requesting support for the creation of a province-wide digital cadastral map, data improvement in urban and rural areas and the scale-up of the Land Records Management Information System (LRMIS), as well as project management and policy development. Promoting a more transparent, efficient, and selective supply of lands will address one of the critical bottlenecks to the supply of affordable housing.

The World Bank is assisting BoR under the project 'Punjab Urban Land Records and System Enhancement Project (PULSE) to support the modernization and digitization of urban land records throughout the province ensuring that land registration processes are efficient and transparent. Under this support, the creation of a province-wide digital cadastral map, data improvement in urban areas and the scale-up of LRMIS, as well as project management and policy development will be carried out. Promoting a more transparent, efficient, and effective supply of urban land will address one of the critical bottlenecks to the supply of affordable housing. The PULSE project has three components.

E-waste Generation

Under Component-1 and Componenet-3, various Information and Communication Technologies (ICTs) will be procured and used in different land record offices to digitize the land records. By virtue of ICTs use, electronic waste (E-waste) is expected to be

generated at the start of the project when obsolete ICTs will be disposed of and by the end of useful life of the procured ICTs. The environmental and health impacts occur during dismantling, recycling and disposal of the E-waste. If E-waste is recycled and disposed of under improper dismantling and extraction facilities and disposal arrangements, then the environment and health impacts occur in the form of discharge of heavy metals in the environment and health risks to the associated workers and surrounding communities. The improper recycling arrangements result in air, water and soil pollution due to release of various pollutants. E-waste generation is identified as one of the major environmental and health risks of the project activities which needs to be managed to comply with the environmental safeguard requirements of the World Bank. The Environmental and Social Management Framework (ESMF) of the project requires to prepare E-waste Management Plan (EWMP) under Environmental and Social Mitigation Plan (ESMP). This EWMP is prepared to comply ESMP of the project.

Hazardous Material in the E-waste

E-waste does not pose any environmental and health impacts unless it is dismantled and recycled. Major reason of these impacts is the improper ways and means to dismantle and recover the material from E-waste due to which hazardous material present in these electrical and electronic equipment (EEE) are released into the environment and the workers involved in dismantling and recycling activities are exposed to these hazardous materials. E-waste contains heavy metals in different proportions. As an example, the personal computer contains heavy metals including lead, aluminum, iron, tin, copper, barium, nickel, zinc, gold, indium, ruthenium, cobalt, palladium, silver, selenium, rhodium etc. The cables, wires and motherboards that have Polyvinyl Chloride (PVC) and Brominated Flame Retardants (BFRs), release dioxins. Dioxins include polychlorinated dibenzodioxins, dibenzofurans, polychlorinated biphenyl, polybrominated biphenyl and perfluroalkyls. The polybrominated biphenyl is used as fire retardant for electronic equipment. The polychlorinated biphenyl is present in dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors. The perfluoroalkyls are present in fluoropolymers in electronics. These dioxins are released as combustion byproducts when different components of E-waste are burnt.

The Polyaromatic Hydrocarbons (PAHs) include different chemical compounds such as acenaphtene, acenaphtylene, anthracene, benz(a) anthracene, benzo(a) pyrene, benzo(e) pyrene, benzo(b) fluoranthene, benzo(ghi) perylene, benzo(j) fluoranthene, benzo(k) fluoranthene, chrysene, dibenz(ah) anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d) pyrene, phenanthrene, and pyrene, which are released as combustion byproducts when different components of E-waste are burnt.

E-waste Legislation

There is no specific E-waste legislation in the country. However, the policies, laws and rules which address environmental concerns and hazardous material, include National Environmental Policy 2005, Pakistan Environmental Protection Act 1997, Hazardous Substance Rules 2003, Punjab Environmental Protection Act 2012, Punjab Hazardous Substances Rules 2018, The Punjab Occupational Safety and Health Act 2019, and Pakistan Penal Code. The international conventions for the management of hazardous waste and E-waste, for which Pakistan is the signatory, include Basel Convention on the Control of Trans-boundary Movement of Hazardous Waste and their Disposal, and Stockholm Convention on Persistent Organic Pollutants.

E-waste Management

In developed countries, E-waste is managed through collection and then recycling at appropriate E-waste recycling facilities. The collection channels include i) municipal collection, ii) retailer take back, and iii) producer take back. Municipal collection systems operate under the Government whereas retailers and producers take back the E-waste under the 'Extended Producer Responsibility' principle. The collected E-waste then undergoes formal recycling at designated recycling facilities specifically designed to recycle the E-waste. These facilities operate under different organizational structures. In Pakistan, E-waste is collected by the scrappers or street waste collectors from homes and offices or by scavengers from streets. This E-waste is mixed with other general waste and treated as waste without any special attention to it. These scrappers and scavengers sell this waste to small waste collectors. The small waste collectors segregate the waste into different categories and sell each category of waste to the specific waste contractor. The waste contractor sells this waste to the recyclers. The recyclers either repair the electrical and electronic equipment and resale these in the market as second-hand equipment or recycle it to recover valuable materials. The valuable materials are sold to the specific buyers/market.

The implementing agency and its departments, including BoR, PLRA, and Provincial Disaster Management Authority (PDMA), haven't produced a significant amount of E-waste, given that LRMIS was established and rolled out in 2016. However, the implementing agency is fully aware of the importance of E-waste for the life cycle of ICT equipment that is toxic but is also a valuable waste stream. The safeguards officials are in place responsible for properly recycling or disposal of the E-waste in compliance with the existing laws regarding environmental concerns and hazardous material. In addition, the implementing agency will hire environmental specialists under PULSE to implement sustainable E-waste recycling and disposal flows.

E-waste Management Plan

Under the current scenario in the country and the province where there is no municipal collection system of E-waste, no mechanism of retailer take back and producer take back, and no formal or certified/licensed E-waste recycling facilities, the only possible E-waste management is described below:

Make the Inventory of the E-waste: Each implementing department will make the inventory of the E-waste. The Project Implementation Unit (PIU) of the respective department will be responsible to make the E-waste inventory and will keep on updating it. This inventory should be reconciled with the inventory of the procured ICTs.

Storage of the E-waste: All the retired and discarded ICTs or the E-waste will be handed over to the administration department. The administration department will receive the E-waste and record it in its E-waste inventory and place in the specified storage bins or storage facilities. The list of the items placed in the bin will be displayed at the designated bin/store room so that anybody can see what type of items are placed inside the designated bin/store room.

Continuous Liaison with the Environmental Protection Agency: It will be the responsibility of the PIU of the project to establish a continuous liaison with the Environmental Protection Agency (EPA) and convince it to take action against the E-waste collectors, dismantlers and recyclers and certify them.

Guidelines for Collectors, Transporters, Dismantlers and Recyclers: EPA will provide the PIU technical support and guidelines for the E-waste collectors and transporters, dismantlers, and recyclers to certify these facilities after compliance with the guidelines.

Visit of the Licensed E-Waste Recycling Facilities: After EPA takes action on E-waste management and certifies the E-waste recyclers in the province, the PIU will visit the certified collection, dismantling, and recycling facilities to ensure that the facilities are complying with the EPA rules and guidelines.

Handing Over the E-waste: The PIU should hand over the collected and stored E-waste to the selected collectors, dismantlers, and recyclers. This handing over or auction will be as per the Punjab Procurement Rules.

Table. Key Activities and Responsibilities of E-waste Management Plan

Activities	Responsibilities	Frequency	Output
Development of Implementation Agencies specific initial E-waste management plan	BoR and PIU	One-time (within 90 days of project effectiveness)	E-waste Management Plan
Identification of E-waste inventory at the start of project	BoR, PLRA, PDMA and PIU	One-time (once procurement plan is finalized)	Initial E-waste Inventory
Liaison with EPC and receiving guidelines of E-waste recycling and disposal	BoR and PIU	Quarterly (continued)	Technical Guidelines
Capacity building and training staff (awareness raising of staff for E-waste management)	PIU, PLRA and PDMA	Once a year	Training Report
Procurement of ICTs equipment and updating e-waste inventory, if needed	BoR, PDMA and PLRA	Based on the Procurement Plan (within 30 days of each procurement)	ICTs Equipment Acquisition
Distribution and operations of ICTs equipment and updating the inventory accordingly.	PLRA and PDMA	Based on the Procurement Plan(within 30 days of each procurement)	Equipment Distribution Report
Collection of retired/obsolete ICTs equipment	PLRA and PDMA	Once a year (if E-waste generated)	Collected E-waste
Recording E-waste inventory and storing the retired and obsolete E-waste	BoR and PIU		Updated E-waste Management Plan and E-waste Inventory
Initiation of E-waste disposal or recycling	BoR and PIU		
Visit and select E-waste recycling facilities	BoR and PIU		
Implementation of formal E-waste disposal and recycling	Licensed Collectors, Transporters,		

	Dismantlers and Recyclers		
Establishment of project specific proper e-waste management stream with selected vendors in consultation with EPA	BoR and PIU	Within 3 years of legal agreement	
Update E-waste inventory	BoR and PIU	On-going (bi-annually)	

1.0 Background

1.1 The Project

The Government of Pakistan (GoP) has initiated a number of pro-poor programs, including the Naya Pakistan Housing Program (NPHP). Launched in April 2019, NPHP seeks to build 5 million low-cost housing units in urban areas across the country within a 5-year timeframe. The program will be implemented in partnership with private developers and banks, with the aim of strengthening the construction sector, creating jobs and boosting economic growth. Although NPHP will target a mix of income groups, it will place special emphasis on the bottom 40 percent of Pakistan's population. Out of the 5 million units, between 2.0 and 2.5 million are expected to be constructed in Punjab Province under the purview of the Punjab Housing and Town Planning Agency (PHATA). NPHP, however, faces numerous challenges as the GoP attempts to achieve the ambitious goals set under the program, particularly targeting housing investments in urban areas where needs are most acute, as well as identifying appropriate lands for housing developments that are near jobs and basic infrastructure, and not prohibitively expensive.

Both the GoP and the GoPb recognize that they will not be able to achieve NPHP's goal of constructing up to 2.5 million low-cost housing units in Punjab if the province's urban land record challenges are not resolved. The NPHP calls urban land records modernization to access a comprehensive data catalog of state land's location and status. As such, the BoR requested Bank assistance to support the modernization and digitization of land records throughout the province ensuring that land registration processes are efficient and transparent. Specifically, it is requesting support for the creation of a province-wide digital cadastral map, data improvement in urban and rural areas and the scale-up of LRMIS, as well as project management and policy development. Promoting a more transparent, efficient, and selective supply of lands will address one of the critical bottlenecks to the supply of affordable housing.

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Under previous Land Records Management and Information Systems Project (LRMIS; P090501), rural land records were digitized whereas under PULSE, the urban land records will be digitized in the LRMIS.

1.1.1 Project Components

The PULSE project has following three components:

- **Component 1: Digital Land Records and Cadastral Maps for LRMIS**
  This component will finance development of a seamless cadastral map linked to digital land records for the whole Province of Punjab. This activity builds on the existing LRMIS that covers about 44.5 million rural land holdings in Punjab. Key activities include preparing the spatial framework for LRMIS, registration of peri-urban and urban properties, and upgrading tax records to urban land records. This component will also support the regularization of unregistered lands in notified informal

settlements to provide secure rights for dwellers occupying plots in previously notified Katchi Abadis on state and public lands. BOR will carry out a pilot phase in Year 1 to develop efficient and cost-effective techniques, followed by a scale-up phase in the remaining years.

- **Component 2: Land for Housing**
  This component will support government agencies to identify and mobilize suitable public lands for development including housing programs. This component will consolidate the state lands identified under Component 1 and the paper records kept by various government authorities. These state lands will be digitalized, georeferenced, and stored in a database in LRMIS to build an inventory of state land asset. The project will finance the establishment of public land asset management procedures and good governance with a monitoring system to ensure transparency and accountability.

- **Component 3: Integrated Land and Geospatial Information Systems and Services**
  This component will support various activities to establish a modern Land Information System, unifying and integrating rural and urban land records. These activities will include: (i) strengthening of ICT equipment and software; (ii) development of the next generation Land Records Management Information System (LRMIS) and Land Information Portal; (iii) digitizing deed records across Punjab Province; (iv) establishment of a provincial spatial data infrastructure (PSDI); and (v) provision of base maps.

- **Component 4: Project Management and Institutional Strengthening**
  This component will support for the Project Implementing Units (PIUs) to manage, implement, and supervise Project activities, and training and skill development in the areas of monitoring and evaluation, communication, audits, social and environmental management, policies and regulations, operations and maintenance, and project management. This component includes public awareness campaigns and other related activities to build confidence in and understanding of the parcel-based land administration, as well as targeted messaging for women and vulnerable groups. Under this Component a grievance redress mechanism (GRM) for the Project will be established and managed to ensure that all grievances, complaints, and concerns are responded to.

1.2 E-waste Generation

Under Component-1 and Componenet-3, various ICTs will be procured and used in different land record offices to digitize the land records. These ICTs will include computers (desktops and laptops), centralized data processors, calculators, cell phones, telephone sets, Wi-Fi devices, LCD/LED screens, microphones, headphones, speakers, printers, scanners, modems, routers, servers, wireless networking technologies, video, multimedia, photocopiers, fax machines, user terminals and systems, wires and cables etc.

By virtue of ICTs use, electronic waste (E-waste) is expected to be generated at the start of the project when obsolete ICTs will be disposed of and by the end of useful life of the procured ICTs. The environmental and health impacts occur during dismantling, recycling and disposal of the E-waste. If E-waste is recycled and disposed of under improper dismantling and extraction facilities and disposal arrangements, then the environment and health impacts occur in the form of discharge of heavy metals in the environment and health risks to the associated workers and surrounding communities. The improper

recycling arrangements result in air, water and soil pollution due to release of various pollutants.

E-waste generation is identified as one of the major environmental and health risks of the project activities which needs to be managed to comply with the environmental safeguard requirements of the World Bank. The Environmental and Social Management Framework (ESMF) of the project requires to prepare E-waste Management Plan (EWMP) under Environmental and Social Mitigation Plan (ESMP). This EWMP is prepared to comply ESMP of the project.

1.3 E-waste Situation in Pakistan

In Pakistan, E-waste is generated from three key sources: domestic manufacturing, domestic consumption, and import. After disposal from these sources, E-waste is collected by scrapers and vendors, who sometimes dismantle the waste in several parts which is, in turn, sold to extractors and dismantlers. Extractors and dismantlers, by using environmentally unsound technologies, extract precious and valuable materials and the leftover waste is then often disposed of either in dumping grounds or water bodies. Sometimes scrapers and dismantlers reassemble different parts of old equipment for resale. Laborers involved in recycling activities may not be fully aware of the potentially harmful consequences of recycling or dismantling electronics, thus exposing themselves to high toxicity. Crude recycling techniques are adopted like physical dismantling, open burning, acid bath, and use of blow torches to extract valuable metals. The informal recycling is growing day by day in Pakistan and is expanded all over the country as small and medium enterprises. Up till now, there is no formal E-waste recycling facility available in Pakistan; all the E-waste is recycled through illegal and/or informal means[1].

Electronic and electrical waste is imported and labeled as 'second-hand equipment'. A very small amount of the imported material is reusable. After the removal of usable items, the bulk of the electrical waste is sent to the recycling industry. Major recycling waste enterprises are located at Karachi. Lahore, Faisalabad, Peshawar, Gujranwala and Islamabad/Rawalpindi are also involved in the recycling and dismantling of the E-waste, but at a small scale, compared to Karachi. Karachi, being a seaport, receives the containers of E-waste from all around the world. After clearance from the port, this waste is sent to warehouses from where scrapers buy the items by weight. The E-waste is dismantled, burned or dumped depending on its composition. Hundreds of workers including teenage children earn their livelihood by dismantling and extraction of valuable items from the E-waste[2].

Pakistan is among 15 countries where electronic E-waste dismantling and recycling is considered a major health hazard. All three major South Asian nations i.e. India, Pakistan and Bangladesh, are among the worst affected by the E-waste. Pakistan produced 433 kilotons of E-waste last year. In 2014, an estimated 12.46 kilotons of old computers were imported into Karachi from various countries[3].

1.4 Structure of E-waste Management Plan

This E-waste Management Plan (EWMP) comprises of six sections. The detail of these six sections is as under:

[1] Iqbal, M., et al., Emerging issue of e-waste in Pakistan: A review of the status, research needs and data gaps, Environmental Pollution (2015), http://dx.doi.org/10.1016/j.envpol.2015.09.002
[2] Ibid
[3] UN Report 2021

Section-1: It provides background of PULSE project and its components and E-waste situation in Pakistan.

Section-2: It gives definition of the E-waste, type of hazardous material present in the E-waste, and description of environmental, health and safety impacts associated with the E-waste recycling practices.

Section-3: It gives detail of national and provincial legislation which are relevant with the environmental and hazardous substances regulations. It also describes international conventions related with the E-waste or hazardous substances.

Section-4: It provides detail of the E-waste inventory for the PULSE project, the expected useful life of each ICT, and hazards associated with these ICTs when these will be converted into E-waste.

Section-5: It describes E-waste management in developed countries and E-waste management situation in Pakistan, and solid waste auction procedure in government departments.

Section-6: It gives detail of the E-waste management plan that how the PULSE should manage its E-waste.

2.0 E-waste Impacts

This section defines the E-waste and its environmental and health impacts arising due to improper dismantling and recycling practices to recover valuable materials from the E-waste.

2.1 E-waste Definition

Electronic waste or E-waste is also called Waste Electrical and Electronic Equipment (WEEE). There is no standard definition of E-waste. A number of countries have come out with their own definitions, interpretations and usage of the term E-waste. The most widely accepted definition of WEEE/ E-waste is as per an EU directive, and this is followed in member countries of European Union and other countries of Europe.

E-waste, as per EU directive (WEEE Directive, EU, 2002a), is defined as "Electrical or electronic equipment which is waste including all components, subassemblies and consumables, which are part of the product at the time of discarding." The categories of electrical and electronic equipment covered by this Directive is given as Annex I.

Basel Convention covers all discarded/disposed materials that possess hazardous characteristics as well as all wastes considered hazardous on a national basis. Annex I refers to E-waste, which is considered hazardous under Art. 1, para. 1(a) of the Convention.

2.2 Hazardous Material in the E-waste

E-waste does not pose any environmental and health impacts unless it is dismantled and recycled. Major reason of these impacts is the improper ways and means to dismantle and recover the material from E-waste due to which hazardous material present in these electrical and electronic equipment (EEE) are released into the environment and the workers, involved in dismantling and recycling activities, are exposed to these hazardous material.

Table-1 gives detail of different hazardous material present in different parts of the E-waste.

Table-1: Hazardous Material in E-waste

Component of E-waste	Possible Hazardous Contents
Plastic	Phthalate plasticize, Brominated Flame Retardant (BFR)
Insulation	Insulation ODS in foam, asbestos, refractory ceramic fiber
CRT (Cathode Ray Tube)	Lead, Antimony, Mercury, Phosphors
LCD (Liquid Crystal Display)	Mercury
Rubber	Phthalate plasticize, BFR
Wiring/Electrical	Phthalate plasticize, BFR, Lead
Circuit Board	Lead, Beryllium, Antimony, BFR
Fluorescent Lamp	Mercury, Phosphorus, Flame Retardants
Thermostat	Mercury
Batteries	Lead, Lithium, Cadmium, Mercury
External Electrical Cables	BFRs, plasticizers
Electrolyte Capacitors (over L/D 25mm)	Glycol, other unknown substances

Source: Compiled from WEEE & Hazardous Waste, A report produced for DEFRA, March 2004, AEA Technology

E-waste contains heavy metals in different proportions. The valuable heavy metals are recovered from E-waste through different methods. As an example, the personal computer contains heavy metals including lead, aluminum, iron, tin, copper, barium, nickel, zinc, gold, indium, ruthenium, cobalt, palladium, silver, selenium, rhodium etc.

The cables, wires and motherboards that have Polyvinyl Chloride (PVC) and Brominated Flame Retardants (BFRs), release dioxins. Dioxins include polychlorinated dibenzodioxins, dibenzofurans, polychlorinated biphenyl, polybrominated biphenyl and perfluroalkyls. The polybrominated biphenyl is used as fire retardant for electronic equipment. The polychlorinated biphenyl is present in dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors. The perfluoroalkyls are present in fluoropolymers in electronics. These dioxins are released as combustion byproducts when different components of E-waste are burnt.

The Polyaromatic Hydrocarbons (PAHs) include different chemical compounds such as acenaphtene, acenaphtylene, anthracene, benz(a) anthracene, benzo(a) pyrene, benzo(e) pyrene, benzo(b) fluoranthene, benzo(ghi) perylene, benzo(j) fluoranthene, benzo(k) fluoranthene, chrysene, dibenz(ah) anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d) pyrene, phenanthrene, and pyrene, which are released as combustion byproducts when different components of E-waste are burnt.

Lead is present in printed circuit boards, cathode ray tubes, light bulbs, televisions, and batteries. Chromium or Hexavalent Chromium is present in anticorrosion coatings used at different parts of the E-waste. Cadmium is present in switches, springs, connectors, printed circuit boards, batteries, infrared detectors, semi-conductor chips, ink or toner photocopying machines, cathode ray tubes, and mobile phones. Mercury is present in thermostats, sensors, monitors, cells, printed circuit boards, and cold cathode fluorescent lamps. Zinc is present in cathode ray tubes, and metal coatings. Nickle and Lithium are present in batteries. Barium is present in cathode ray tubes, and fluorescent lamps. Beryllium is present in power supply boxes, computers, x-ray machines, and ceramic components of electronics.

Most of these hazardous chemicals are found in the plastic housing of the electronic equipment to reduce flammability, insulating material, solder of printed circuit boards, glass panels, gaskets of computer monitors, connectors and hard drives.

2.3 E-waste Environmental and Health Impacts

Different hazardous materials, as mentioned above, are released during E-waste recycling. Mostly these materials are hazardous chemicals and heavy metals which are released into the environment and pose health risks. Hazardous materials are released when E-waste is dismantled, plastic parts are burnt, metals are recovered through chemical processes and discarded parts are disposed of on land and water under unsafe manner. Owing to unsafe recycling practices, the health of the workers involved in the E-waste recycling operations and communities living in the vicinity of E-waste recycling operations are at risk.

The scrappers don't use protective gears. They handle extremely toxic waste with their bare hands. Workers involved with the breaking of the computers are at the risk of inhalation of dust that may contain lead, barium oxide and phosphorus. Lead may cause neurotoxicity, high blood pressure, and muscle pains, and learning disabilities among children. Barium oxide can cause severe skin irritation and ingestion is harmful, and

chronic exposure may lead to damage of Central Nervous System (CNS), spleen, liver, kidney or bone marrow.
Gold is extracted from E-waste either by burning the gold containing components at high temperatures, or using leaching chemicals like cyanide solution. Burning releases toxic gases and disposal of cyanide solution or other leaching chemicals into the drain or on land pollutes water and soil.

Mostly the above mentioned hazardous chemicals and toxic metals are persistent toxic substances (PTSs), which are released in the environment and can enter the food webs. Several PTSs are known to be endocrine disrupters, posing adverse health effects such as reproductive disorders, developmental deformities, and cancer in both humans and wildlife.

Dioxins, released from burning of E-waste are known carcinogens, which accumulate in the human body and may cause changes in the immune system, glucose metabolism and reproductive problems.

Inhalation of cadmium fumes or particles can be life threatening. Cadmium exposure may cause kidney damage. The International Agency for Research on Cancer (IARC) has classified cadmium as a human carcinogen (group I) on the basis of sufficient evidence in both humans and experimental animals.

Acute mercury exposure may give rise to lung damage. Chronic poisoning is characterized by neurological and psychological symptoms, such as tremor, changes in personality, restlessness, anxiety, sleep disturbance and depression. High mercury exposure results in permanent nervous system and kidney damage. It has also been possible to detect proteinuria at relatively low levels of occupational exposure. Metallic mercury is an allergen, which may cause contact eczema.

The symptoms of acute lead poisoning are headache, irritability, abdominal pain and various symptoms related to the nervous system. People who have been exposed to lead for a long time may suffer from memory deterioration, prolonged reaction time and reduced ability to understand. Acute exposure to lead is known to cause proximal renal tubular damage. Long-term lead exposure may also give rise to kidney damage.

Inorganic arsenic is acutely toxic and intake of large quantities leads to gastrointestinal symptoms, severe disturbances of the cardiovascular and central nervous systems, and eventually death. Populations exposed to arsenic *via* drinking water show excess risk of mortality from lung, bladder and kidney cancer, the risk increasing with increasing exposure. There is also an increased risk of skin cancer. Studies on various populations exposed to arsenic by inhalation, such as smelter workers, pesticide manufacturers and miners in many different countries consistently demonstrate an excess lung cancer.

Beryllium can cause sensitization, lung and skin disease in a significant percentage of exposed workers.

Calcium chromate, chromium trioxide, lead chromate, strontium chromate, and zinc chromate are known human carcinogens. An increase in the incidence of lung cancer has been observed among workers in industries that produce chromate and manufacture pigments containing chromate.

Exposure to relatively high concentrations of antimony (9 mg/m^3 of air) for a longer period of time can cause irritation of the eyes, skin and lungs. As the exposure continues more

serious health effects may occur, such as lung diseases, heart problems, diarrhea, severe vomiting and stomach ulcers.
Exposure to Lithium can cause loss of appetite, nausea, vomiting, diarrhea and abdominal pain, headache, muscle weakness, twitching, blurred vision, loss of coordination, tremors, confusion, seizures and coma.

Zinc can cause eminent health problems, such as stomach cramps, skin irritations, vomiting, nausea and anaemia. Very high levels of zinc can damage the pancreas and disturb the protein metabolism, and cause arteriosclerosis.

Cobalt dust may cause an asthma like disease with symptoms ranging from cough, shortness of breath and dyspnea to decreased pulmonary function, nodular fibrosis, permanent disability, and death. Exposure to cobalt may cause weight loss, dermatitis, and respiratory hypersensitivity.

The two products of PVC combustion are of particular concern including hydrogen chloride, which is corrosive, highly toxic gas that can burn skin and cause severe, permanent respiratory damage; and dioxin, the most dangerous known man-made carcinogen, which will persist in the environment for a long period of time. PVC is the largest contributor to the world's dioxin burden.

Occupational exposures to high levels of pollutant mixtures containing PAHs has resulted in symptoms such as eye irritation, nausea, vomiting, diarrhea and confusion. Mixtures of PAHs are also known to cause skin irritation and inflammation. Health effects from chronic or long term exposure to PAHs may include decreased immune function, cataracts, kidney and liver damage (e.g. jaundice), breathing problems, asthma like symptoms, and lung function abnormalities, and repeated contact with skin may induce redness and skin inflammation. Naphthalene, a specific PAH, can cause the breakdown of red blood cells if inhaled or ingested in large amounts.

3.0 E-waste Legislation

3.1 National and Provincial Legislations

There are following policies and laws which address environmental concerns and hazardous material in the country and the Punjab province:

- National Environmental Policy 2005
- Pakistan Environmental Protection Act 1997
- Hazardous Substance Rules 2003
- Punjab Environmental Protection Act 2012
- Punjab Hazardous Substances Rules 2018
- The Punjab Occupational Safety and Health Act 2019
- Pakistan Penal Code

3.1.1 National Environmental Policy 2005

The National Environmental Policy provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of freshwater bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives directions for addressing the cross sectoral issues as well as the underlying causes of environmental degradation and meeting international obligations.

Policy measures recommends to i) enact the National Clean Air Act, ii) ensure reduction and control of harmful emissions through regulatory programs, iii) promote cleaner production technologies, iv) introduce discharge licensing systems for industry, v) establish cleaner production centers and promote cleaner production techniques and practices, vi) encourage reduction, recycling and reuse of municipal and industrial solid and liquid wastes, and vii) provide financial and other incentives (reduction/elimination of tariffs, low interest loans, appreciation certificates and awards) for technology up-gradation, adoption of cleaner technology, implementation of pollution control measures and compliance with environmental standards.

3.1.2 Pakistan Environmental Protection Act 1997

Pakistan Environmental Protection Act 1997 (PEPA 1997) is the basic legislative tool empowering the Government to frame regulations for the protection of the environment. It is a comprehensive legislation and provides the basic legal framework for protection, conservation, rehabilitation, and improvement of the environment. The act is applicable to a wide range of issues and extends to air, water, soil, marine, and noise pollution, and to the handling of hazardous wastes.

Environmental pollution control associated with hazardous waste is addressed in this act under Section 13 and 14. Under Section 13 ‘Prohibition of Import of Hazardous Waste’, no person shall import hazardous waste into Pakistan and its territorial waters, Exclusive Economic Zone and historic waters. Under Section 14 ‘Handling Hazardous Substances’, no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous waste except under a license issued by the Federal Agency and in such manner as may be prescribed or in accordance with the provision of any other law or of any international treaty, convention, protocol, code, standard, agreement or other instruments to which Pakistan is a party.

3.1.3 Hazardous Substance Rules 2003

Under the Hazardous Substance Rules 2003, made under PEPA 1997, license will be required for the import and transportation of hazardous substance from Federal or Provincial agency. The application for the grant of license for the industrial activity involving generation, collection, consignment, transport, treatment, disposal, storage, handling or import of hazardous substances, will also be accompanied with EIA report and safety plan. The validity of the license will be for three years from the date of issue. The licensee will notify any major accident occurring at licensed facility to provincial and federal agencies. There will be packing and labelling requirement, safety precautions for the premises and workers which will have to be followed. The licensed facility may be inspected by the provincial or federal staff.

3.1.4 Punjab Environmental Protection Act 2012

Environmental pollution control associated with hazardous waste is addressed in Punjab Environmental Protection Act 2012 under Section 13 and 14. Under Section 13 'Prohibition of Import of Hazardous Waste', no person shall import hazardous waste into the Punjab. Under Section 14 'Handling Hazardous Substances', no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous waste except under a license or in accordance with the provision of any other law or of any international treaty, convention, protocol, code, standard, agreement or other instruments to which Pakistan is a party.

Section 12 is for the environmental impact assessment of the new projects which states that no project construction or production will be allowed to commence without conducting and submitting Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) study to the provincial agency and getting no objection certificate.

Under Section 16, Provincial Agency can issue Environmental Protection Order where agency is satisfied that the discharge or emission of any effluent, waste, air pollutant or noise, or the disposal of waste, or handling of hazardous substance, or any other act or omission is likely to occur, or is occurring, or has occurred, in violation of any provision of this act, rules or regulations or of the condition of license, or is likely to cause, or is causing, or has caused an adverse environmental effect. The Provincial Agency may, after giving the person responsible for such discharge, emission, disposal, handling, act or omission an opportunity of being heard, by order, direct such person to such measures as the Provincial Agency may consider necessary with such period as may be specified in the order.

3.1.5 Punjab Hazardous Substances Rules 2018

These rules are made under Punjab Environmental Protection Act 2012 to manage hazardous substances in the province for their collection, generation, handling, consignment, transport, treat, dispose of, manufacturing and storage. The names of the hazardous substance and their threshold quantities are listed in Schedule 1, 2, 3, and 4 which are regulated under these rules.

The concerned authorities are required to inspect the subject industrial activity once a year and submit the report on the compliance of the rules by the occupiers to the EPA annually. The occupier is required to notify the concerned authority in case of major accident within the premises or outside the premises of the licensee within 48 hours during manufacturing, loading or unloading, supply, storage, marketing, and

transportation of hazardous substances. The notified officer will take appropriate actions to prevent accidents from recurring.
The occupier of the subject industrial activity will require to acquire license from concerned authority i.e. EPA to operate the facility after submitting Hazardous Substance Report. The occupier is also required to submit safety report to the concerned authority 90 days before commencing the industrial activity. This safety report will be updated annually. The occupier is also required to prepare and keep up to date an onsite emergency plan. It shall be the duty of the Rescue 1122 to prepare and keep up to date an adequate off-site emergency plan with details that how emergencies relating to a possible major accident on that site will be dealt with.

The rules provide guidelines to the occupier regarding packaging and labelling of the hazardous material, conditions to be maintained for the premises where hazardous substance is generated, collected, consigned, treated, disposed of, stored or handled, general and specific safety precautions to be taken at the facility and for the workers, and requirements of the safety plan and waste management plan.

3.1.6 The Punjab Occupational Safety and Health Act 2019

Under this act, the employer would be responsible to ensure the health and safety of the workers at workplaces. The act mentions health and safety requirements which need to be ensured to be complied by the employer/site in-charge and the workers. The Chief Inspector and the inspectors appointed under the act shall be responsible to enforce health and safety requirements prescribed by the act. Penalties shall be imposed in case of noncompliance of the requirements.

3.1.7 Pakistan Penal Code

The Pakistan Penal Code discusses offences where public or private properties and/or human lives are affected due to intentional or accidental misconduct of an individual or body of people. The Code defines the penalties for violations concerning pollution of air, water bodies and land.

3.2 International Conventions

Pakistan is signatory to the following international conventions which are related with the management of the hazardous waste.

- Basel Convention on the Control of Trans-boundary Movement of Hazardous Waste and their Disposal
- Stockholm Convention on Persistent Organic Pollutants

3.2.1 Basel Convention on the Control of Trans-boundary Movement of Hazardous Waste and their Disposal

The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 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. This convention also requires from the party to ensure the availability of adequate

disposal facilities, for the environmentally sound management of hazardous wastes and other wastes.
The Annex-VIII hazardous waste, of the convention 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.
- A2010 glass waste from cathode ray tubes and other activated glass destined for direct reuse and not for recycling or final disposal.
- 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.

3.2.2 Stockholm Convention on Persistent Organic Pollutants

Under Stockholm Convention on Persistent Organic Pollutants (POPs), it is required by the party to take measures to reduce or eliminate the unintentional release of POPs such as Hexachlorobenzene, pentachlorobenzene, polychlorinated biphenyls, and polychlorinated dibenzo-*p*-dioxins and dibenzofurans from open burning of waste.

3.3 Gaps in the Legislation

The current regulations at both provincial and federal levels, lack specific provisions pertinent to E-waste management. Hazardous substances, mentioned under Hazardous Substance Rules 2003 and 2018, to be controlled, do not mention E-waste, rather different hazardous chemicals are mentioned which can be the part of the E-waste or released during dismantling, burning, chemical processing or disposing on the land. Enforcement of these provisions are weak in the country and Punjab due to lack of enforcement infrastructure and resources.

There are no specific rules and guidelines to regulate E-waste recyclers and their facilities and its disposal. The E-waste recyclers are not supposed to get license from the authority and regulate their facilities. There are also no safe disposal, and formal recycling facilities in Pakistan and Punjab to allow safe and sound management of the E-waste. The project implementing departments will be unable to deliver their E-waste to such recyclers or to such facilities. Also the implementation departments have not established any procedures to handle E-waste in safe manner.

Generally, in Pakistan, there is no secured landfill, even no sanitary landfill, or any waste treatment facility to dispose of or treat the waste safely.

4.0 E-waste Inventory

Under Component-1 and 3 of PULSE project, different ICTs will be procured to establish a modern Land Information System for unifying and integrating rural and urban land records. These components will involve development of the next generation LRMIS, development of Land Information Portal, strengthening the existing Data Center and its backup sites, equipping new and updating existing Arazi (lands, cultivated lands, fields) Record Centers (ARCs) and digitizing remaining deed records across Punjab Province.

Under these components different ICTs will be procured such as computers, scanners, printers, plotters; Servers and chassis for data storage and backup facilities; networking and connectivity (LAN/WAN); and other equipment (video surveillance, electronic queue, access control devices, etc.) for ARCs and other offices. Also, the obsolete ICTs will be discarded and replaced with new ICTs. The obsolete ICTs and the newly procured ICTs after the end of their useful life will become the E-waste.

Table-2 gives detail of the newly procured ICTs for PULSE.

Table-2: Newly Procured Inventory of ICTs

#	Item	Quantity
1	Laptops/Desktops	2,600
2	Document Scanners	320
3	Mid-range Printers	320
4	Entry-level Printers	160
5	Communication Equipment for ARCs	160
6	Chassis for Servers and Storages	3
7	Servers	22
8	Server Expansion Modules	6
9	Network Equipment for Data Centers	12
10	Data Storage	1
11	Video Surveillance Packages	2

Source: PC-1 PULSE (as of September 2021)

The list of the obsolete ICTs is not available as the Punjab Land Records Authority (PLRA) under BoR has already been in the process of upgrading and/or replacing the outdated ICT equipment employed more than five years ago through its FY20-21 budget, which would not be expected to retire within the PULSS project lifetime.

Table-3 gives detail of the estimated useful life of the above-mentioned ICTs.

Table-3: Estimated Useful Life of Procured ICTs

#	Item	Quantity	Estimated Useful Life (Year)	Weight (kg)	Weight (kg)
				Unit	Total
1	Laptops/Desktops	2,600	10	2.1	5460
2	Document Scanners	320	8	3.7	1184
3	Mid-range Printers	320	8	30	9600
4	Entry-level Printers	160	8	5.2	832
5	Communication Equipment for ARCs	160	6	5.6	896
6	Chassis for Servers and Storages	3	10	14.5	43.5
7	Servers	22	5	30.4	668.8
8	Server Expansion Modules	6	5	16.3	97.8
9	Network Equipment for Data Centers	12	10	35.3	423.6
10	Data Storage	1	10	819	819
11	Video Surveillance Packages	2	10	31.2	62.4

It is envisaged from the above table that the E-waste will be generated mostly after the project life of 5 years. The quantity of E-waste will not be considerable given that majority of ICT equipment is small devices that are either reusable or generate an insignificant amount of toxic metals.

4.1 Hazard Analysis

The above-mentioned procured ICTs have the potential to pose environmental and health hazards, if these were handled improperly as discussed in the previous sections. The detail of the hazards associated with these ICTs, after end of their useful life and converted into E-waste and handing over to the recyclers, is given in Section 2.3.

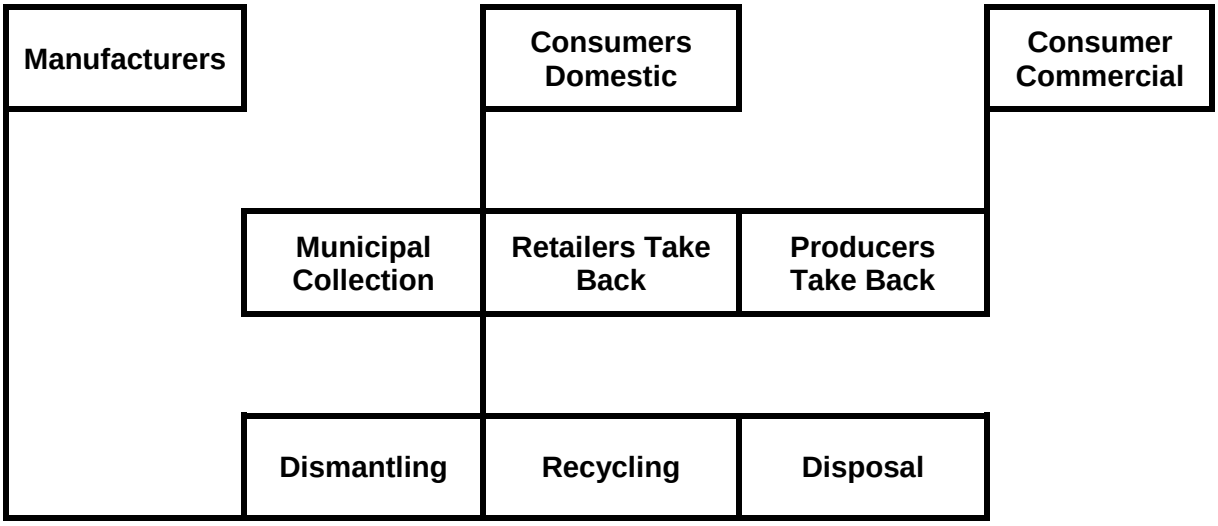
5.0 E-waste Management

5.1 E-waste Management in Developed Countries

In developed countries, E-waste is managed through collection and then recycling at appropriate E-waste recycling facilities. The collection channels include i) municipal collection, ii) retailer take back, and iii) producer take back. Municipal collection systems operate under the Government whereas retailers and producers take back the E-waste under the 'Extended Producer Responsibility' principle[4]. The collected E-waste then undergoes formal recycling at designated recycling facilities specifically designed to recycle the E-waste. These facilities operate under different organizational structures.

E-waste management in developed countries is illustrated in Figure-1.

Figure-1: E-waste Management in Developed Countries



5.2 E-waste Management in Pakistan

In Pakistan neither E-waste collection nor its recycling is regulated under any legal framework. There is no E-waste management policy in the country. The legislations regulate hazardous material but E-waste is not included in the hazardous substances and not considered to be hazardous material in the country. The retailers and producers are not under any compulsions to take back the post-consumer products. There is no policy principle which addresses 'Extended Producer Responsibility' for waste management in the country.

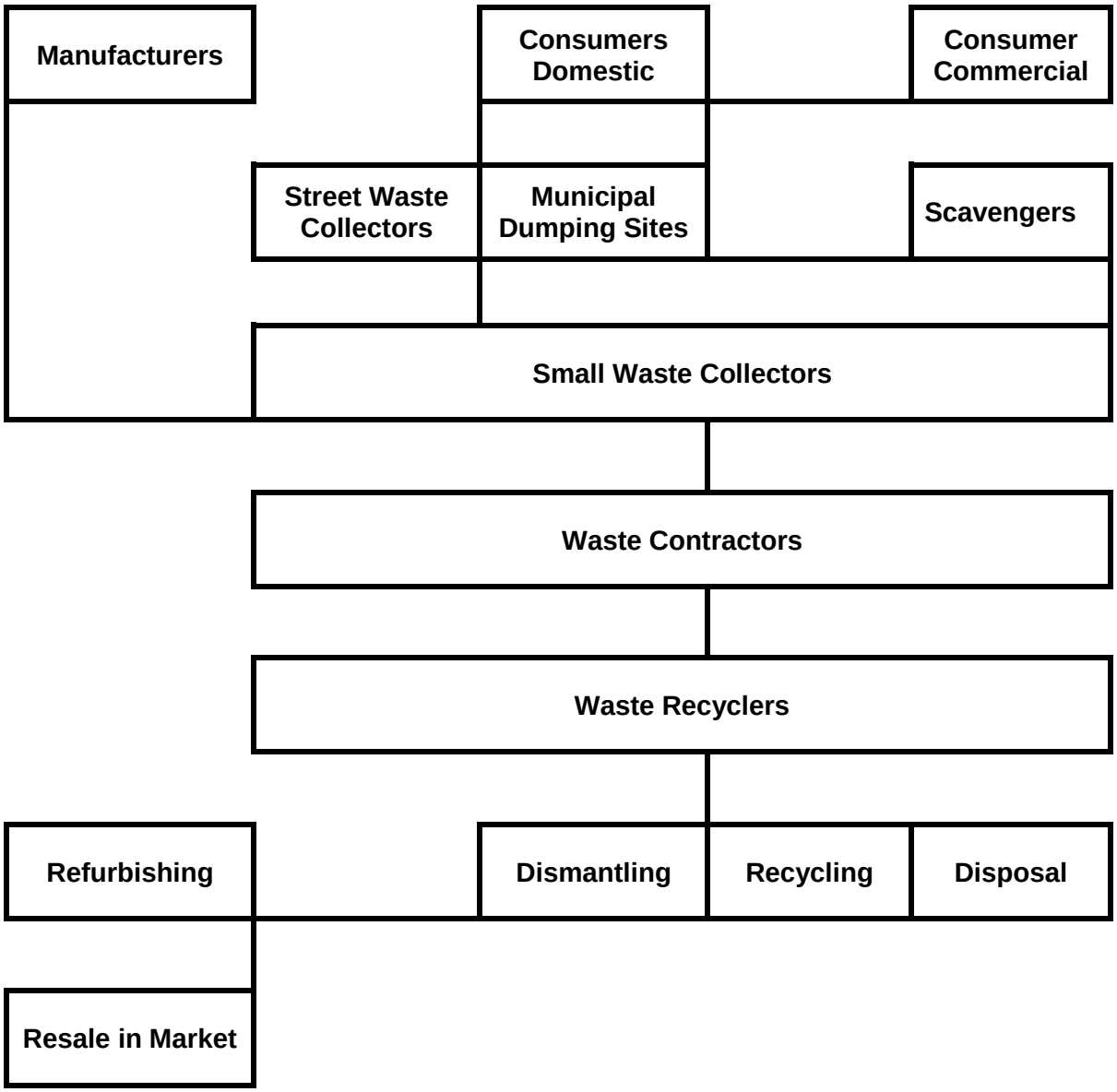
The E-waste recycling is carried out informally without taking environmental safeguards. There is no legal mechanism in the country to regulate these informal recycling facilities. The Hazardous Substances Rules address to certify those facilities where hazardous substances are handled but E-waste recycling facilities are not considered under these rules because these wastes are not listed under hazardous substance.

[4] Extended Producer Responsibility is a policy approach under which producers are given a significant responsibility i.e. financial and/or physical, for the treatment or disposal of post-consumer products.

E-waste is collected by the scrappers or street waste collectors from homes and offices or by scavengers from streets. This E-waste is mixed with other general waste and treated as waste without any special attention to it. These scrappers and scavengers sell this waste to small waste collectors. The small waste collectors segregate the waste into different categories and sell each category of waste to the specific waste contractor. The waste contractor sells this waste to the recyclers. The recyclers either repair the electrical and electronic equipment and resale these in the market as second-hand equipment or recycle it to recover valuable materials. The valuable materials are sold to the specific buyers/market.

E-waste management in Pakistan is illustrated in Figure-2.

Figure-2: E-waste Management in Pakistan



5.3 Solid Waste Auction Procedure in the Government Departments

The solid waste or scrap of public departments of the Government of Punjab is auctioned as per the Punjab Procurement Rules 2014. The auction notice is advertised at the website of Punjab Procurement Regulatory Authority (PPRA) and national newspapers. The interested parties submit the prescribed bid documents along with the required bid security money to the concerned department or procuring agency. The bid documents of all the bidders are opened publicly in the presence of all the bidders or their representatives. All the bid documents are evaluated as per the set evaluation criteria. The party fulfilling all the requirements of the tender procedure and quoting highest amount for the solid waste is selected by the auction committee. The selected party pays the required amount and takes the said waste in his custody. The auction process is executed under the supervision of the nominated auction committee by the concerned department.

However, there is no formal recycling system in place, including E-waste recycling in Punjab. A strong informal network including waste pickers on streets, communal waste container sites and dumpsites, and itinerant waste buyers capture the recyclables and E-waste in Punjab Province. The formal waste collectors also separate the recyclables from the waste collected from the communal container. The collected recyclables are either reused by the collector or passed to the major junk dealers through a local junk shop network. Sorting of all waste is carried out manually without proper protective measures.

5.4 E-Waste Management of the Implementing Agency

The implementing agency and its departments, including BoR, PLRA, and PDMA, haven't produced a significant amount of E-waste, given that LRMIS was established and rolled out in 2016. However, the implementing agency is fully aware of the importance of E-waste for the life cycle of ICT equipment that is toxic but is also a valuable waste stream. The safeguards officials are in place responsible for properly recycling or disposal of the E-waste in compliance with the existing laws regarding environmental concerns and hazardous material. In addition, the implementing agency will hire environmental specialists under PULSE to implement sustainable E-waste recycling and disposal flows.

6.0 E-waste Management Plan

This section describes the proposed E-waste management plan for the implementing departments of the PULSE project. This plan can be implemented by the implementing departments to avoid hazardous impacts associated with the dismantling and recycling of the E-waste.

Under the current scenario in the country and the province where there is no municipal collection system of E-waste, no mechanism of retailer take back and producer take back, and no formal or certified/licensed E-waste recycling facilities, the only possible E-waste management is described below:

6.1 Make the Inventory of the E-waste

Each implementing department will make the inventory of the E-waste. The PIU of the respective department will be responsible for developing the E-waste inventory and updating it. This inventory should be reconciled with the inventory of the procured ICTs. In some cases, during the implementation of the project, the existing or new ICT equipment would become part of the E-waste, ensuring that the inventory is updated periodically for incorporating any changes with respect to allocation, movement, auction etc. This type of E-waste will also be included in the inventory with the remarks 'Obsolete ICTs' against such E-waste. This inventory will be useful in identifying the quantum of the E-waste collected in the respective department.

6.2 Storage of the E-waste

All the discarded ICTs or the E-waste will be handed over to the administration department[5]. The administration department will receive the E-waste and record it in its E-waste inventory, and place it in the specified storage bins or storage facilities based on the volume and recycling purposes of E-waste. There will be one or two storage bins allocated for the E-waste storage. The list of the items placed in the bin will be displayed at the bin so that anybody can see what type of items are placed inside the bin.

The storage bins should have appropriate space for the collection of the items. The bin should be covered from all sides with one opening from the top for placing and removing the E-waste items. The bins should be placed under covered area to protect it from sunlight and rain with proper ventilation. The bins should be placed under normal room temperature. There should be arrangement in the storage room to remove heat during hot months of June, July and August such as exhaust fans. The surface of the storage bins should be impermeable which should not allow to seep in or seep out any material to/from the bin.

6.3 Continuous Liaison with the Environmental Protection Agency

The implementing departments cannot hand over E-waste to any recycler or the scrap collector because of the risks that the E-waste may be handled improperly in the absence of certified/licensed recycler/facility in the province. In the absence of this control, there are chances that the E-waste mishandling will pose environment and health risks to the environment, labor, and the community.

It will be the responsibility of the PIU of the project to establish a continuous liaison with the Environmental Protection Agency (EPA) and convince it to take action against the E-

[5] The Director of Human Resources and Administration will be responsible for handling its E-waste and keeping records.

waste collectors, dismantlers and recyclers and certify them. In the first step, the PIU will seek guidelines from EPA on E-waste in the hazardous substances and pursue in applying Hazardous Substances Rules to all the recycling facilities and issue licenses after ensuring that the rules are being complied.

6.4 Guidelines for Collectors, Transporters, Dismantlers and Recyclers

The PIU (including BoR and its implementing departments) will seek technical support and guidelines from EPA for the E-waste collectors and transporters, dismantlers and recyclers.

Collectors: The guidelines for the collector will be simply related with the safe storage of the E-waste. The storage place will be proper with respect to protecting the waste from sunlight and rain (weatherproof covering), placing waste on impermeable floor to avoid seepage of the hazardous material and waste segregation according to type of the waste. The store should be safe with respect to fire. The storage area should have the provision of spillage collection facilities and where appropriate, decanters and cleanser-degreasers as well. The workers should be equipped with proper PPE while handling the waste. The segregation of E-waste should be in five categories, as given below:

1- Refrigeration equipment: Due to ODS usage, this has to be separated from other E-waste

2- Other large household appliances: because of their shredding with end-of-life vehicles and other light iron, they need to be separated from other waste

3- Equipment containing CRTs: the CRTs need to remain intact because of health and safety reasons. Therefore, TVs and computer monitors will have to be collected separately from other waste and handled carefully

4- Lighting (linear and compact fluorescent tubes): this needs to be deposited in a special container (due to Mercury) to ensure it does not contaminate other waste and that it can be recycled

5- All other E-waste: This equipment can be collected in the same container because there are no recycling or health and safety reasons

Transporters: The transport of E-waste should be safe so that it could not break/damage the E-waste to avoid release of hazardous material. The surface of the transport vehicle should be impervious, and equipped with containment arrangement and spill kits, to manage releases, in case of any accident.

Dismantlers: The guidelines for the dismantlers should mainly focus on the manual dismantling of different parts of the E-waste without using any chemicals or any burning process. The labor involved in the dismantling should be equipped with proper PPE while handling the waste.

Decontamination/ Dismantling is done manually. It includes the following steps:

(i) Removal and collection of all liquid and gases from the E-waste
(ii) Removal of parts containing hazardous/ dangerous substances (CFCs, Hg switches, PCB)
(iii) Removal of easily accessible parts containing valuable substances (cable containing copper, steel, iron, precious metal containing parts, e.g., contacts)
(iv) Segregation of hazardous/dangerous substance, and removal of easily accessible parts

Recyclers: The guidelines for the recyclers will be specific for the type and nature of the recycling process to be adopted by the recyclers. However, whatever the process is

adopted, it should be safe for environment, and workers and community health. The major E-waste recycling techniques are decontamination and disassembly or repair followed by shredding of different fractions. E-waste fractions emitted after shredding go for metal recovery. The remaining of E-waste fractions are disposed of either in landfills or incinerated.

Following unit operations are involved at recycling facilities:

- **Segregation of ferrous metal, non-ferrous metal and plastic:** This separation is generally carried out after shredding and followed by mechanical and magnetic separation process.
- **Recycling/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, non-ferrous metals and precious metals are smelted in smelting plants.
- **Treatment/disposal of dangerous materials and waste:** Shredder light fraction is disposed of in landfill sites or sometimes incinerated, CFCs are treated thermally, Poly Chlorinated Biphenyl (PCB) is incinerated or disposed of in underground storages, Mercury (Hg) is often recycled or disposed of in underground landfill sites.

6.5 Visit of the Licensed E-waste Recycling Facilities

After EPA takes action on E-waste management and certifies the E-waste recyclers in the province, the PIU will visit the certified collection, dismantling, and recycling facilities to ensure that the facilities are complying with the EPA rules and guidelines. After the visit, PIU will select the best recycler for handing over PULSE E-waste whenever required.

6.6 Handing Over the E-waste

The PIU should hand over the collected and stored E-waste to the selected collectors, dismantlers and recyclers. This handing over or auction will be as per the Punjab Procurement Rules.

6.7 Establishment of project specific proper e-waste management stream with selected vendors in consultation with EPA

Based on the various steps mentioned above, the PIU will develop, test and further strengthen a proper e-waste management stream with selected vendors in consultation with all implementing agencies and under the guidance of EPA.

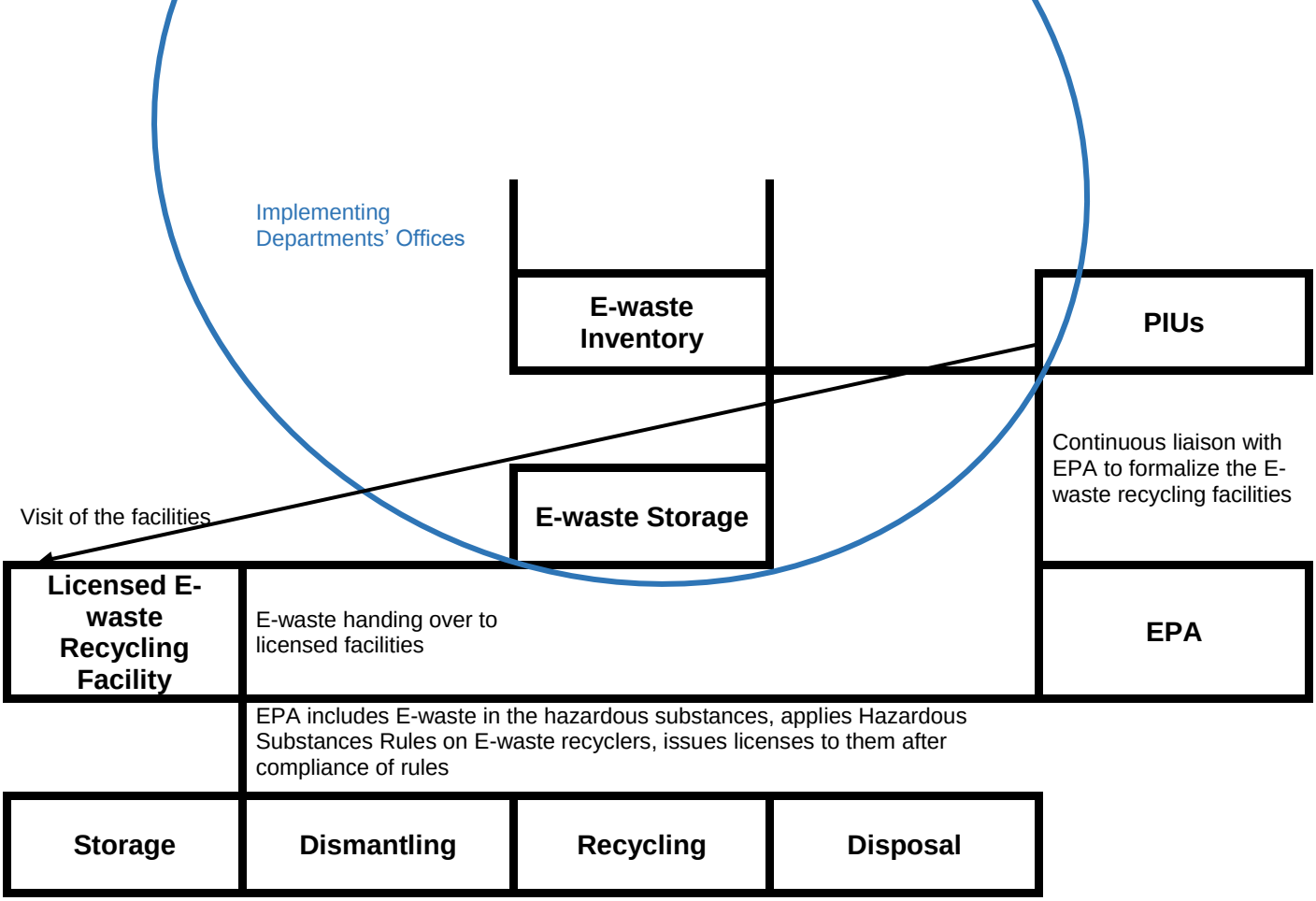
The key activities and responsibilities of each procedures to implement the E-waste management plan is illustrated in Table 4 and Figure-3:

Table 4. Key Activities and Responsibilities of E-waste Management Plan

Activities	Responsibilities	Frequency	Output
Development of IA specific initial E-waste management plan	BoR and PIU	One-time (within 90 days of project effectiveness	E-waste Management Plan
Identification of E-waste inventory at the start of project	BoR, PLRA, PDMA and PIU	One-time (once procurement	Initial E-waste Inventory

		plan is finalized)	
Liaison with EPC and receiving guidelines of E-waste recycling and disposal	BoR and PIU	Quarterly (continued)	Technical Guidelines
Capacity building and training staff (awareness raising of staff for E-waste management)	PIU, PLRA and PDMA	Once a year	Training Report
Procurement of ICTs equipment and updating e-waste inventory, if needed	BoR, PDMA and PLRA	Based on the Procurement Plan (within 30 days of each procurement)	ICTs Equipment Acquisition
Distribution and operations of ICTs equipment and updating the inventory accordingly.	PLRA and PDMA	Based on the Procurement Plan(within 30 days of each procurement)	Equipment Distribution Report
Collection of retired/obsolete ICTs equipment	PLRA and PDMA	Once a year (if E-waste generated)	Collected E-waste
Recording E-waste inventory and storing the retired and obsolete E-waste	BoR and PIU		Updated E-waste Management Plan and E-waste Inventory
Initiation of E-waste disposal or recycling	BoR and PIU		
Visit and select E-waste recycling facilities	BoR and PIU		
Implementation of formal E-waste disposal and recycling	Licensed Collectors, Transporters, Dismantlers and Recyclers		
Establishment of project specific proper e-waste management stream with selected vendors in consultation with EPA	BoR and PIU	Within 3 years of legal agreement	
Update E-waste inventory	BoR and PIU	On-going (bi-annually)	

Figure-3: E-waste Management Plan



ANNEX-I: E-Waste Categorization as per EU and Basel Convention

European Union (EU)

As per Annex IA to Directive 2002/96/EC (WEEE), categories of electrical and electronic equipment covered by this directive is as under:

1- Large household appliances
2- Small household appliances
3- IT and telecommunications equipment
4- Consumer equipment
5- Lighting equipment
6- Electrical and electronic tools (with the exception of large scale stationary industrial tools)
7- Toys, leisure and sports equipment
8- Medical devices (with the exception of all implanted and infected products)
9- Monitoring and control instruments
10- Automatic dispensers

List of products which fall under the above categories are given below:

1- Large Household Appliances

- Large cooling appliances
- Refrigerators
- Freezers
- Other large appliances used for refrigeration, conservation and storage of food
- Washing machines
- Clothes dryers

- Dish washing machines
- Cooking
- Electric hot plates
- Microwaves
- Other large appliances used for cooking and other processing of food
- Electric heating appliances
- Electric radiators
- Other fanning, exhaust ventilation and conditioning equipment

2- Small Household Appliances

- Vacuum cleaners
- Carpet sweepers
- Other appliances for cleaning
- Appliances used for sewing, knitting, weaving and other processing for textiles
- Iron and other appliances for ironing, mangling and other care of clothing
- Toasters
- Fryers
- Grinders, coffee machines and equipment for opening or sealing containers or packages
- Electric knives
- Appliances for hair cutting, hair drying, tooth brushing, shaving. Massage and other body care appliances
- Clocks, watches and equipment for the purpose of measuring indicating or registering time scales

3- IT and Telecommunication Equipment

- Centralized data processing
- Mainframes
- Minicomputers
- Printer units
- Personal computing
- Personal computers (CPU, mouse, screen and keyboard included)
- Laptop computers (CPU, mouse, screen and keyboard included)
- Notebook computers
- Notepad computers
- Printers
- Copying equipment
- Electrical and electronic typewriters
- Pocket and desk calculators
- And other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means
- User terminals and systems
- Facsimile
- Telex
- Telephones
- Pay telephones
- Cordless telephones
- Cellular telephones
- Answering systems
- And other products or equipment of transmitting sound, images or other information by telecommunications

4- Consumer Equipment

- Radio sets
- Television sets
- Video cameras
- Video recorders
- Hi-fi recorders
- Audio amplifiers
- Musical instruments
- Other products or equipment for the purpose of recording or reproducing sound or image, including signals or other technologies for the distribution of sound and image than by telecommunications

5- Lighting Equipment

- Luminaries for fluorescent lamps with the exception of luminaries in households
- Straight fluorescent lamps
- Compact fluorescent lamps
- High intensity discharge lamps, including pressure sodium lamps and metal lamps
- Low pressure sodium lamps
- Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

6- Electrical and Electronic Tools (with the exception of large scale stationary industrial tools)

- Drills
- Saws
- Sewing machines
- Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of 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
- Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means
- Tools for mowing or other gardening activities

7- Toys, Leisure and Sports Equipment

- Electric trains or car racing sets
- Hand held video game consoles
- Video games
- Computers for biking, diving, running, rowing, etc.
- Sports equipment with electric or electronic components
- Coin slot machines

8- Medical Devices (with the exception of all implanted and infected products)

- Radiotherapy equipment
- Cardiology
- Dialysis

- Pulmonary ventilators
- Nuclear medicine
- Laboratory equipment for in-vitro diagnosis
- Analyzers
- Freezers
- Fertilization tests
- Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability

9- Monitoring and Control Instruments

- Smoke detector
- Heating regulators
- Thermostats
- Measuring, weighing or adjusting appliances for household or as laboratory equipment
- Other monitoring and control instruments used in industrial installations (e.g. in control panels)

10- 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
- All appliances which deliver automatically all kind of products

Basel Convention

A1010: Metal wastes and waste consisting of alloys of any of the following:

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Lead
- Mercury
- Selenium
- Tellurium
- Thallium

A1020: Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following:

- Antimony; antimony compounds
- Beryllium; beryllium compounds
- Cadmium; cadmium compounds
- Lead; lead compounds
- Selenium; selenium compounds
- Tellurium; tellurium compounds

A1030: Wastes having as constituents or contaminants any of the following:

- Arsenic; arsenic compounds
- Mercury; mercury compounds
- Thallium; thallium compounds

A1090: Ashes from the incineration of insulated copper wires

A1150: Precious metal ash from incineration of printed circuit boards not included on list B

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.

A1180: Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury switches, glass from cathode ray tubes and other activated glass and PCB capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III. Annex IX, contains the mirror entry

B1110: Electrical and electronic assemblies given below:

- Electronic assemblies consisting only of metals or alloys
- Waste electrical and electronic assemblies or scrap (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury switches, glass from cathode ray tubes and other activated glass and PCB capacitors, or not contaminated with Annex I.

A1190: Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB1, lead, cadmium, other organohalogen compounds or other Annex I constituents to an extent that they exhibit Annex III characteristics.

A2010: Glass waste from cathode ray tubes and other activated glasses

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