


# Punjab Clean Air Program (PCAP) Standard Operating Procedures (SOPs) & Guidelines for E-Waste Management

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# LIST OF ACRONYMS

| Abbreviation | Full Form |
|---|---|
| **ABC Analysis** | Analysis based on Asset value categorization (A, B, C) |
| **AQMS** | Air Quality Monitoring Station(s) |
| **BMS** | Battery Management System |
| **BOQ** | Bill of Quantities |
| **CRM** | Crop Residue Management |
| **DC** | Delivery Challan |
| **DLI** | Disbursement Linked Indicator |
| **DLR** | Disbursement Linked Result |
| **EPD** | Environment Protection Department |
| **EPA** | Environmental Protection Agency |
| **ESS** | Environmental and Social Standard(s) |
| **EV** | Electric Vehicle |
| **EHS** | Environmental, Health and Safety |
| **E-Waste** | Electronic Waste |
| **GHGs** | Greenhouse Gases |
| **GIN** | Goods Issuance Note |
| **GPS** | Global Positioning System |
| **GRN** | Goods Receipt Note |
| **IA(s)** | Implementing Agency(s) |
| **ICT** | Information and Communication Technology |
| **IAD** | Internal Audit Department |
| **LOTO** | Lock-Out / Tag-Out |
| **OBD** | On-Board Diagnostics |

| | |
|---|---|
| **OHS** | Occupational Health and Safety |
| **PCB** | Printed Circuit Board |
| **PCAP** | Punjab Clean Air Program |
| **PforR / P-for-R** | Program-for-Results |
| **PITB** | Punjab Information Technology Board |
| **$PM_{2.5}$** | Particulate Matter with diameter ≤ 2.5 microns |
| **PMTA** | Punjab Mass Transit Authority |
| **PRIDE** | Punjab Resource Improvement and Digital Effectiveness |
| **RA** | Result Area |
| **RFQ** | Request for Quotation |
| **SLA** | Service Level Agreement |
| **SLCPs** | Short-Lived Climate Pollutants |
| **SOP(s)** | Standard Operating Procedure(s) |
| **UPS** | Uninterruptible Power Supply |
| **VICS** | Vehicle Inspection and Certification System |

# Executive Summary

The Punjab Clean Air Program (PCAP) represents one of the most significant environmental initiatives undertaken by the Government of Punjab to address the persistent challenge of deteriorating air quality across the province. Designed as a multi-sectoral program, PCAP introduces a series of modern interventions across transport, agriculture, environmental monitoring, regulatory enforcement, and laboratory systems. These interventions collectively aim to reduce the concentration of particulate matter, especially $PM_{2.5}$, along with other smog-forming pollutants that continue to pose risks to public health, economic productivity, and ecological balance. With the introduction of advanced technologies such as electric buses, Crop Residue Management (CRM) machinery, Air Quality Monitoring Stations (AQMS), and modernized fuel testing laboratories, PCAP naturally generates new and complex streams of electronic waste (e- waste). These waste streams contain components such as lithium-ion batteries, electronic control units, GPS modules, circuit boards, sensors, UPS systems, digital laboratory analyzers, communication devices, and various forms of embedded electronics used across program activities. Such materials often contain hazardous metals, corrosive electrolytes, chemical residues, and ignition-prone cells. Without a clear framework for handling and disposal, this waste poses substantial risks to environmental quality, occupational health, and overall program sustainability. Accordingly, a dedicated E-Waste Management SOP Manual is essential for ensuring that these risks are systematically addressed. This manual provides a comprehensive procedural framework for managing all e-waste generated through PCAP interventions. It outlines the workflows, safety measures, institutional responsibilities, guidelines, documentation requirements, and reporting structures necessary to safeguard workers, protect communities, and ensure compliance with relevant environmental standards. The manual emphasizes safe handling practices, structured storage arrangements, secure transportation procedures, and environmentally sound recycling and disposal pathways. It aims to create uniformity across departments, enabling all implementing agencies to manage e-waste in a consistent and regulated manner.

A crucial element in the development of this manual is the foundational work carried out under the Punjab Resource Improvement and Digital Effectiveness (PRIDE) Program. The PRIDE Program produced Punjab's first standardized SOPs for ICT-related e-waste management, laying the groundwork for inventory control, maintenance procedures, condemnation processes, transportation protocols, storage requirements, and auction or disposal mechanisms. These SOPs have already been integrated into government systems, making them well understood and operationally tested. In recognition of their importance and usefulness, the PCAP E-Waste Manual incorporates the first six PRIDE SOPs in their complete

and original form. Their inclusion allows for procedural continuity and supports the extension of these practices to more complex and emerging categories of e-waste generated through PCAP activities.

While PRIDE provides the foundational framework, PCAP expands the scope of e-waste management significantly. The program's interventions create entirely new categories of electronic waste that require specific handling procedures. Electric mobility, for instance, introduces high-voltage battery systems and charger assemblies that must be stored and transported using specialized safety protocols. Super Seeder and CRM machinery generate waste streams containing GPS modules, control systems, and sensor-based electronics that require anti-static handling and controlled disposal. AQMS installations produce sensitive waste such as gas analyzers, meteorological sensors, UPS units, and communication hardware that demand careful deactivation and packaging. Modernized fuel testing laboratories introduce analytical instruments and PCB-intensive equipment that must be managed in accordance with hazardous waste standards. Even the vehicle buy-back program contributes substantial e-waste in the form of legacy electronic systems removed from older vehicles. The manual also aligns itself with the World Bank's Environmental and Social Standards, particularly ESS1 on risk assessment, ESS3 on resource efficiency and pollution prevention, ESS4 on community health and safety, and ESS10 on stakeholder engagement. These standards, along with the Basel Convention, the Punjab Environmental Protection Act, and Pakistan's Hazardous Substances Rules, form the regulatory backbone guiding all e-waste processes. By ensuring compliance with these frameworks, the manual not only meets legal requirements but also positions PCAP as a model program for sustainable environmental governance. In addition to procedural guidance, this manual introduces a strong monitoring and reporting system designed to ensure accountability at all stages of the e-waste lifecycle. This includes the maintenance of departmental e-waste registers, proper issuance and tracking of condemnation certificates, transport manifests, storage inspection reports, and annual compliance submissions. These mechanisms are essential for documenting progress, identifying gaps, and supporting continuous improvement in e-waste management practices.

In summary, the PCAP E-Waste Management SOP Manual provides a complete, structured, and future-focused approach for handling complex electronic waste streams associated with Punjab's transition toward cleaner technologies. By integrating the established PRIDE SOPs and expanding them to new sectors introduced under PCAP, the manual ensures that electronic waste is managed safely, efficiently, and in full alignment with national and international environmental safeguards. Its purpose is not only to guide daily operations but also to support the long-term sustainability, credibility, and environmental responsibility of the Punjab Clean Air Program.

# Chapter 1: Introduction

## 1. Introduction to the Punjab Clean Air Program (PCAP)

The Punjab Clean Air Program (PCAP) is a landmark initiative undertaken by the Government of Punjab in close partnership with the World Bank to address chronic air pollution challenges in the province. Punjab has experienced some of the highest levels of ambient particulate pollution (particularly $PM_{2.5}$) in South Asia, resulting in significant public health impacts, economic losses, and environmental degradation. Factors contributing to poor air quality include rapid urbanization, outdated vehicle fleets, biomass burning practices, industrial non-compliance, weak fuel quality controls, and inadequate environmental monitoring infrastructure.

PCAP provides a transformative platform to tackle air pollution through a multi-sectoral strategy that combines regulatory reforms, clean technology deployment, enhanced monitoring networks, agricultural mechanization for reduced residue burning, institutional capacity-building, and data- driven environmental governance. The program aims not only to reduce pollutant emissions but also to institutionalize systems that prevent environmental deterioration in the long term. The program brings together several implementing departments, including the Environment Protection Department (EPD), Transport Department, Agriculture Department, Industries Department, Planning & Development Board, and autonomous/subordinate bodies. Each plays a distinct role in implementing activities that can significantly influence the air quality trajectory of Punjab. PCAP follows a Program-for-Results (P for R) financing approach, disbursements are linked to specific achievements under Disbursement Linked Indicators (DLIs) and their corresponding Disbursement Linked Results (DLRs). These DLIs/DLRs serve as the backbone of the program's operational framework and ensure accountability, transparency, and performance-based progress across all sectors.

A large share of PCAP interventions relies on the procurement and use of technology-rich equipment and digital systems, such as electric buses, monitoring devices, laboratory analyzers, fuel quality testing instruments, CRM machinery, and other electronic systems. As such, the program will inevitably generate growing volumes of electronic waste (e-waste) over the coming years. This waste must be handled responsibly, following international standards and best practices, to avoid negative environmental outcomes and ensure compliance with national and World Bank's safeguards.

# Chapter 2: Background & Rationale

## 1. Background

The Punjab Clean Air Program (PCAP) is a transformative, multi-sectoral initiative aimed at significantly reducing ambient concentrations of particulate matter, short-lived climate pollutants (SLCPs), and greenhouse gases (GHGs). Designed under a Program-for-Results (PforR) framework, PCAP leverages institutional reforms, clean technology adoption, and modern environmental governance instruments to address Punjab's chronic air pollution challenges. PCAP's interventions span across three principal Result Areas, each driving technological modernization in environmental monitoring, public transportation, agricultural mechanization, and fuel quality assurance. As these interventions involve sophisticated electronic devices, high voltage systems, digital monitoring equipment, battery-powered units, and ICT infrastructure, they inevitably generate varying forms of electronic waste (e-waste). The safe handling of this e- waste is essential not only for environmental protection but also to ensure the success and sustainability of PCAP's Disbursement Linked Indicators (DLIs). This document outlines the background and rationale for establishing comprehensive Standard Operating Procedures (SOPs) for the management of e-waste across PCAP interventions.

## 2. PCAP's Technological Footprint and the Growing Need for E-Waste Management

PCAP has introduced modern hardware and digital systems across its three Result Areas. These include air quality monitors, emissions inventory tools, fuel quality testing laboratories, public transport electrification, e-mobility solutions for two- and three-wheelers, vehicle inspection equipment, and mechanized crop residue management machinery. Each of these interventions relies heavily on electronic components such as sensors, GPS units, circuit boards, data loggers, UPS and lithium-ion batteries, analyzers, actuators, diagnostic tools, ICT systems, chargers, and telematics hardware. Over the program lifecycle, these components will become obsolete, malfunction, or reach the end of their useful life creating a consistent and expanding stream of e- waste. In the absence of structured SOPs, such waste risks being informally discarded, improperly recycled, or mishandled, resulting in environmental contamination, worker safety hazards, and non-compliance with national and World Bank environmental safeguards. Therefore, the development of an E-Waste Management SOPs Manual is essential to support PCAP's environmental objectives and ensure regulatory compliance.

## 3. Rationale for E-Waste Management SOPs Based on PCAP's Three Result Areas

PCAP's three Result Areas and nine DLIs rely heavily on electronic, electrical, and battery-powered technologies. As a result, e-waste generation is inherent to the program's operational landscape. Developing comprehensive SOPs for E-Waste Management is not only essential for environmental protection but also a prerequisite for achieving DLRs, maintaining World Bank safeguard compliance, ensuring worker safety, and sustaining institutional credibility. The SOPs serve as a unified, future-oriented framework that supports Punjab's transition to cleaner technologies while ensuring that such advancements do not create new environmental challenges. With proper implementation, PCAP can become a national model for integrating air quality reforms with responsible e-waste management. The SOPs must respond to these realities by addressing risk categories, operational processes, and regulatory requirements.

### Result Area 1: Air Quality Management, Governance, and Awareness Raising

This Result Area focuses on strengthening Punjab's environmental monitoring systems, regulatory governance frameworks, institutional capacity, fuel quality enforcement, emissions inventory systems, and public awareness.

**Link to E-Waste Generation:**

| Result Area Description | Advanced Electronic Systems Deployed |
|---|---|
| Under this Result Area, PCAP deploys advanced electronic systems, including: | Regulatory-grade Air Quality Monitoring Stations |
| | Portable air quality monitors |
| | ICT infrastructure for emissions inventory development |
| | Digital platforms for public awareness and citizen engagement |
| | Fuel testing laboratory analyzers and calibration equipment |

These technologies contain sensitive electronic components, heavy metals, chemical contaminants, sensors, and batteries.

### Associated DLIs

| DLI | Description | Sources of E-Waste |
|---|---|---|
| DLI-1 | Additional regulatory-grade monitors added to the air quality monitoring network. | • Damaged analyzers<br>• Obsolete calibration modules<br>• Expired sensors<br>• UPS batteries<br>• Circuit boards and gas sampling hardware |
| DLI-2 | Integrated air pollutant/SLCP/GHG emissions inventory system developed and used routinely. | • Servers<br>• Data management systems<br>• Laptops<br>• Tablets<br>• Field instruments (end-of-life ICT e-waste) |
| DLI-3 | Fuel quality testing laboratories with mobile and fixed facilities operational. | • Digital analyzers<br>• Calibration sensors<br>• UPS batteries<br>• PCB-heavy equipment |
| DLI-4 | Interactive public information and behavioral change campaigns conducted. | • LED screens<br>• ICT tools<br>• Communication devices<br>• Other digital outreach equipment (e-waste from upgrades/malfunctions) |

## Rationale for SOPs

### Result Area 1: Necessitates SOPs that address

- Safe handling and disposal of hazardous lab equipment
- Degassing and decommissioning of AQMS analyzers

- Secure storage of damaged sensors and data loggers
- Formal mechanisms for ICT equipment disposal
- Licensed transport and recycling of hazardous battery waste

Without SOPs, devices containing toxic metals (cadmium, lithium, lead, mercury) or chemical residues pose risk to public health and the environment.

### Result Area 2: Transport Sector Abatement Measures

This Result Area focuses on reducing vehicular emissions through public transport modernization, electric mobility promotion, strengthened vehicle inspections, and removal of highly polluting vehicle

**Link to E-Waste Generation**

| Link to E-Waste Generation | Technologies Introduced |
|---|---|
| These technologies contribute to electronic waste as components reach end-of-life, become damaged, or require upgrading. | • Electric buses<br>• EV chargers and depot telematics systems<br>• Lithium-ion batteries and battery management units<br>• Digital inspection tools at VICS centers<br>• Sensors and communication units<br>• Buy-back and scrappage program equipment<br>• ICT infrastructure for fleet monitoring |

### Associated DLIs

| DLI | Description | Sources of E-Waste |
|---|---|---|
| DLI-5 | Expanded Cleaner Public Transport in Lahore Division (Electric Buses). | • EV batteries<br>• AC/DC chargers<br>• ECUs• Displays and cameras<br>• Fire-damaged or degraded battery modules |
| DLI-6 | Transition to e-2/3 wheelers (New Vehicles). | • Battery packs<br>• Controllers<br>• GPS/telematics units<br>• Chargers |
| DLI-7 | Expanded Vehicle Inspections. | • Faulty diagnostic machines<br>• Handheld analyzers<br>• OBD devices<br>• ICT systems used at test centers |
| DLI-8 | Buyback of Polluting Vehicles. | • Legacy vehicle electronics (ignition systems, alternators, ECUs, sensors, meters) |

## Rationale for SOPs

Result Area 2 requires strict SOPs because transport-related e-waste is among the most hazardous due to:

- High-voltage battery fires
- Lithium electrolyte leakage
- Toxic heavy metals
- Complex, multi-layered electronic components

### The SOPs must establish procedures covering:

- Battery isolation and fire containment
- LOTO applications for high-voltage systems
- Safe removal of on-board electronics
- Segregation of hazardous vs. non-hazardous components
- Prevention of informal-sector recycling

Given the scale of electric mobility interventions, lack of SOPs could pose major environmental and safety risks.

## Result Area 3: Agriculture Sector Abatement Measures:

Under Result Area 3 of the Punjab Clean Air Program (PCAP) Agriculture Sector, Abatement Measures, the Government of Punjab aims to reduce agricultural emissions by promoting mechanized crop residue management technologies. Open burning of crop straw has long been recognized as a major contributor to smog episodes in Punjab, generating high levels of $PM_{2.5}$, black carbon, and other pollutants that impair visibility, damage respiratory health, and degrade air quality across the province. To address this, PCAP is supporting the dissemination of Super Seeders to farmers at subsidized rates. The initiative targets widespread adoption of mechanized alternatives to burning, particularly in rice-wheat cropping systems, where residue accumulation is significant. Super Seeders enable simultaneous sowing of wheat and incorporation of rice straw into the soil, eliminating the need for post-harvest burning. As part of PCAP's clean agriculture transition, this machinery plays a critical role in reducing emissions and enhancing soil health. However, unlike traditional implements, modern Super Seeders integrate multiple electronic components essential for precision operation, monitoring, and performance tracking. These electronic systems inevitably generate electronic waste (e-waste) as they malfunction, degrade, or require replacement over time. For this reason, development of Standard Operating Procedures (SOPs) for the management of Super Seeder–related e-waste is necessary to ensure environmental safety, regulatory compliance, and sustainability of PCAP interventions.

### Technological Composition of Super Seeders and E-Waste Risks

Super Seeders procured through PCAP include modern digital components designed to support precision agriculture and compliance monitoring. These components include:

- GPS modules for geospatial tracking and performance recording

- Electronic control units (ECUs) for operation and sensor communication
- Printed circuit boards (PCBs) embedded in control modules
- Electronic sensors for depth, fuel, vibration, and moisture
- Wiring harnesses and connectors
- Battery-supported components for powering trackers
- Digital display units (optional, depending on model)

**Unlike purely mechanical implements, these electronic subsystems are vulnerable to:**

- Dust and particulate intrusion
- Moisture and field humidity
- Vibration and mechanical shock
- Heat exposure
- Wear-and-tear over multiple cropping cycles

With each failure or upgrade, the electronic components become e-waste, containing metals, plastics, embedded circuits, and sometimes hazardous substances such as lead solder or lithium- ion cells.

**Associated DLI**

| DLI | Description | Sources of E-Waste |
|---|---|---|
| DLI-9 | Expanding mechanized crop straw management (CRM machinery). | • Electronic modules<br>• PCB assemblies<br>• GPS trackers<br>• Sensor boards<br>• Battery-supported control units |

**Rationale for SOPs**

As Super Seeders become central to Punjab's clean agriculture transition, the electronic components embedded within them create new waste management challenges that must not

be overlooked. With thousands of units in circulation, improper handling of e-waste may undermine the environmental progress PCAP seeks to achieve.

**Developing SOPs for Super Seeder e-waste management ensures:**

- Rural environmental protection
- Farmer and mechanic safety
- Compliance with World Bank safeguards
- Sustainability of agricultural modernization
- Prevention of informal and unsafe recycling routes
- Long-term integrity of PCAP's Result Area 3 interventions

These SOPs, integrated into the broader PCAP framework, position Punjab as a leader in environmentally responsible agricultural technology deployment.

# 4. Cross-Cutting Rationale for Developing PCAP E-Waste SOPs

## 4.1 Ensuring Compliance with World Bank Environmental and Social Standards (ESS) ESS1, ESS3, ESS4, and ESS10

This requires robust systems to manage hazardous materials. E-waste falls squarely under ESS3 (Resource Efficiency and Pollution Prevention), demanding formal procedures for lifecycle management.

## 4.2 Ensuring Safety of Workers and Communities

Lithium-ion batteries, PCB boards, and laboratory electronics can cause chemical burns, toxic exposure, or fires. SOPs mitigate these risks by establishing:

- PPE requirements
- Controlled storage
- Handling procedures
- Emergency response mechanisms

### 4.3 Preventing Environmental Contamination

Improper e-waste disposal may contaminate soil and groundwater with:

- Lead
- Cadmium
- Mercury
- Chromium
- Persistent Organic Pollutants

SOPs ensure safe disposal and prevent illegal dumping.

### 4.4 Supporting Institutional Accountability for DLR Achievement

DLRs require traceable progress records. E-waste SOPs establish documentation tools such as:

- Inventory registers
- Condemnation forms
- Transport manifests
- Disposal certificates

These strengthen institutional transparency.

### 4.5 Preventing Informal-Sector Recycling

Informal recyclers use unsafe methods such as open burning, acid leaching, and crude dismantling. SOPs ensure PCAP components are routed only to authorized facilities.

### 4.6 Institutional Capacity Assessment Framework Supporting SOP Implementation

This table presents the framework for periodic institutional capacity assessments supporting the implementation of e-waste management SOPs. The assessment evaluates capacities in inventory management, environmental safety, and vendor oversight using standardized and verifiable indicators. Results from the assessment are used to identify capacity gaps and to

design targeted training and technical assistance interventions. This feedback mechanism ensures continuous improvement in SOP compliance and overall program performance.

| Capacity Pillar | Assessment Dimension | Illustrative Indicators | Scoring Scale | Assessment Method | Use of Results |
|---|---|---|---|---|---|
| **Inventory Management** | Systems & Processes | • Existence of standardized inventory system<br>• Traceability of e-waste from collection to disposal<br>• Timeliness and completeness of reporting | 1–5 (Very Weak to Strong) | Document review; system checks | Identify training needs on inventory systems, data management, and reporting |
| | Data Quality | • Accuracy and consistency of records<br>• Frequency of data updates | 1–5 | Data audits; spot checks | Targeted TA on data validation and quality assurance |
| **Environmental Safety & OHS** | SOP Compliance | • Adherence to SOPs for handling, storage, and transport<br>• Proper use of PPE | 1–5 | Site inspections; compliance audits | Targeted training on SOP application and workplace safety |
| | Risk Management | • Incident reporting mechanisms in place<br>• Emergency preparedness and response capacity | 1–5 | Interviews; drill reviews | TA on risk mitigation and emergency response |
| **Vendor Oversight & Compliance** | Licensing & contracting | • Use of licensed recyclers and disposal facilities<br>• Clear contractual environmental obligations | 1–5 | Contract review; registry checks | Strengthen procurement and contracting capacity |
| | Monitoring & Enforcement | • Frequency of vendor audits<br>•Documentation of non-compliance and corrective actions | 1–5 | Audit reports; inspection records | TA on compliance monitoring and enforcement |

# Chapter 3: Acknowledgement of PRIDE Program & Framework Integration

The PRIDE Program pioneered the first formal ICT E-Waste SOPs in Punjab. PCAP acknowledges this contribution and adopts the core SOP modules on inventory, maintenance, condemnation, transportation, storage, and disposal.

## 1. Introduction

The Punjab Resource Improvement and Digital Effectiveness (PRIDE) Program introduced the first standardized and government-endorsed framework for e-waste management in Punjab. Prior to PRIDE, e-waste handling across government departments was inconsistent, undocumented, and largely dependent on informal practices. No systematic guidelines existed for equipment tracking, condemnation, secure storage, internal transfers, or environmentally sound disposal. PRIDE changed this landscape by establishing a structured, institutionalized set of six Standard Operating Procedures (SOPs) designed specifically for the management of ICT-related electronic waste across provincial departments. These SOPs created a unified practice that could be adopted by all government entities to improve traceability, accountability, and compliance with national and international standards. As the Punjab Clean Air Program (PCAP) introduces modern technologies across environmental monitoring, cleaner transport, agriculture machinery, fuel testing laboratories, and public information systems, PCAP will generate large volumes of e-waste throughout its lifecycle. To ensure responsible management of this e-waste and to maintain consistency with existing government practice, PCAP has adopted the core six SOPs developed under PRIDE.

## 2. Overview of PRIDE's Core Six SOPs

PRIDE developed detailed SOPs, each addressing a critical step in the lifecycle of electronic equipment. While originally designed for ICT equipment, each SOP contains principles, workflows, and administrative mechanisms that are universally applicable to electronic waste management across sectors including transport, agriculture, environmental monitoring, and laboratories.

### 1. SOP-01: Establishment of ICT Inventory:

This SOP outlines procedures for establishing and maintaining an updated inventory of all equipment, including computers, diagnostic devices, sensors, UPS systems, and peripheral electronics. It standardizes:

- Data fields for inventory
- Responsibility assignment
- Asset lifecycle tracking
- Systematic recording of damaged or obsolete equipment

### 2. SOP-02: Maintenance of ICT Equipment:

This SOP introduces regular maintenance procedures to prolong equipment lifespan and reduce premature waste generation. It includes:

- Routine inspection cycles
- Basic troubleshooting
- Documentation of equipment repairs
- Preventive maintenance schedules

### 3. SOP-03: Declaration of Condemned ICT Equipment:

This SOP formalizes the process of identifying equipment that is beyond repair and requires disposal. It establishes:

- Criteria for condemnation
- The Technical Committee's role
- Documentation and verification processes
- Approval workflow before condemnation

### 4. SOP-04: Inter-Departmental Transportation of Condemned ICT Equipment:

This SOP defines safe and accountable procedures for transporting e-waste from departments to central storage facilities or authorized recyclers. It covers:

- Transport permissions
- Packaging and labeling
- Movement logs
- Chain-of-custody records

### 5. SOP-05: Storage of Condemned ICT Equipment:

This SOP sets requirements for safe storage of e-waste, including:

- Segregation by type and hazard level
- Ventilation and safety controls
- Access restrictions
- Inventory reconciliation procedure

### 6. SOP-06: Auction / Disposal of E-Waste:

This SOP governs the final disposal of e-waste through auction or transfer to authorized recyclers. It provides:

- Procedures for auction committees
- Requirements for EPA-approved recyclers
- Documentation and compliance certificates
- Recordkeeping and reporting

Collectively, these SOPs form a complete lifecycle framework, rom procurement to disposal, ensuring a controlled, transparent, and environmentally responsible e-waste management process.

## 3. Why PCAP Is Adopting PRIDE's Core Six SOPs:

As PCAP expands its technological operations, several factors justify the adoption of PRIDE's SOPs as the foundational structure for PCAP's E-Waste Management Manual.

### 3.1 Institutional Continuity and Government-Wide Harmonization

PRIDE's SOPs have already been adopted across several provincial departments. Their use under PCAP promotes:

- Cross-departmental consistency
- Administrative familiarity

- Harmonized reporting formats
- Avoidance of duplicative systems
- Smooth coordination between PCAP, EPD, Transport, Agriculture, PITB, and other agencies

Institutional continuity also reduces training costs and avoids confusion arising from multiple parallel procedures.

### 3.2 Proven, Field-Tested Procedures

PRIDE's SOPs were developed through extensive consultation, piloted across departments, and refined based on real administrative challenges. They have demonstrated effectiveness in:

- Maintaining accurate electronic inventories
- Ensuring accountability in transfers and storage
- Preventing loss, theft, or misplacement of assets
- Ensuring safe disposal through authorized recyclers

PCAP benefits from this tested and mature system rather than creating new SOPs from scratch.

### 3.3 Applicability Beyond ICT Equipment:

While PRIDE's SOPs were designed for ICT waste, their structure is universally applicable to any type of e-waste, including:

- AQMS analyzers
- PCB boards in monitoring stations
- Electric bus components (ECUs, sensors, batteries)
- Fuel laboratory analyzers
- GPS modules in Super Seeders
- Vehicle inspection scanners
- Digital displays and communication units

### 3.4 Strong Governance and Transparency:

PCAP is a results-based financing program requiring transparent documentation for DLR verification. PRIDE's SOPs provide:

- Standardized forms
- Audit trails
- Chain-of-custody records
- Condemnation certificates
- Transport manifests
- Disposal certificates

This documentation is essential for verifying compliance with World Bank environmental safeguards and internal accountability requirements.

### 3.5 Alignment with World Bank Environmental and Social Standards (ESS1, ESS3, and ESS4):

World Bank ESS requirements mandate safe handling, controlled disposal, and traceability of hazardous materials. PRIDE's SOPs help PCAP meet these obligations by ensuring:

- Pollution prevention measures (ESS3)
- Worker safety and hazard controls (ESS4)
- Lifecycle management of equipment (ESS1)

They also help demonstrate compliance during annual audit missions and environmental performance reviews.

### 3.6 Scalable Framework for PCAP's Expanded E-Waste Streams:

| PRIDE SOPs (Core Framework) | Additional PCAP SOPs/Guidelines Needed | Focus Area |
|---|---|---|
| Provide a scalable administrative and procedural foundation for environmental and e-waste management. | Lithium-ion battery handling for electric buses | Safe handling, storage, and disposal of EV batteries |
| | Calibration waste and PCB-heavy analyzers from fuel labs | Managing hazardous lab electronic waste |
| | AQMS instrument decommissioning | Responsible retirement of air quality monitoring instruments |
| | Telematics and GPS units in CRM machinery | Disposal and data security for embedded electronics |
| | Buy-back vehicle electronics | Handling legacy ECUs, sensors, meters, and other components |
| Overall Link | The foundational SOPs establish the structure; PCAP adds technical guidelines for the new technologies introduced under the program. | Integration of administrative and technical e-waste management |

### 3.7 Risk Reduction and Environmental Safeguards:

Adopting PRIDE SOPs reduces environmental risks by:

- Ensuring controlled storage
- Preventing informal sector recycling
- Eliminating unauthorized dumping
- Mandating authorized recyclers
- Controlling hazardous battery waste

This strengthens PCAP's environmental integrity and protects communities from exposure to harmful substances.

### 3.8 Supports Efficient Implementation Across PCAP Result Areas:

PRIDE's SOPs support all three PCAP Result Areas:

**Result Area 1:** Monitoring equipment and fuel labs generate ICT-like e-waste → manageable through core SOPs.

**Result Area 2:** EV buses, chargers, telematics, and vehicle inspection tools follow lifecycle processes identical to ICT → inventory, maintenance, condemnation, storage, disposal.

**Result Area 3:** Super Seeder electronics (GPS, control units, sensors) must be inventoried, condemned, stored, and disposed through controlled workflows → same SOP governance.

PRIDE's six core SOPs provide a robust, proven, and government-approved foundation for the lifecycle management of electronic waste. Their adoption by the Punjab Clean Air Program ensures that PCAP benefits from:

- Institutional consistency across government
- Tested and field-validated procedures
- A strong governance and reporting structure
- Compliance with national and international environmental safeguards
- A scalable administrative backbone capable of supporting emerging technology

By integrating PRIDE's SOPs into PCAP's expanded e-waste management framework, the Government of Punjab positions PCAP as a model of responsible, transparent, and sustainable environmental program implementation. The adoption of these SOPs ensures that PCAP's modern technologies, while aimed at reducing air pollution, do not themselves become sources of new environmental harm.

# Chapter 4: Scope, Definitions, Legal, Regulatory & World Bank Safeguard Alignment

The Punjab Clean Air Program (PCAP) operates within a clearly defined legal and safeguard landscape that combines national environmental regulations, provincial laws, international conventions, and the World Bank's Environmental and Social Framework. The development and implementation of Standard Operating Procedures (SOPs) for e- waste management under PCAP must therefore be firmly rooted in this framework. Proper alignment is not only a compliance requirement; it is also essential to ensure that PCAP's clean air interventions do not inadvertently create new environmental or health risks through unmanaged electronic waste.

## 4.1 Objective and Applicability

This section forms part of the Environmental and Social Management System (ESMS) of the Punjab Clean Air Program (PCAP) and establishes the scope, definitions, and legal framework governing the management of electronic waste (e-waste) generated under the Program.

The objective of this section is to ensure that all e-waste arising from PCAP-financed activities is managed in a manner consistent with:

- Applicable national and provincial environmental legislation,
- Pakistan's international obligations, and
- The World Bank Environmental and Social Framework (ESF) applicable to Program-for-Results (PforR) financing.

The provisions of this section apply to all Implementing Agencies (IAs), contractors, vendors, service providers, and facilities involved in the procurement, operation, maintenance, replacement, storage, transport, recycling, or disposal of electronic equipment under PCAP.

## 4.2 Scope of E-Waste

For the purposes of the PCAP ESMS, e-waste includes all electrical and electronic equipment and components financed, owned, operated, or retired under the Program that have reached end-of-life, become obsolete, or are declared condemned.

E-waste under PCAP is generated across all Result Areas and Disbursement Linked Indicators (DLIs) and includes, but is not limited to:

### a. ICT and Digital Systems

- Servers, computers, tablets, communication devices, and peripherals
- Digital display systems and public information equipment

### b. Environmental Monitoring and Laboratory Systems

- Air Quality Monitoring Station (AQMS) analyzers and sensors
- Calibration equipment, laboratory analyzers, and UPS systems

### c. Transport Sector Interventions

- Electric bus batteries, battery management systems, chargers, and ECUs
- Vehicle inspection, diagnostics, and telematics equipment
- Electronic components removed through vehicle buy-back programs

### d. Agricultural Mechanization

- GPS units, electronic control modules, sensors, and PCB boards embedded in Super Seeders and CRM machinery

### e. Batteries and Energy Storage

- Lithium-ion batteries, lead-acid batteries, and other embedded energy storage systems

## 4.3 Definitions

- **Electronic Waste (E-Waste / WEEE):**
  Electrical or electronic equipment, including components and accessories, that has been discarded or is intended for disposal.
- **Hazardous E-Waste:**
  E-waste containing substances or components that pose environmental, health, or safety risks, including heavy metals, toxic chemicals, flammable electrolytes, corrosive substances, or high-voltage elements.

- **Authorized Facility:**
  A recycler, transporter, or disposal facility holding valid licenses or approvals from the relevant Environmental Protection Agency.

- **Chain-of-Custody:**
  A documented system of control ensuring traceability of e-waste from the point of generation through final recycling or disposal.

- **Condemned Equipment:**
  Equipment formally declared obsolete or non-functional in accordance with approved procedures and classified as e-waste.

### 4.4 Legal and Regulatory Framework

E-waste management under PCAP shall be carried out in compliance with the following legal and regulatory instruments, as applicable:

#### National and Provincial Laws

- Pakistan Environmental Protection Act, 1997
- Punjab Environmental Protection Act, 2012
- Hazardous Substances Rules, 2003
- National Hazardous Waste Management Policy, 2022
- Punjab Occupational Safety and Health Act, 2019

#### International Obligations

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

Transboundary movement of hazardous e-waste is not permitted under PCAP, unless explicitly authorized under applicable law and fully compliant with Basel Convention requirements.

### 4.5 Alignment with World Bank Environmental and Social Standards

E-waste management under PCAP is an integral part of the Program's environmental risk management and is aligned with the following World Bank Environmental and Social Standards:

## ESS1 – Environmental and Social Risk Management

ESS1 on Assessment and Management of Environmental and Social Risks and Impacts requires that the program anticipate and manage environmental risks arising from its activities. The deployment of AQMS networks, digital fuel testing laboratories, electric buses, charging infrastructure, vehicle inspection systems and Super Seeders all generate electronic and hazardous waste as an inherent side effect. By developing detailed, activity-specific guidelines for AQMS e-waste, EV and depot components, Super Seeders, fuel labs and buy-back vehicles and anchoring them in the PRIDE lifecycle framework of inventory, maintenance, condemnation, storage, transport and disposal— PCAP demonstrates that these risks have been systematically identified and addressed at the operational level. PCAP identifies e-waste as an inherent environmental risk associated with technology-intensive interventions and manages this risk through defined procedures for inventory, handling, storage, transport, and disposal.

## ESS3 – Resource Efficiency and Pollution Prevention

ESS3 on Resource Efficiency and Pollution Prevention and Management is directly connected to the prevention of uncontrolled e-waste disposal and pollution. This standard emphasizes waste minimization, proper management of hazardous materials and the promotion of reuse and recycling where feasible. PCAP's SOPs take these principles into account in several ways: they encourage preventive maintenance to extend equipment life, require repair and refurbishment where safe and economical, insist on the segregation of reusable and non-reusable components, and mandate that all final disposal and recycling of hazardous electronic components be carried out only through authorized, environmentally compliant facilities. The SOPs for fuel testing laboratories, for instance, clearly distinguish between ordinary ICT scrap and chemically contaminated e-waste, ensuring that the latter is treated as hazardous waste and not mixed with general recyclables. The Program promotes waste minimization, reuse where feasible, environmentally sound recycling, and controlled disposal of hazardous electronic waste.

## ESS4 – Community Health and Safety

ESS4 on Community Health and Safety is equally important, given the potential for battery fires, chemical exposure, and informal scavenging of discarded electronics. If lithium-ion packs, PCB boards, or contaminated analyzers are discarded in open fields, near communities or through informal recycling chains, they pose serious risks to workers, farmers, mechanics and nearby residents. The PCAP e-waste SOPs respond to ESS4 by requiring controlled storage conditions (e.g., fire-safe battery rooms, ventilated storage for contaminated electronics), use of appropriate personal protective equipment, emergency response plans for spills and fires, and strict prohibition of informal burning or dumping of electronic components. This is reflected clearly in

the SOPs for electric bus depots, Super Seeders and buy-back vehicle dismantling, which all emphasize worker training, PPE and safe dismantling techniques.

In these SOPs Measures are in place to prevent exposure of workers, farmers, depot staff, and communities to risks associated with battery fires, chemical releases, and informal recycling.

### ESS10 – Stakeholder Engagement and Grievance Redress

Information on safe e-waste handling and disposal is integrated into PCAP's stakeholder engagement activities, and grievances related to e-waste are addressed through the Program's Grievance Redress Mechanism (GRM). ESS10 on Stakeholder Engagement and Information Disclosure comes into play where farmers, mechanics, depot staff and laboratory personnel interact with e-waste. Although ESS10 is often associated with consultations and public communication, in the context of e-waste management it also implies that stakeholders must be informed of associated hazards and proper handling rules. The PCAP SOPs therefore envisage awareness sessions for farmers receiving Super Seeders, orientation for depot staff managing EV batteries, and training for laboratory technicians and inspectors so that they understand not only how to operate equipment, but also how to handle and segregate waste at the end of its life. This is consistent with the behavioral change and awareness-raising objectives of Result Area 1. Stakeholder engagement and grievance redress mechanisms established under PCAP apply to all e-waste management activities, ensuring that affected stakeholders can raise concerns and receive timely responses in accordance with ESS10.

In addition to the ESSs, the World Bank's Environmental, Health, and Safety (EHS) Guidelines provide technical reference points. The general EHS Guidelines and sector- specific guidance for waste management, battery handling and laboratory safety inform detailed provisions in PCAP's SOPs, such as requirements for spill containment, ventilation, labeling, secondary containment for batteries, and segregation of incompatible waste streams. By referencing these guidelines in the SOPs, PCAP aligns its operational instructions with international good practice, making it easier to demonstrate due diligence during supervision and audit missions. Finally, the decision to base PCAP's e-waste SOPs on the PRIDE structure creates a direct bridge between program-level safeguards and existing government systems. The PRIDE SOPs already reflect core legal and regulatory expectations: they define inventory responsibilities, enforce proper condemnation procedures, standardize transport documentation through manifests, and require the involvement of authorized recyclers. PCAP's additional guidelines for AQMS, electric buses and depots, Super Seeders, fuel testing laboratories and buy-back vehicles simply extend this tested framework into new technical domains, while keeping full alignment with Pakistan's legal regime and the World Bank safeguard architecture. In sum, the legal, regulatory and safeguard alignment of PCAP's e-

waste management SOPs ensures that the program's efforts to clean the air are matched by equally robust efforts to prevent new forms of pollution and risk. By embedding national law, provincial regulation, international conventions and World Bank standards directly into the design and content of its SOPs, PCAP establishes an integrated, compliant and future-proof system for managing the electronic waste generated by its own interventions.

At the national level, e-waste management is governed primarily through the Pakistan Environmental Protection Act and subsidiary hazardous substances and hazardous waste rules, complemented by national policies on hazardous waste and chemicals. These instruments define hazardous substances, regulate their handling, storage, transportation and disposal, and require that any activity involving hazardous materials must prevent pollution and safeguard public health. Since a large part of PCAP's e-waste such as lithium-ion batteries, lead-acid UPS units, PCB-based analyzers, sensors, and contaminated laboratory electronics fall into the hazardous category, the SOPs developed for PCAP must reflect the same principles: controlled handling, prevention of releases, and routing of waste only to authorized facilities. At the provincial level, the Punjab Environmental Protection Act and the rules made thereunder empower the Punjab Environmental Protection Department (EPD) and the Punjab EPA to regulate hazardous waste, license recyclers, enforce environmental standards and inspect facilities. This means that any e-waste flow generated by PCAP whether from Air Quality Monitoring Stations (AQMS), electric buses and depots, Super Seeders, fuel testing laboratories, or buy-back vehicles must be managed in such a way that it can withstand scrutiny by provincial regulators. By basing PCAP's SOPs on the already-approved PRIDE framework and explicitly linking storage, transport and disposal steps to provincial licensing and approval requirements, the program ensures that its internal procedures are fully compatible with the enforcement role of Punjab EPA.

Internationally, Pakistan is party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Although PCAP's e-waste is expected to be managed domestically, the Basel principles still apply: hazardous wastes must be minimized, managed in an environmentally sound manner, and prevented from being exported to facilities that cannot handle them properly. The SOPs developed for PCAP especially for high-risk waste streams like lithium-ion batteries from electric buses and e-2/3 wheelers, chemical-contaminated laboratory instruments, and PCB-heavy analyzers—translate these obligations into operational practice by requiring use of licensed hazardous waste recyclers, prohibiting informal export or sale of hazardous components, and documenting each step through manifests and disposal certificates. The World Bank's Environmental and Social Framework adds another critical layer to this alignment. PCAP is financed under a Program-for-Results (PforR) modality, which ties disbursements to measurable outcomes; but it must simultaneously respect the principles

embedded in key Environmental and Social Standards (ESS). For e-waste management, three standards are particularly relevant.

Note: *Under PCAP, disposal of e-waste through informal scrap dealers, kabarias, or unlicensed dismantlers is prohibited, regardless of economic value or reuse potential. All third-party vendors engaged for e-waste handling under PCAP shall be subject to due diligence and audit requirements as part of the Program's Environmental and Social Management System.*

### 4.6 E-Waste Management Performance Indicators under PCAP

To ensure effective implementation of the E-Waste Management SOPs under PCAP, Implementing Agencies (IAs) shall monitor performance using a set of simple, measurable, and auditable Key Performance Indicators (KPIs). These indicators enable PCAP and IAs to track compliance with environmental and safety requirements, verify that e-waste is handled through authorized channels, and identify operational gaps requiring corrective action.

The KPI framework supports the Program's Environmental and Social Management System (ESMS) by providing evidence-based monitoring aligned with ESS1 (risk management) and ESS3 (pollution prevention). Regular monitoring of these indicators helps assess institutional performance, improve recordkeeping, strengthen accountability, and support reporting to PCAP management and the World Bank.

**Table I-1: E-Waste Management Key Performance Indicators**

| KPI Code | Indicator | Unit of Measurement | Source of Verification | Reporting Frequency | Responsible Official |
|---|---|---|---|---|---|
| **KPI-EW-01** | Total e-waste generated | No. of items / kg | Asset Inventory Register, Condemnation Records | Quarterly | Site In-Charge / Storekeeper |
| **KPI-EW-02** | E-waste transferred to authorized recyclers | No. of items / kg | Shipment Manifest, Custody Transfer Forms | Quarterly | E-Waste Manager |
| **KPI-EW-03** | Certificates of recycling/destruction received | Number | Recycling/Disposal Certificates | Quarterly | E-Waste Manager |

| KPI Code | Indicator | Unit of Measurement | Source of Verification | Reporting Frequency | Responsible Official |
|---|---|---|---|---|---|
| **KPI-EW-04** | Storage inspections conducted | Number | Storage Inspection Log | Monthly / Quarterly | Store Manager / Site In-Charge |
| **KPI-EW-05** | Vendor audits conducted | Number | Vendor Audit Checklist | Annual | E-Waste Manager / Internal Audit |
| **KPI-EW-06** | E-waste incidents reported and addressed | Number | Incident Report Forms | Quarterly | Site In-Charge / E-Waste Manager |
| **KPI-EW-07** | Staff trained on e-waste SOPs | Number of staff | Training Attendance Records | Annual | IA Administration / HR |
| **KPI-EW-08** | Percentage of e-waste disposed through licensed facilities | Percentage (%) | Disposal Certificates and Vendor Records | Quarterly | E-Waste Manager |

## Implementation Guidance

1. KPI data shall be compiled by Implementing Agencies using records generated under SOP-01 to SOP-07.

2. The designated E-Waste Manager or E&S Focal Person shall consolidate KPI data on a quarterly basis.

3. KPI reports shall be reviewed by Implementing Agencies and shared with PCAP for program-level monitoring.

4. KPI trends shall be used to identify operational gaps, improve compliance, and support environmental and social performance reporting.

5. All KPI-related documentation shall be retained for internal audit and World Bank supervision, as applicable.

## Green Procurement and Vendor Take-Back Requirements

To promote resource efficiency and lifecycle responsibility in accordance with ESS3 and Good International Industry Practice (GIIP), all Implementing Agencies (IAs) shall incorporate green procurement and vendor take-back provisions into procurement documents, contracts, and technical specifications for electronic equipment financed under PCAP.

The following minimum requirements shall apply:

1. Energy Efficiency and Durability
    - Preference shall be given to equipment meeting recognized energy efficiency standards.
    - Equipment shall be selected based on durability, reparability, and availability of spare parts.
2. Extended Warranty
    - Procurement documents shall require minimum warranty coverage consistent with industry standards to extend useful life and reduce premature e-waste generation.
3. Reparability and Upgradeability
    - Where feasible, preference shall be given to modular equipment that allows component replacement rather than full unit disposal.
4. Vendor Take-Back Mechanisms
    - Bidding documents shall require suppliers to disclose available take-back, recycling, or refurbishment programs.
    - Where feasible, suppliers shall provide free-of-charge take-back of end-of-life equipment supplied under PCAP.
5. Extended Producer Responsibility (EPR) Compliance
    - Vendors shall demonstrate compliance with applicable national hazardous waste regulations.
    - Evidence of environmentally sound recycling or recovery pathways shall be required.

Failure to comply with these requirements may result in disqualification during procurement or contract termination in case of non-performance.

# Chapter 5: PCAP Waste Streams & Risk Profiles

## Result Area 1: Air Quality Management, Governance & Awareness

Result Area 1 introduces regulatory-grade monitoring systems, digital emissions inventory tools, fuel testing laboratories, and ICT-based public information platforms. These systems produce e-waste that is often chemically contaminated, PCB-heavy, or battery-dependent.

### Key Waste Streams under RA-1:

| Result Area (RA-1) | Key Waste Streams |
|---|---|
| RA-1: Air Quality Monitoring, Emissions Inventory Systems, Public Information, and Fuel Testing Activities | • Sensors, gas analyzers, UV photometers<br>• Electronic pumps, PCB boards<br>• Calibration cylinders and sampling modules<br>• UPS and lead-acid batteries<br>• ICT equipment (servers, tablets, LED displays)<br>• Laboratory analyzers, digital meters, spectroscopy devices |

**Risk Profile**

These components may contain hazardous substances such as heavy metals (lead, mercury, chromium), corrosive chemicals, high-voltage capacitors, and lithium batteries. Their improper disposal may contaminate air, soil, and groundwater. Additionally, broken analyzers and sensors pose occupational risks due to chemical residues and sharp metal edges.

## Result Area 2: Transport Sector Abatement Measures:

Result Area 2 deploys electric buses, e-2/3 wheelers, vehicle inspection hardware, and buy-back scrappage systems. This result area generates large volumes of high-risk e- waste, including high-voltage lithium-ion batteries.

| Result Area (RA-2) | Key Waste Streams |
|---|---|
| RA-2: Cleaner and Electric Transport (Buses, 2/3-Wheelers, Inspection, Buy-Back) | • Lithium-ion battery packs (EV buses, e-bikes, e-rickshaws) Battery management systems (BMS)<br>• ECUs, telematics units, GPS systems<br>• EV chargers and power modules<br>• On-board diagnostics, CCTV, LED displays<br>• Obsolete vehicle electronics from buy-back vehicles |

### Risk Profile

Transport-related e-waste has the highest hazard potential due to risks such as thermal runaway, electrical shock, fire hazards, electrolyte leakage, and emissions from burning lithium-based materials. Legacy vehicle electronics contain lead solder, plastic casings, and copper wires that can release toxic fumes if informally recycled.

## Result Area 3: Agriculture Sector Abatement Measures:

Result Area 3 supports the subsidized distribution of Super Seeders and other CRM machinery. These machines contain embedded electronics essential for precision agriculture and performance monitoring.

### Key Waste Streams under RA-3

- GPS modules and telemetry devices
- PCB cards and control boards
- Motion and vibration sensors
- Battery-supported modules
- Wiring harnesses and connector assemblies

### Risk Profile

Waste generated in rural environments can easily enter open landfills or be burned in fields. This exposes farmers and rural communities to chemical fumes, heavy metals, and battery hazards.

Moisture, dust, and mechanical stress further degrade electronic components, increasing waste frequency.

## 3. Consolidated Table: PCAP Waste Streams & Risk Profile (By Result Area and DLI)

Below is a **master table** summarizing each DLI, the associated waste streams, and a risk rating based on environmental and occupational hazards.

**Table: PCAP Waste Streams & Risk Profile by DLI**

| Result Area | DLI | Associated PCAP Intervention | Waste Streams Generated | Hazard / Risk Profile |
|---|---|---|---|---|
| RA-1: Air Quality Management, Governance & Awareness | **DLI-1** | **Expansion of AQMS network** | **PCB boards, sensors, pumps, gas analyzers, UPS batteries** | High risk (chemical exposure, heavy metals, battery leakage) |
| | **DLI-2** | **Emissions inventory system** | **Servers, ICT hard ware, communication modules** | Medium risk (ICT waste, data storage components) |
| | **DLI-3** | **Fuel quality testing labs operational** | **Lab analyzers, spectroscopy devices, PCB-heavy instruments, UPS** | High risk (chemical contamination, PCB toxicity) |
| | DLI-4 | Public information & awareness campaigns | LED screens, display units, ICT tools, power supplies | Medium risk (ICT scrap, fluorescent components) |
| **Result Area** | **DLI** | **Associated PCAP Intervention** | **Waste Streams Generated** | **Hazard / Risk Profile** |

| | | | | |
|---|---|---|---|---|
| RA-2: Transport Sector Abatement Measures | DLI-5 | Electric Buses deployed | High-voltage batteries, ECUs, telematics, chargers, screens | Very high risk (fire hazard, electrolyte leakage, thermal runaway) |
| | DLI-6 | Transition to e-2/3Ws | Lithium-ion packs, controllers, GPS devices, chargers | High risk (flammable batteries, circuit failures) |
| | DLI-7 | Expanded vehicle inspections | Diagnostic tools, OBD scanners, test system electronics | Medium risk (ICT-type waste, plastic casings, PCBs) |
| | DLI-8 | Buyback of polluting vehicles | Legacy ECUs, wiring, meters, alternators, sensors | High risk (mixed electronic waste, heavy metals) |
| RA-3: Agriculture Sector Abatement Measures | DLI-9 | Mechanized crop straw management (Super Seeders) | GPS units, PCB boards, sensors, wiring harnesses | Medium–High risk (heavy metals, battery modules) |

# Chapter 6: National Regulations Relevant to E-Waste Management

## 1. Pakistan Environmental Protection Act,1997

Pakistan Environmental Protection Act 1997 is a fundamental piece of legislation that gives the government the power to formulate rules and regulations for environmental protection. It is a comprehensive legislation offering the fundamental legal basis for preserving, enhancing, and protecting the environment. The legislation covers a wide variety of concerns, including the treatment of hazardous wastes, air, water, soil, marine, and noise pollution. Sections 13 and 14 of the Act deal with environmental pollution control related to hazardous waste. No individual is allowed to transport hazardous waste into Pakistan, its territorial seas, its Exclusive Economic Zone, or its historic waterways, according to Section 13 of the Constitution, which forbids such importation. No person is allowed to create, collect, consign, transport, treat, dispose of, store, handle, or import hazardous waste without first obtaining a license from the Federal Environmental Protection Agency and following any applicable regulations or in accordance with the terms of any other law or any provisions of any international treaty, convention, protocol, code, standard, agreement, or other instruments to which Pakistan is a party. This is stated in Section 14, "Handling Hazardous Substances."

## 2. Hazardous Substance Rules, 2003

The import and transportation of hazardous substances from a Federal or Provincial Environmental Protection Agency will be subject to licensing requirements under the HazardousSubstanceRegulations2003.The Environmental Impact Assessment report and safety plan will also be submitted with the license application for any industrial operation involving the production, collection, consignment, transit, treatment, disposal, storage, handling, or import of hazardous chemicals. The licensee will report each significant accident happening at a licensed facility to provincial and federal authorities. There will be requirements for packaging and labelling as well as worker and workplace safety measures that must be adhered to. The provincial or federal employees may inspect the licensed establishment.

## 3. National Environmental Policy, 2005

Pakistan's environmental issues, notably inefficient waste management that can severely influence the ecosystem, are addressed in the National Environmental Policy, 2005. It suggests using legislative initiatives to ensure the limiting, recycling, and control of harmful emissions from

waste. It promotes the establishment of a licensing system for businesses involved in waste management.

## 4. Punjab Environmental Protection Act, 2012

Sections 13 and 14 of the Punjab Environmental Protection Act 2012 cover environmental pollution control related to hazardous waste. No one is allowed to bring hazardous waste into the territory of Punjab, as stated in Section 13 of the law. It is against the law to produce, collect, relegate, transport, treat, dispose of, store, handle, or import hazardous waste unless authorized by a license or in accordance with the terms of another law or an international treaty, code, convention, protocol, agreement, standard, or other instrument to which Pakistan is a party, according to Section 14 of the law on handling hazardous substances. “Suppose the provincial agency determines that the release or emission of any effluent, waste, air pollutant, noise, disposal of waste, handling of a hazardous substance, or any other act or omission is likely to occur or has occurred in violation of any provision of this Act, rules, or regulations, or of the conditions of a license, or is likely to cause, or has caused, an unfavorable effect on the environment. In that case, the agency may issue an environmental protection order. After providing the individual responsible for the discharge, emission, handling, conduct, or omission an opportunity to be heard, the provincial agency may direct that person to take whatever actions it deems necessary by issuing an order.

## 5. Punjab Occupational Safety and Health Act, 2019

The employer would be tasked with ensuring the workers' health and safety at work under the terms of this Act. According to the law, employers, site managers, and employees are all required to guarantee that certain health and safety standards are met. The Chief Inspector and the inspectors designated under the Act are accountable for enforcing the legislation's health and safety regulations. If the conditions are not met, penalties will be applied. The Act gives information regarding employers' obligations towards their employees' health and safety.

## 6. Pakistan Penal Code

The Pakistan Criminal Code describes offences that result from the purposeful or unintentional wrongdoing of a person or group of persons and that impact public or private property, as well as human life. Penalties for infractions involving air, water, and land pollution are laid forth in the Code.

## 7. National Hazardous Waste Management Policy, 2022

The policy aims to facilitate the implementation of international treaties and conventions at the national level to improve the definition and implementation of Hazardous Waste Management (HWM) for better environmental management, clarify institutional responsibilities related to HWM, and strengthen the management of hazardous and other wastes. As these matters are pivotal for reducing environmental pollution, the Policy on HWM has the following main objectives:

- To facilitate the implementation of the relevant provisions of the Basel Convention, the Stockholm Convention, and the Minamata Convention on Mercury at the national level.
- To prevent, minimize, and control hazardous waste generation in the country
- To control the transboundary movements of hazardous waste.
- To create an enforcement mechanism through an effective regulatory framework and monitoring, inspection, and verification system.
- To build the capacity of all relevant stakeholders for Environmentally Sound Management of hazardous waste in Pakistan.

# Chapter 7: SOPs for E-Waste Management System Adopted From PRIDE

The following SOPs have been prepared for the e-waste management of PCAP's IAs. These SOPs describe the steps to be undertaken by Ias of PCAP for the establishment of an electronic equipment inventory, which is a prerequisite for e-waste management. The ICT Equipment Inventory and E-Waste Management system shall be developed either through an online database or manually. These SOPs outline the procedures to be adopted for the establishment of an electronic equipment inventory and the processes for the collection, segregation, off-site transportation, handling, recycling, and disposal of e-waste in an environmentally sound manner.

The SOPs have been developed for the environmentally safe management of e-waste by PRIDE partner organizations. Therefore, the same SOPs will be followed under PCAP, keeping in view the requirements of the interventions to be undertaken during the program. There is a need for every PCAP Implementing Agency (IA) to nominate an "E- Waste Manager / Section Officer" who will be responsible for establishing the e-waste management system and overseeing its implementation in accordance with the SOPs described hereunder.

## SOP-01: Establishment of Equipment inventory

### Purpose

This SOP aims to define procedures for the establishment of an inventory for all equipment, which will eventually become e-waste with the passage of time.

### Scope

This Procedure is applicable to each PCAP Partner.

### Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012).

### Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers.

| Designation | Role | Key Responsibilities |
|---|---|---|
| **Head of Implementing Agency / Asset Owner** | Accountable Authority | Overall accountability for establishment and maintenance of the equipment inventory system; ensures institutional compliance with e-waste SOPs. |
| **E-Waste Manager / Section Officer** | Responsible Officer | Establishes and maintains the equipment inventory and asset tracking system; assigns unique asset IDs; ensures periodic verification and reporting. |
| **Site In-Charge / Storekeeper** | Custodian | Maintains physical custody of equipment; ensures correct tagging, labeling, and location records; reports damaged or obsolete equipment. |
| **IT / Technical Officer** | Technical Support | Provides technical verification of equipment status; supports tagging, data entry, and lifecycle tracking. |
| **Internal Audit Department (IAD)** | Oversight | Conducts periodic verification of inventory records and physical assets; reports discrepancies and corrective actions. |

Note: Each item of electronic equipment shall be assigned a unique Asset Identification Number (AIN), linked to serial number, location, custodian, and lifecycle status. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

## Procedure

- Inventory for equipment shall be maintained, including servers, desktops, laptops, printers, scanners, gas Analyzers, Particulate Monitors, calibrations instruments, different types of meters and testers, tablets, mobile phones, ICT hardware for digital campaigns, all types of batteries, all types of equipment pertaining to EV, wiring harness etc.,
- Equipment purchased from a vendor along with Delivery Challan (DC) shall be received by authorized personnel. Equipment received shall be compared with the Purchase Order and Delivery Challan to ensure completeness and appropriateness with respect to specifications and quantities ordered.
- If the equipment is according to the specifications, a copy of the DC shall be acknowledged and returned to the vendor. The Equipment Inventory and E- waste Manager will create a Good Receipt Note (GRN), and the inventory will be updated.

- **The distribution of GRN shall be as follows:**

  - Original GRN along with original Delivery Challan to Accounts Payable Department for release of payment.
  - Copy for record retention (ICT Equipment Inventory and E-waste Manager)
  - Copy for record retention (IT Department)

- All equipment shall be entered in the inventory.
- Inventory records shall be maintained and updated regularly.
- Each item of equipment shall be assigned a unique Tag Number in the system for cyclic inventory count.
- The inventory audit/review system shall be in place.
- Records maintained under this SOP shall contribute to KPI-EW-01 reporting.
- At the time of procurement, Implementing Agencies shall give preference to electronic equipment that meets green procurement criteria, including energy efficiency, durability, and availability of vendor take-back mechanisms, where feasible.

**Storage of e- material**

i. The equipment received shall be stored at their specified locations under the supervision of the Equipment Inventory and E-waste Manager. The storage area shall be demarcated into the following sub-areas:

- Receiving and inspection area.
- Project-related equipment.
- Stock items.
- Tools/instruments and equipment.
- Condemned items.

ii. The equipment shall be stored in an accessible area to facilitate further issuance to the requisitioning department. The Equipment Requisition Form is attached as **Annexure-B**.

iii. Access to the storage area shall be restricted to authorized personnel only.

iv. Each Equipment storage location shall be identified on datasheets / Ledger / System with a Tag Number.

v. Measures shall be taken to protect inventory against deterioration and adequately insure its value against.

### Labelling of Equipment

- All the equipment should be properly labelled with a Tag Number along with normal hardware and software labels.
- Labels must be legible and prominently displayed.
- Personnel are not allowed to all error remove existing labels on the equipment.
- The Equipment Inventory and E-waste Manager need to ensure that labels and other kinds of warning signs are clearly placed on the equipment.
- The information and importance of the labels on equipment must be conveyed to all the staff.

### Environmental, Occupational Health and Safety Requirements

In effective handling, lifting or transportation of electronic equipment from one place to another or its improper use can damage the equipment or hurt the user. In severe circumstances, these injuries could leave a lasting impact. The following Environmental, Occupational Health and Safety Requirements be adopted:

- Ensure that all users of equipment are handling it safely.
- Utilize lifting and transportation of equipment carrying assistance, as well as use manual aids, to the fullest extent possible.
- When feasible, keep only small or light objects above shoulder or below knee height, and place heavier items between shoulder and hip height.

- Avoid assignments that require stretching or twisting; use your legs and knees to bend and lift instead of your back.
- Take regular rest intervals to prevent the onset of fatigue, particularly where manual handling activities are repetitive.
- Ensure the load has no hot, cold, or sharp edges that might cut someone.
- Make sure path ways are clear of obstacles.
- Make complete and correct use of PPE.
- Report any issues about manual handling to a responsible person right away.

## Issuance of Electronic Equipment

I. On receipt of approved Electronic Equipment Requisition with instruction for either full delivery or partial delivery, a Goods Issuance Note (GIN) shall be generated and issuance record to be logged in the Ledger/Equipment Inventory and E-waste System after proper counting and physical measuring. GIN is attached as **Annexure-C.**

II. 3 copies of GIN shall be made for the following distribution:

a. Receiver copy.

b. Accounts copy.

c. Focal Department copy.

III. The acknowledgement shall be obtained from the person receiving the equipment.

IV. If equipment is to be transferred outside the storage area, the authorized personnel shall also prepare and approve a Gate Pass.

V. 4 copies of DN shall be made for the following distribution:

a. Receiver copy

b. Accounts copy.

c. IT/Focal department copy

d. Gate/Security copy.

**Physical count of Electronic Equipment**

All equipment shall be physically counted on pre-defined dates by the Internal Audit Department (IAD) and the IT Department/Focal Persons of the IAs.

**Management Reporting**

Following Equipment Inventory and E-waste Management, reports shall be prepared:

| S. No | Report | Reviewed by | Purpose | Frequency |
|---|---|---|---|---|
| 1. | Equipment Stock Position Report | Head of IT Cell/Focal Person | It sets out the stock positions with the Department on a quarterly basis or as and when required basis. | As and when required |
| 2. | Ageing Analysis | Head of IT Cell/Focal Person | It is used to analyze the status of equipment by their age, hard and software installed. The report will be able to generate hard and software upgradation's demand. | As and when required |
| 3. | ABC Analysis | Head of IT Cell/Focal Person | It is used to analyse the equipment by its value for the identification of high-value items and their access controls. | As and when required |
| 4 | Stock count discrepancies report | Head of IT Cell/ Internal Audit. | To investigate and resolve differences between physical and recorded inventory. | As and when required |

## Form1.1: Equipment Inventory

| Financial Details | | | | | | | | Location | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date<br>(1) | Type of Equipment<br>(2) | Serial Number (ID)<br>(3) | Brand & Model No.<br>(4) | Manufacturing Year<br>(5) | Software detail<br>(6) | Tag No.<br>(7) | Date of Purchase<br>(8) | Name of Vendor<br>(9) | Purchase Price<br>(10) | Office<br>(11) | City<br>(12) |
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## Form1.2: Data Sheet for E-Waste Management

| Data Sheet of Electric Equipment Inventory and E-waste Management for PCAP's IAs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Maintenance Record | | | E-waste Generation | | | | | Disposal of E-waste | |
| The expiry date of warranty (13) | Software Upgradation log (14) | Hardware upgradation Log (15) | Date declared condemned. (16) | Transportation to Lahore (17) | E-waste Storage Location at Lahore (18) | Issuance of RFQ for Auction of E-waste (19) | Name of Selected Vendor (20) | Delivery of e-waste to vendor (21) | Vendor's Report on e-waste asper SOPs (22) |
| | | | | | | | | | |
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## SOP-02: Maintenance of ICT equipment

### Purpose

This SOP aims to define procedures for the maintenance of electronic equipment.

### Scope

This procedure is applicable to each office of PCAP's IAs

### Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012); The Punjab Occupational Safety and Health Act, 2019.

### Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers.

| Designation | Role | Key Responsibilities |
|---|---|---|
| **Equipment User / Operator** | Initiator | Reports malfunction or damage; ensures safe use of equipment during operation. |
| **Site In-Charge** | Supervisor | Verifies maintenance requests; ensures equipment is safely isolated prior to maintenance. |
| **E-Waste Manager / Section Officer** | Accountable Officer | Authorizes maintenance actions; ensures replacement parts and removed components are recorded as potential e-waste. |
| **IT / System Engineer** | Responsible Technician | Carries out diagnostics, repair, and replacement; ensures removed components are handled as per SOPs. |
| **Authorized Maintenance Vendor** | Service Provider | Performs maintenance in accordance with OHS and environmental requirements; returns replaced components to IA custody. |

**Accountability Note:** Final responsibility for any e-waste generated during maintenance rests with the Implementing Agency, irrespective of vendor involvement. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

## Procedure

- Electric equipment in use by the employee as well as newly procured equipment to be properly maintained to ensure longer useful life.
- Employees shall file a request for maintenance of equipment describing details of malfunction through email, phone call, or in a letter to the IT Administrator.
- The IT Administrator/focal person shall assign the task of maintenance of equipment to system engineers based on the nature of the request for maintenance.
- If the equipment needs hardware replacement or new equipment, then the System Engineer will inform the IT Administrator/focal person for authorization.
- If the equipment needs replacement of a component shall be done by the Technical Engineer, and an entry log will be made in the Equipment Inventory and E-waste Management System as well as by updating **Form 1.**
- Any equipment or component posing a fire hazard shall not be used again and thus be replaced by new equipment.
- The ICT administrator/Focal Person shall ensure **Maintenance Form 2** is filled for any maintenance Required outside of the office premises.
- The user of the equipment shall put up maintenance requests in the given.

## Form 2:

- If any component replacement has been done by the repairer, the data shall also be added to Form 1.
- The equipment shall be transported in a careful manner from the office to the repairer's workshop.

## Form 2: Maintenance Request form for equipment

<table>
<tr><td>Form No:</td><td></td><td colspan="2">Request Form for Maintenance work on equipment</td><td>Organization Name:</td></tr>
<tr><td>Requestor ’ s Name:</td><td>Date:</td><td>Department/Sub-Department:</td><td>Room No. (if applicable)</td><td>Description of Malfunction of Equipment:</td></tr>
<tr><td colspan="4">Details of Maintenance Work Required:</td><td>Contractor/Repairer:</td></tr>
<tr><td>Approved</td><td>Disapproved</td><td>Authorizer’s Signature:</td><td>Date:</td><td>Additional Remarks:</td></tr>
<tr><td colspan="5">To be used only by the System Engineer when equipment returns after maintenance</td></tr>
<tr><td colspan="5">Description of issues resolved: (as per the attached maintenance receipt provided by the repairer)</td></tr>
<tr><td>Issues Resolved:<br>Yes ☐<br>No ☐</td><td>Repairer’s contact information:</td><td>Amount paid: (Receipt Attached)</td><td colspan="2">Final Remarks:</td></tr>
</table>

## SOP-03: Declaration of Condemned ICT Equipment

### Purpose

This SOP aims to define procedures for the declaration of Condemned electronic equipment.

### Scope

This procedure is applicable to each office of the PCAP's IAs.

### Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012); The Punjab Occupational Safety and Health Act, 2019

### Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers.

| Designation | Role | Key Responsibilities |
|---|---|---|
| **Site In-Charge** | Initiator | Identifies non-functional or obsolete equipment and initiates condemnation request. |
| **IT / Technical Officer** | Technical Evaluator | Assesses repairability; recommends condemnation where equipment is beyond economic repair. |
| **E-Waste Manager / Section Officer** | Responsible & Accountable | Reviews technical assessment; formally declares equipment as condemned; updates asset inventory and e-waste register. |
| **Head of Implementing Agency** | Approving Authority | Approves condemnation decisions as per delegated financial and administrative powers. |
| **Internal Audit Department** | Oversight | Verifies condemnation records and compliance with approved procedures. |

Note: Upon condemnation, custody of the asset shall be formally transferred from the user/site to the designated e-waste custodian, with the transfer recorded in the asset register. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

**Procedure**

Electronic equipment that is no longer repairable by the ICT Equipment Inventory and E-Waste Manager shall be declared as a “Condemned item”.

A final inspection by the ICT Equipment Inventory and E-Waste Manager or designated officer of the Implementing Agency shall be carried out for declaration of the “Condemned Equipment.”

- IT technicians shall check whether some parts of the “Condemned Equipment” could be reused to fix it with operative equipment.
- The condemned items that are no longer usable will be classified as e-waste.
- The condemned equipment item shall be replaced by a new one on an urgent basis.
- The inventory of the new equipment shall be updated as per the requirement in

**Form1.**

- Arrangements for the storage of condemned items are to be made by the IT/technical support staff in coordination with the manager of the storage room.
- Details of e-waste generated by the department/office and further handling shall be filled in Form **3.**

**Form3: Maintaining E-Waste Generation and Handling Record**

| **FORM FOR MAINTAINING E-WASTE RECORD** | |
|---|---|
| | |
| **Date of EPD Approval Issuance:**<br><br>Approval Date**:** | **EPD approval no**. |
| **Quantity of E-waste generated or handled:** | |
| Name | Quantity |
| **Description of e-waste handling methodology:** | |

| **Description of E-waste items:** |
| --- |
| |

# SOP-04: Inter departmental Transportation of Condemned Equipment (e-waste)

## Purpose

This SOP aims to define procedures for interdepartmental transportation of Condemned electronic equipment. This SOP is applicable to PCAP's IAs that have multiple offices at District and Divisional levels)

## Scope

This procedure is applicable to each office at the District and Divisional levels of PCAP's IAs.

### Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012); The Punjab Occupational Safety and Health Act, 2019

### Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers**.**

| Designation | Role | Key Responsibilities |
|---|---|---|
| **E-Waste Manager / Section Officer** | Accountable Officer | Authorizes transportation; ensures permits, manifests, and custody transfer documentation are completed. |
| **Site In-Charge (Sending Site)** | Custodian | Ensures safe packaging, labeling, and handover of e-waste to transporter. |
| **Authorized Transporter** | Responsible Party (Transit) | Transports e-waste safely in accordance with permit conditions and SOPs; prevents damage, leakage, or loss. |
| **Receiving Facility / Central Store** | Custodian (Receiving) | Confirms receipt; signs custody transfer forms; ensures compliant storage. |
| **Internal Audit / Third-Party Monitor** | Oversight | Verifies transport records, manifests, and compliance. |

**Note:** E-waste shall not be transported without a completed shipment manifest and signed custody transfer record at dispatch and receipt. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

## Procedure

Electric equipment that has been declared as a “condemned item” and thus has become e-waste in the divisional or district-level offices of the PCAPs IAs shall be transported to Lahore for auction.

- The Equipment Inventory and E-waste Manager shall coordinate with sub- offices at district and divisional levels for a transportation plan to bring all condemned equipment to Lahore for Auction.
- All the condemned equipment must be properly packed so that no damage shall occur during transportation.
- The selected vehicle shall meet the requirement of safe delivery of condemned equipment, and it must be covered for safe delivery of equipment.
- The selected vehicle shall be equipped with a first aid kit, and a spill kit shall be available for any spill/leakage of hazardous substances like a battery bank.
- The transport vehicle selected shall be used only up to 80% of its capacity.
- Small equipment, such as power cables, RAMs, sensors, analyzers, Drives, etc., shall be Transported in specific containers consisting of Plastic.
- Any e-waste item with a risk of leakage or explosion, such as batteries, shall be transported cautiously.
- Batteries and any such e-waste item consisting of terminals shall be transported in plastic or cardboard boxes.
- The batteries, such as vehicles & laptop batteries without recessed terminals and mobile phone batteries, shall be wrapped up with electrical tapes to avoid electrical conductivity in case of contact with other charged equipment.
- If the battery has recessed terminals, it can simply be packed with clear tape or a wrapping sheet, depending on the size of the battery.
- All condemned equipment shall be transferred using a serial-number-level manifest including AIN, description, quantity, weight (where applicable), and receiving signature.
- Record regarding e-waste transported for storage shall be maintained in Form4.

- In case transport is outsourced, a selected member of the relevant office department shall accompany the e-waste transporter to ensure safe transport to the main branch.
- Transport-related accidents or spills involving e-waste shall be treated as incidents under SOP-07.

## Form 4: Transportation Request form for E-waste

| | | | | | |
|---|---|---|---|---|---|
| **Form No.** | **Request Form for Inter departmental Transportation of E-waste** | | | | **Organization Name:** |
| **E-waste origin office/department:** | | **Requestor's Name and Designation:** | | | **Date of transportation of E-waste:** |
| **Details of transported e-waste:** | | | | | |
| **Date** | **Serial No.** | **Equipment** | **Hardware and software or other details** | **Tag Nos.** | **Designated storage Location** |
| | | | | | |
| | | | | | |
| | | | | | |
| **Further Details, if any:** | | | **Date and Time of receiving:** | **Receiver's Signature and Remarks:** | |
| **To be used only by the ICT Equipment Inventory and E-waste Manager** | | | | | |
| **Storage area Location:** | | | **Information about storage (if specific):** | | |
| **Final Remarks:** | | **Store Manager's Signature and data of receiving:** | | | |

# SOP-05: Storage of Condemned Equipment

## Purpose

The purpose of this SOP is to define procedures for the storage of Condemned equipment.

## Scope

This procedure is applicable to each office/department/sub-department office. Storage inspection records shall support KPI-EW-04 reporting.

## Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012); The Punjab Occupational Safety and Health Act, 2019.

## Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers.

| Designation | Role | Key Responsibilities |
|---|---|---|
| **Store Manager / Site In-Charge** | Responsible Custodian | Maintains segregated and labeled storage; conducts routine inspections; ensures safety controls. |
| **E-Waste Manager / Section Officer** | Accountable Officer | Ensures storage conditions comply with SOPs and EHS requirements; authorizes storage duration and movement. |
| **OHS / Safety Officer (where applicable)** | Safety Oversight | Ensures availability of spill kits, fire protection, PPE, and emergency procedures. |
| **Internal Audit Department** | Oversight | Conducts periodic inspections and reports non-compliance. |

Note: Stored e-waste shall remain under the custody of the designated store manager, with inventory reconciliation conducted at least quarterly. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

**Procedure**

- Segregate e-waste as per defined categories.
- Before storage of condemned items, it shall be made sure that the data storage devices have been formatted and all data has been erased.
- E-waste is to be stored in a specific designated area/room.
- The storage area shall be far from any heat-generating area or a fire hazard such as kitchens, smoking areas, etc.
- The area shall be accessible to authorized personnel only.
- Baseline knowledge and understanding of e-waste handling and storage are to be given to the store staff.
- Small e-waste is to be stored in separate boxes for each component, e.g., sensors, analyzers, Hard drives, Wires, Power Cables, Batteries and any other such component generated under and DLR of PCAP.
- Wooden, plastic or card board boxes/compartments to be used for storage of small equipment. Metal compartments for storage of such equipment shall be avoided.
- Any reusable item that has to be stored before usage shall be stored separately in Boxes separate from condemned items.
- The store management is responsible for ensuring that the stored items are not damaged due to haphazard placements.
- First aid training is to be given to all employees or a significant proportion.
- Any item that has any suspicion of leakage or explosion, such as batteries, shall not be stored but rather disposed of with the help of **Re furbisher, kabaria, dismantler or recycler**.
- Concerns raised by staff or community members regarding unsafe storage conditions shall be addressed through the PCAP GRM.

The storage area must adhere to the following rules for a safe and accident-free storage period of e-waste.

- The storage area must be covered with more than one entrance to ensure escape in case of any emergency.
- The areas shall be kept free of any fire hazard, such as malfunctioning electronics or circuit boards.
- Any uninsulated or barbed wiring shall be immediately removed from the storage area.
- The storage area shall be free of short-circuiting risks.
- The storage area must be well-ventilated.
- Proper sign age to indicates to rage area storing flammable equipment.
- Items that are flammable shall be stored away from oxidizing agents (items that spontaneously heat up, explosives, etc.).
- An automatic or manual firefighting apparatus shall be available for the flammable storage area.
- The storage space shall be marked with "**flammable equipment**" signage.
- Oxidizers shall not be kept close to liquids with low flash points in storage.
- Acids and items susceptible to acid fumes shall be kept in a cold, dry, well- ventilated space that is ideally made of wood.
- Equipment that is dangerous when stored or that can break down into toxic components when exposed to heat, moisture, acids, or acid fumes shall be kept out of the sun's direct rays and stored in a cold, well-ventilated space.
- Toxic substances that are incompatible with one another shall be kept apart.
- Equipment that is corrosive shall be kept in a cold, well-ventilated location (above their freezing point). They shall undergo routine inspections to ensure that the containers have been labelled and kept sealed. Corrosives shall be separated from other equipment.
- The storage area shall have a fire and emergency response system, such as fire extinguishers.

- In case of hazardous waste from the store equipment pills, drys and shall be present at the site.
- Request for declaration and storage of condemned items shall be made asper **Form5.**
- Any spill, fire, or suspected battery instability observed during storage shall be managed in accordance with SOP-07.
-

## Form 5: Storage Request form for Equipment

| | | | | |
|---|---|---|---|---|
| **Form No.** | **Request Form for Storage of Equipment** | | | **Organization Name** |
| **Maintenance Form No.** | **Requestor's Name and Designation:** | | **Date of Declaration of Condemned Item:** | |
| **Further details, if any:** | **Serial No and Tag No. of Equipment** | | | |
| **Details of reusable components, if any:** | | **Date:** | | **Additional Remarks:** |
| **To be used only by the Equipment Inventory and E-waste Manager** | | | | |
| **Store room No.** | | **Information about storage method:** | | |
| **Equipment dismantled (for taking out reusable components)** | **Final Remarks** | | | **Store Manager's Signature:** |
| **Yes** ☐ | | | | |
| **No** ☐ | | | | |

### Minimum Storage, Packaging, and Labeling Standards

All condemned electronic equipment and e-waste generated under PCAP shall be stored, packaged, and labeled in a manner that prevents environmental contamination, fire hazards,

equipment damage, and risks to workers and surrounding communities. The following minimum standards shall be applied by all Implementing Agencies and storage facilities handling e-waste.

### Segregation Requirements

E-waste shall be segregated based on hazard characteristics to prevent chemical reactions, fire risks, and contamination. Hazardous e-waste shall not be stored together with non-hazardous electronic waste. Batteries, particularly lithium-ion and lead-acid batteries, shall be stored in a designated area separate from other electronic equipment. Equipment containing liquids, chemicals, or calibration substances shall be isolated from dry electronic waste and stored in appropriate containment. Components that may present fire risks, including batteries, capacitors, and flammable electronic modules, shall be stored away from heat sources, electrical panels, and other potential ignition sources.

### Packaging Standards

All e-waste shall be packaged in a manner that prevents physical damage, leakage, short-circuiting, or accidental exposure during storage and handling. Batteries shall be stored in non-conductive packaging, and exposed terminals shall be insulated to prevent short circuits. Fragile electronic components and PCB-containing equipment shall be placed in shock-resistant containers or protective packaging. Equipment contaminated with liquids or chemical residues shall be stored in leak-proof containers with secondary containment where necessary to prevent spills.

### Labeling Requirements

All stored e-waste shall be clearly labeled to ensure traceability, safe handling, and emergency preparedness. Labels shall be visible and durable and shall include, at a minimum, the hazard classification of the stored material (such as battery, flammable, or toxic), the Asset Identification Number (AIN), the date of storage, and the designation of the responsible custodian. Storage areas shall also display emergency contact information for responsible personnel in case of fire, spill, or other incidents.

### Spill Prevention and Emergency Preparedness

All storage locations used for condemned electronic equipment and e-waste under PCAP shall maintain adequate spill prevention and emergency preparedness arrangements to minimize risks to workers, facilities, and the surrounding environment. Storage areas shall be equipped with appropriate spill response materials, including spill kits suitable for battery electrolyte leaks and chemical residues from laboratory or monitoring equipment. Fire extinguishers suitable for electrical and battery-related fires shall be available in accessible locations within or near the storage area and maintained in working condition.

Emergency procedures for responding to spills, fires, or equipment instability shall be displayed visibly within the storage area. These procedures shall include emergency contact information and basic response steps to ensure timely and safe containment of incidents. Any spill, fire, leakage, or safety concern observed in the storage area shall be reported immediately and managed in accordance with SOP-07: Incident Response for E-Waste Management.

### Inspection and Recordkeeping

Storage of condemned equipment shall be treated as a controlled activity requiring periodic inspection, documentation, and corrective action where necessary. The designated custodian or store manager shall conduct weekly inspections of the e-waste storage area to verify compliance with segregation, packaging, labeling, and safety requirements described in this SOP.

An inspection checklist shall be used to document storage conditions, safety equipment availability, and any observed risks or non-compliance. Where deficiencies are identified, immediate corrective action shall be initiated and recorded. Unresolved issues shall be reported to the E-Waste Manager or E&S Focal Person for follow-up.

All inspection records, corrective action notes, and related documentation shall be retained as part of the e-waste management recordkeeping system for internal audit, regulatory review, and World Bank supervision, as applicable.

# SOP-06: Auction of E-waste

## Purpose

This SOP aims to define procedures for the Auctions of the stored e-waste present, which must be disposed of on a yearly basis.

## Scope

This procedure is applicable to E-waste storage locations, which will be managed by the Equipment Inventory and E-waste Manager. Vendor audit records shall support KPI-EW-05 reporting.

## Reference

Basel Convention; Pakistan Environmental Protection Act 1997; National Hazardous Waste Management Policy 2022; Punjab Environmental Protection Act 1997 (Amended 2012); The Punjab Occupational Safety and Health Act, 2019.

## Assigned Roles and Responsibilities

The assigned designation will be allocated by the Department Administration and will be allocated and notified as per there relevant tiers.

| Designation | Role | Key Responsibilities |
|---|---|---|
| **E-Waste Manager / Section Officer** | Accountable Officer | Coordinates auction or disposal process; ensures only licensed recyclers are engaged; obtains certificates. |
| **Auction / Disposal Committee** | Decision Authority | Conducts transparent auction or disposal process in accordance with rules and SOPs. |
| **Authorized Recycler / Disposal Facility** | Responsible Executor | Recycles or disposes e-waste in an environmentally sound manner; issues recycling/destruction certificates. |
| **Implementing Agency Head** | Institutional Accountability | Retains final accountability for compliance with environmental and legal requirements. |
| **Internal / Third-Party Auditor** | Independent Oversight | Verifies vendor compliance, certificates, and corrective actions. |

**Note:** Final disposal shall be considered complete only upon receipt and verification of a Certificate of Recycling or Destruction issued by an authorized facility. Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix given in this SOP.

**Procedure**

- The auction of e-waste shall be carried out in an orderly and transparent manner.
- The auction process shall be carried out on a yearly basis.
- The auction shall be carried out two months prior to the closing of the financial year.
- Only bidders complying with Environmental, Occupational Health and Safety regulations set by the Government of Punjab shall be allowed to participate in the auction.
- The auctioneers shall comply with the Pakistan Environmental Protection Act 1997and Punjab Environmental Protection Act 1997(Amended 2012) for e- waste handling due to the presence of potentially hazardous substances.
- Auction documents shall come with a BOQ (Bill of Quantity) of the available e- waste being auctioned and details of SOPs to be complied with for recycling and disposal in an environmentally friendly manner.
- Before the commencement of the auction process, a meeting with local e-waste handlers, e-g, Refurbisher, Kabarias and dismantlers shall be held to fix a minimum price for each equipment depending on its refurbishing and recycling capacity.
- The transport of the auctioned equipment to the successful bidder's location shall be carried out as per the following guidelines:
- The bidder shall arrange safe transportation of e-waste to his premises.
- In order to avoid any hazard, covered and impermeable vehicles shall be selected.
- The transport vehicle selected shall be used only up to 80% of its capacity.
- The selected vehicle shall be equipped with a first aid kit placed in the front, and a spill kit shall be available for any spill/leakage of hazardous substances.
- Small equipment, such as RAMs, Hard Drives, Batteries, etc., shall be transported in specific containers consisting of wood or plastic.
- Any e-waste item with a risk of leakage or explosion, such as batteries, shall be transported cautiously.

- Batteries and any such e-waste item consisting of terminals shall be transported in plastic or cardboard boxes.
- The batteries, such as laptop batteries with recessed terminals and mobile phone batteries, shall be wrapped up with electrical tapes to avoid electrical conductivity in case of contact with other charged equipment.
- If the battery has recessed terminals, it can simply be packed with clear tape or a wrapping sheet, depending on the size of the battery.
- Record regarding e-waste transported for storage shall be maintained in Form 1 as well as the department's auction forms already in use for auctions.
- PCAP shall engage only vendors that meet defined environmental, occupational health and safety, technical, and legal eligibility criteria for e-waste (or such type of waste specially hazardous) transport, recycling, and disposal. Implementing Agencies shall conduct pre-qualification screening prior to engagement and periodic audits during contract implementation to ensure continued compliance with applicable laws, SOPs, and World Bank Environmental and Social Standards.
- Where vendor or manufacturer take-back programs exist, Implementing Agencies shall utilize such arrangements in preference to third-party disposal, provided they meet applicable legal and environmental requirements.
- Prior to award or disposal, the Implementing Agency shall verify the validity of EPA licenses, transport permits, and facility authorization documents.

- Note: Final accountability for environmentally sound disposal remains with the Implementing Agency, notwithstanding outsourcing to licensed recyclers. Moreover, Under PCAP, disposal of e-waste through informal scrap dealers, kabarias, or unlicensed dismantlers is prohibited, regardless of economic value or reuse potential. Although specific regulations regarding collection, transportation and disposal of E-waste are not yet available. Currently it is usually considered to be regulated under Hazardous/Industrial waste. However, EPA is working on various streams of such kind of waste which will be implemented if approved during the course of PCAP.

## RACI Matrix for E-Waste Management under PCAP

| E-Waste Management Activity | Asset Owner (IA) | E-Waste Manager | Site In-Charge / Storekeeper | Transporter | Recycler / Disposal Facility | Auditor |
|---|---|---|---|---|---|---|
| **Asset inventory & tagging** | A | R | C | – | – | I |
| **Equipment maintenance** | A | R | C | – | – | I |
| **Declaration of condemnation** | A | R | C | – | – | I |
| **Temporary storage** | A | R | R | – | – | I |
| **Transportation of e-waste** | A | R | C | R | – | I |
| **Recycling / disposal** | A | R | – | C | R | I |
| **Incident response** | A | R | R | C | C | I |
| **Record keeping & reporting** | A | R | C | C | C | I |
| **Audit & verification** | C | C | C | C | C | R |

**Legend:**

- **R – Responsible:** Executes the activity
- **A – Accountable:** Ultimately answerable for compliance
- **C – Consulted:** Provides input or support
- **I – Informed:** Kept informed of progress or outcomes

## PCAP E-Waste Chain-of-Custody Tracking Sheet

| Sr. No | Asset ID | Serial No. | Custodian | Date of transfer | Mode of transfer | Transporter | Receiving facility | Certificate reference |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# SOP-07: Incident Response for E-Waste Management

## Purpose

To define procedures for prevention, notification, response, investigation, and corrective action in case of incidents related to e-waste management under PCAP.

## Scope

This SOP applies to all PCAP Implementing Agencies, sites, storage facilities, transport operations, and vendors involved in handling e-waste.

## Types of Incidents Covered

- Battery fires or thermal runaway
- Chemical spills or leaks (e.g., batteries, lab equipment)
- Transport accidents involving e-waste
- Data breaches or improper disposal of data-containing equipment
- Any incident posing risk to health, safety, or the environment

## Roles and Responsibilities

| Role | Responsibility |
|---|---|
| **Site In-Charge** | Immediate response, area isolation, first notification |
| **E-Waste Manager** | Incident coordination, reporting, corrective actions |
| **OHS / Safety Officer** | Emergency response, PPE, containment |
| **Implementing Agency Head** | Oversight, escalation, regulatory coordination |
| **Vendor (if involved)** | Immediate notification and cooperation |
| **Internal Audit / PCAP** | Review, verification, lessons learned |

Note: Roles and responsibilities under this SOP shall be implemented in accordance with the RACI Matrix provided in SOP-6.

## Incident Response Procedure

### Step 1: Immediate Response

- Stop work immediately
- Isolate affected area

- Use spill kits, fire extinguishers, or containment materials
- Ensure personal safety and PPE use

### Step 2: Notification

- Notify Site In-Charge and E-Waste Manager immediately
- Serious incidents (fire, injury, major spill) to be escalated to:
- Implementing Agency Head
- PCAP Coordination Unit

### Step 3: Containment and Control

- Prevent spread to drains, soil, or public areas
- Secure damaged equipment
- Engage emergency services if required

### Step 4: Documentation

- Record incident details using Incident Report Form
- Include photographs, witness statements, and asset IDs

### Step 5: Investigation and Corrective Action

- Identify root causes
- Define corrective and preventive actions
- Assign responsibility and timelines

### Step 6: Reporting and Closure

- Close incident after corrective actions
- Report summary in quarterly KPI report
- Serious incidents to be flagged for World Bank supervision, if required.

### Implementation Guidance

- The Incident Report Form (Annexure-H) shall be completed for all e-waste-related incidents and retained for audit and monitoring purposes.
- The Emergency Contact List (Annexure-I) shall be displayed visibly in e-waste storage areas and updated periodically.

- Incident records shall feed into KPI monitoring and quarterly reporting under PCAP.
- Stakeholders may submit grievances related to e-waste incidents through the PCAP GRM in addition to internal reporting channels. The GR mechanism for E-Waste management under PCAP is given as under:

## Grievance Redress Mechanism (GRM) for E-Waste Activities

### Purpose

This subsection establishes a structured Grievance Redress Mechanism (GRM) applicable to all e-waste management activities conducted under the Punjab Clean Air Program (PCAP). The mechanism ensures that workers, contractors, vendors, farmers, depot staff, and community members can raise concerns related to e-waste handling, storage, transport, disposal, or safety risks in a timely and transparent manner, consistent with ESS10 (Stakeholder Engagement and Information Disclosure).

### Scope

The GRM applies to grievances arising from:

- Storage and handling of e-waste at offices, depots, laboratories, and agricultural facilities
- Transport of condemned equipment
- Battery handling and fire safety concerns
- Vendor recycling or disposal practices
- Occupational health and safety risks
- Environmental contamination concerns
- Informal disposal or suspected non-compliance with SOPs

This mechanism applies to all Implementing Agencies (IAs), contractors, vendors, and third-party facilities engaged under PCAP.

### Complaint Categories

Complaints related to e-waste activities may fall under the following categories:

1. Environmental Concerns
    - Improper storage or dumping of e-waste
    - Battery leakage or chemical spills
    - Open burning or informal recycling

2. Occupational Health and Safety (OHS) Issues
    - Lack of PPE
    - Unsafe battery handling
    - Exposure to hazardous materials
3. Transport and Disposal Concerns
    - Unauthorized transport
    - Use of unlicensed recyclers
    - Missing disposal certificates
4. Community Health and Safety
    - Fire risk from stored batteries
    - Public exposure to dismantled electronics
5. Procedural Non-Compliance
    - Failure to follow chain-of-custody procedures
    - Missing inventory records
    - Vendor misconduct

### Submission Channels

Grievances may be submitted through:

- Written complaint to the Site In-Charge
- Email to the IA E-Waste Manager
- Telephone hotline (if available)
- Existing PCAP Grievance Redress System
- Complaint drop-box (where applicable)
- Anonymous complaints shall also be accepted.

### Grievance Handling Procedure

### Step 1: Registration and Acknowledgement (Within 7 Days)

- All grievances shall be recorded in the E-Waste GRM Register.

- The complainant shall receive written or verbal acknowledgement within seven (7) working days of receipt.
- The grievance shall be categorized and assigned to the responsible officer for review.

### Step 2: Review and Resolution (Within 30 Days)

- The designated E-Waste Manager or E&S Focal Person shall investigate the complaint.
- Site inspection or document verification may be conducted where required.
- Corrective actions shall be initiated, if applicable.
- A resolution response shall be provided to the complainant within thirty (30) calendar days of grievance registration.

If additional time is required due to complexity, the complainant shall be informed with justification.

### Step 3: Escalation to PCAP

If the complainant is not satisfied with the resolution at the Implementing Agency level:

- The grievance may be escalated to the PCAP Coordination Unit / Program Director.
- PCAP shall review the case and issue a final decision within 15 working days of escalation.
- PCAP may require additional investigation, independent review, or corrective measures.

### Confidentiality and Protection

- Confidentiality of complainants shall be maintained.
- No retaliation shall be permitted against any individual raising a grievance.
- Sensitive OHS-related or misconduct complaints shall be handled with discretion.

### Documentation and Reporting

- All grievances and resolutions shall be documented.
- Summary of e-waste-related grievances shall be included in quarterly KPI reporting.
- Repeated or systemic issues shall trigger review of SOP implementation.

### Linkage to Incident Response

Where a grievance involves:

- Fire,
- Spill,

- Chemical exposure,
- Serious injury,

The case shall immediately be managed in accordance with SOP-07: Incident Response for E-Waste Management, in addition to GRM processing.

# Chapter 8: Guidelines for the IAs of PCAP for Adoption of SOPs of E-Waste Management from PRIDE Program:

The Punjab Clean Air Program (PCAP) introduces a diverse set of technological interventions across multiple sectors including environmental monitoring, transport electrification, fuel testing laboratories, crop residue management machinery, and regulatory data systems. Each of these interventions generates substantial and variable forms of electronic waste (e-waste) throughout their operational life cycle. Given the cross-sectoral nature of PCAP and the involvement of multiple implementation agencies such as the Environment Protection Department (EPD), Transport Department, Punjab Mass Transit Authority (PMTA), Agriculture Department, PITB, and district-level units, the development of uniform guidelines for e-waste management is essential for ensuring safe, consistent, and compliant handling of all e-waste streams generated under the program. PCAP introduces electronic-intensive systems such as regulatory-grade Air Quality Monitoring Stations (AQMS), lithium-ion battery–powered electric buses and charging depots, digital vehicle inspection tools, GPS-embedded Super Seeders, laboratory analyzers, communication hardware, and ICT-based public information systems. These technologies produce high-risk waste streams including PCB-heavy components, chemical-contaminated lab instruments, lithium-ion and lead- acid batteries, telematics devices, wiring harnesses, sensors, and circuit boards. Without standardized guidelines, each agency may handle such materials differently, resulting in inconsistencies, unmanaged risks, regulatory gaps, and potential environmental or occupational Hazards.

Guidelines are therefore required to ensure that all PCAP implementing agencies follow a harmonized, structured, and legally compliant approach based on PRIDE's established SOP framework and aligned with the Punjab Environmental Protection Act, national hazardous waste rules, and World Bank ESS1, ESS3, and ESS4 requirements. These guidelines will clarify agency responsibilities for inventory management, routine maintenance, identification and condemnation of end-of-life equipment, secure storage, safe transportation, and environmentally sound disposal through EPA-authorized recyclers. They will also define procedures for handling specialized hazardous streams such as high-voltage EV batteries, PCB-based laboratory analyzers, and electronic components embedded in agricultural machinery.

In addition, the guidelines will provide essential direction on occupational health and safety (OHS) protocols, documentation requirements, chain-of-custody procedures, emergency response measures, and training needs. By establishing a unified standard, they will enable oversight bodies to monitor compliance effectively, ensure traceability, support DLR verification, and prevent informal recycling or unsafe disposal practices. Ultimately, these guidelines are critical for ensuring that PCAP's technological advancements—intended to reduce air pollution—do not

create parallel environmental risks through unmanaged e-waste streams, and that all interventions remain sustainable, responsible, and fully aligned with national and international safeguards.

## 1. Guidelines for E-Waste Management for Air Quality Monitoring Stations (AQMS)

| Section | Details |
|---|---|
| Title | Guidelines for Management of E-Waste Generated from Air Quality Monitoring Stations (AQMS) |
| Purpose | To provide procedures for safe handling, storage, transportation, and disposal of e-waste from fixed and mobile AQMS units, ensuring compliance with Punjab EPA, World Bank ESS, and environmental best practices. |
| Scope | Applies to all AQMS under PCAP including regulatory-grade monitors, portable analyzers, calibration equipment, communication modules, and digital hardware. |
| Responsible Entities | **Directorate of Monitoring (EMC):** Maintain inventory, identify damaged equipment, initiate condemnation. **District Monitoring Teams:** Remove, pack, label, and transport faulty electronics. **Authorized Recycler:** Treat, dismantle, or recycle PCB-heavy analyzers and batteries. |
| Identification of Faulty Equipment | Malfunctions identified during routine calibration; faulty items logged in inventory as per SOP-01. |
| Removal Procedures | Power disconnected; UPS isolated; insulated tools used; analyzers sealed in anti-static bags. |
| Safe Handling Measures | PPE mandatory; chemical-containing sensors handled with gloves, goggles, and masks; expired calibration cylinders treated as hazardous waste. |
| Storage Requirements | Airtight, dust-free containers for PCB analyzers; batteries on spill trays; temperature below 30°C; no flammable materials. |
| Transportation | Labelled cartons (“Hazardous Electronic Waste”); cylinders transported upright; Transport Manifest (Annex-C) required. |
| Safety & OHS | PPE compulsory; spill kits for batteries; restricted access to storage area. |
| Disposal | All AQMS e-waste transferred to Punjab EPA–approved recyclers. |
| Compliance | SOP-01 to SOP-06; Punjab EPA requirements; World Bank ESS. |

## 2. Guidelines for E-Waste Management for Electric Buses & Charging Depots

| Section | Details |
|---|---|
| Title | Guidelines for Management of E-Waste from Electric Buses, Charging Systems, and Depots |
| Purpose | To ensure safe handling and disposal of hazardous EV electronic components in compliance with WB ESS and hazardous waste rules. |
| Scope | Covers Electric Buses, Charging Depots, Maintenance Workshops, and Fleet Monitoring Units under PCAP. |
| Key Definitions | BMS, HV Battery, ECU, Thermal Runaway. |
| Responsible Entities | **Transport Dept./MTA:** Inventory management and SOP compliance. **Depot Manager:** Safe dismantling and storage. **Authorized Recycler:** Safe recycling of EV batteries and electronics. |
| Identification & Isolation | HV battery faults identified via diagnostics; electronic systems removed using anti-static precautions. |
| Safe Removal Procedures | Only certified technicians allowed; HV gloves, face shield, insulated tools mandatory; batteries moved on insulated trolleys. |
| Handling of Chargers | Power disconnected; PCBs removed and sealed in anti-static bags. |
| Storage Requirements | Fire-proof, ventilated battery rooms; temperature below 27°C; detectors installed; PCBs stored in anti-static bins. |
| Transportation | Approved containers for HV batteries; no transport during peak heat; Transport Manifest under SOP-04. |
| Safety & OHS | Class D & $CO_2$ extinguishers; emergency response plan; staff training every 6 months. |
| Disposal | Only licensed lithium-ion battery recyclers engaged; documentation per SOP-06. |
| Compliance | WB ESS1, ESS3, ESS4; Punjab Hazardous Substances Rules 2003; SOP-01 to SOP-06. |

## 3. Guidelines for E-Waste Management for Super Seeders

| Section | Details |
|---|---|
| Title | Guidelines for the Management of E-Waste Generated from Super Seeders |
| Purpose | To guide safe management of electronic components integrated into Super Seeders. |
| Scope | Covers GPS units, sensors, wiring harnesses, tracking devices under PCAP. |
| Key Definitions | CRM Machinery, PCB, GPS Tracker. |
| Responsible Entities | **Agriculture Dept.:** Inventory management and condemnation approval. **Testing Units:** Removal, inspection, packing. **Authorized Recyclers:** Recycling of PCBs and wiring. |
| Identification | Field staff log damaged components and report to District Agriculture Officer. |
| Removal Procedures | Power disconnected; insulated tools used; components stored in cushioned anti-static bags. |
| Handling of Wiring | Avoid unnecessary cutting; wiring coiled and secured. |
| Storage Requirements | Anti-static bins; weatherproof cabinets; segregation of components. |
| Transportation | SOP-04 Transport Manifest; sealed cartons labeled “Agriculture E-Waste.” |
| Safety & OHS | Gloves and masks required; no burning of electronics; farmer awareness encouraged. |
| Disposal | As per approved SOPs. |
| Compliance | SOP-01 to SOP-06; World Bank ESS3; Punjab Environmental Protection Act. |

## 4. Guidelines for E-Waste Management for Fuel Quality Testing Laboratories

| Section | Details |
|---|---|
| Title | Guidelines for Management of E-Waste from Fuel Quality Testing Laboratories |
| Purpose | To ensure safe handling and disposal of electronic and chemically contaminated lab equipment. |
| Scope | Applies to fixed and mobile fuel testing labs under PCAP. |
| Key Definitions | Analytical Instrument, PCB, UPS Battery, Contaminated E-Waste. |
| Responsible Entities | **EPD:** Inventory, condemnation approval, oversight.<br>**Lab Operators:** Identification, dismantling, logging. Authorized<br>**Recycler:** Detoxification and recycling. |
| Identification | Equipment failures logged daily and entered in Lab E-Waste Register. |
| Decontamination | External cleaning with approved solvents; contaminated items labeled accordingly. |
| Removal Procedures | Power isolated; insulated tools used; analyzers stored in protective cases. |
| Calibration Cylinders | Stored upright; treated as hazardous waste. |
| Storage Requirements | Segregated racks; ventilated rooms; spill trays for batteries; hazard labeling. |
| Transportation | SOP-04 Transport Manifest; spill-proof containers; cushioned packaging. |
| Safety & OHS | PPE mandatory; spill kits available; proper ventilation required. |
| Disposal | As per relevant SOPs. |
| Compliance | SOP-01 to SOP-06; Punjab EPA Act 2012; Hazardous Substances Rules 2003; WB ESS3. |

## 5. Guidelines for E-Waste Management for Buyback of Polluting Vehicles

| Section | Details |
|---|---|
| Title | Guidelines for Management of E-Waste from Vehicle Buyback and Scrappage Program |
| Purpose | To standardize safe handling and disposal of vehicle electronics removed during buyback and scrappage. |
| Scope | Covers ECUs, sensors, wiring, meters, alternators, dashboard electronics. |
| Key Definitions | ECU, Sensor Assemblies, Legacy Electronics, Scrappage Facility. |
| Responsible Entities | **Transport Dept.:** Inventory and oversight. **Scrappage Operators:** Removal, segregation, record keeping. **Authorized Recycler:** Safe recycling of electronics. |
| Vehicle Inspection | Documentation verified; battery and electrical systems disabled. |
| Component Removal | Insulated tools used; ECUs, sensors, wiring segregated by type. |
| Data Security | Digital units wiped before disposal. |
| Packaging | Anti-static bags for PCBs; sealed pouches for sensors; wiring bundled securely. |
| Storage Requirements | Weatherproof rooms; segregated shelves; no stacking; SOP-05 records maintained. |
| Transportation | Closed vehicles; delivery to EPA-approved recyclers only. |
| Safety & OHS | PPE mandatory; fire safety measures; no smoking near facilities. |
| Disposal | As per approved SOPs. |
| Compliance | SOP-01 to SOP-06; Punjab EPA scrappage guidelines; WB ESS1, ESS3, ESS4. |

# Chapter 9: Recommendations for Strengthening E-Waste Management SOPs under PCAP

The Punjab Clean Air Program introduces advanced technologies across monitoring, transport, agriculture, and laboratory systems, resulting in a growing and diverse stream of electronic waste. To ensure environmental protection, institutional compliance, and operational efficiency, the following recommendations are proposed for strengthening and implementing the E-Waste Management SOPs developed for PCAP.

1. Adopt PRIDE's Foundational SOPs (modified in this manual for PCAP). PCAP should formally adopt these SOPs as the baseline framework and extend them in the light of guidelines for AQMS, electric buses, charging depots, fuel testing laboratories, Super Seeders, and buy- back vehicle components.

2. Ensure Clear Departmental Roles and Inter-Agency Coordination EPD, Transport, Agriculture, PITB, and implementing partners must have clearly defined roles for inventory updates, condemnation requests, waste storage, and documentation.

3. Establish Certified and Secure E-Waste Storage Facilities Dedicated storage rooms, ventilated, access-restricted, fire-protected, and equipped with spill-control trays—must be maintained at district and central levels. Separate areas should be designated for hazardous waste (e.g., lithium batteries, PCB-heavy analyzers) and non- hazardous ICT scrap to prevent mixing.

4. All movement of e-waste within and outside departments should follow SOPs to ensure traceability and prevent leakage into the informal recycling sector. Each manifest must include unique ID codes, transport dates, authorized signatories, and recycler details.

5. Partner Only with EPA-Approved and Technically Competent Recyclers PCAP must contract recyclers licensed under Punjab EPA and compliant with hazardous waste rules. Particular caution is required for lithium-ion battery recycling, PCB boards, laboratory analyzers, and chemical-contaminated electronics.

6. Strengthen Occupational Health and Safety (OHS) Compliance Staff involved in handling electronic waste, especially high-voltage EV batteries and chemical- exposed instruments, must be trained in safe handling, PPE use, emergency response, and spill management. Depot and lab staff should undergo refresher training every six months.

7. Conduct Periodic Environmental Audits and SOP Compliance Reviews Independent audits should assess SOP adherence, identify risks in storage and handling, evaluate recycler

performance, and recommend corrective measures. Results must be shared with CMU-PCAP.

8. Integrate Community and Stakeholder Awareness on Safe Disposal Particularly for Result Area 3 (agriculture), farmers and machinery operators must be sensitized to the risks of burning wires, discarding PCB boards in fields, or storing damaged GPS units at home. Awareness materials should be distributed alongside machinery.

9. Continuously Update SOPs to Reflect Technological Changes as PCAP expands electric mobility, laboratory science, and sensor-based monitoring, new waste streams will emerge. SOPs should be reviewed annually and revised in line with technological evolution, regulatory updates, and recycling market conditions.

10. These recommendations ensure that PCAP's E-Waste Management SOPs are not only compliant with regulatory and safeguard standards but also operationally effective, future-ready, and capable of supporting the long-term environmental sustainability goals of the program.

## Annexure-A: Goods Receipt Note

Goods Receipt into Blocked Stock for Inspection

Posting Date: Equipment Doc:

Receiving Date: Delivery Note:

Vendor No.:

Vendor Name:

PO Number:

Remarks: Page ___of ___

**Equipment S. No:** **Storage Location:**

| S.No | Description | A/C Assignment | Units | Quantity |
|---|---|---|---|---|

Inspection

Remarks:

Movement Type: Created by:

Reason: Goods Recipient:

| Receiving Section | Quality Inspector / User depth. | Acceptor (stores/user) |
|---|---|---|
| Date: | | |
| | | |

## Annexure-B: Equipment Requisition Form

### MATERIAL REQUISITION FORM

| Equipment Maintenance Request | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Details | | | | | | | | Location | | Maintenance I | Equipment Upgradation Details | | |
| Date (1) | Type of Equipment (2) | Serial Number (3) | Brand & Model No. (4) | Manufacturing Year (5) | Software detail (6) | Hardware details (7) | Tag No. (8) | Office (9) | City (10) | Problem Description (11) | Software Upgradation log (12) | Hardware upgradation Log (13) | Remarks (14) |
| | | | | | | | | | | | | | |
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## Annexure-C: Goods Issuance Note

Posting Date: _____ Equipment Doc.:

Current Date: _____ Equipment Slip: _____

Assignment: _____

Plant: _____

| | Item Code | Storage Loc./ | | |
|---|---|---|---|---|
| | **Description** | **Storage Bin** | **Units** | **Quantity** |

Movement Type: Created by:

Reason: Goods Recipient:

Unloading Point

| Issued By: | Received By: | Authorized Signature: |
|---|---|---|
| **Date:** | Date: | Date: |
| | | |

## Annexure-D: Hazardous E-Waste Components, Risks, and Management Measures

| Component Category | Hazard Characteristics | Key Risks | ESMS Management Measures |
|---|---|---|---|
| **Lithium-ion batteries** | Flammable electrolytes | Fire, explosion | Fire-resistant storage, licensed transport and recycling |
| **Lead-acid batteries** | Lead, sulfuric acid | Chemical exposure, contamination | Secondary containment, authorized recyclers |
| **PCB boards / ECUs** | Heavy metals, flame retardants | Toxic emissions | Controlled dismantling, no informal recycling |
| **AQMS & lab analyzers** | Chemical residues | Occupational exposure | PPE, hazardous classification, secure storage |
| **GPS & telematics** | Embedded batteries | Fire, data risks | Battery isolation, data wiping |
| **EV chargers** | High voltage components | Electrical shock | LOTO procedures, trained staff |

## Annexure-E: Vendor Pre-Qualification Checklist (SOP-06)

Purpose:

To verify that vendors engaged for transport, recycling, or disposal of e-waste under PCAP meet minimum legal, technical, and safety requirements.

Vendor Name:

Type of Service: ☐ Transport ☐ Recycling ☐ Disposal ☐ Other

Assessment Date:

Assessed By:

| Requirement | Yes / No | Remarks |
|---|---|---|
| **Valid EPA license for relevant activity** | | |
| **Business registration certificate available** | | |
| **Facility capacity adequate for e-waste handling** | | |
| **Trained staff available for hazardous waste handling** | | |
| **OHS procedures in place** | | |
| **PPE available for workers** | | |
| **Emergency response arrangements available** | | |
| **Vendor agrees to comply with PCAP SOPs** | | |
| **Vendor agrees to provide recycling/destruction certificates** | | |

Assessment Result:

☐ Qualified

☐ Conditionally Qualified

☐ Not Qualified

Signature (E-Waste Manager / Evaluator):

Date:

## Annexure-F: Vendor Audit Checklist (SOP-06)

Purpose:
To conduct periodic audits of vendors engaged in e-waste transport, recycling, or disposal under PCAP.

Vendor Name:
Audit Location:
Audit Date:
Auditor Name:

### A. Facility Inspection

| Item | Compliant (Yes/No) | Remarks |
|---|---|---|
| Storage area organized and segregated | | |
| Hazard labeling visible | | |
| Fire safety equipment available | | |
| Spill response materials available | | |
| No informal dismantling observed | | |

### B. Documentation Review

| Document | Available (Yes/No) | Remarks |
|---|---|---|
| EPA license valid | | |
| Transport permits (if applicable) | | |
| Recycling/destruction records | | |
| Chain-of-custody records | | |
| OHS procedures | | |

### C. Audit Findings

Describe key observations:

### D. Corrective Action Plan (CAP) Tracking

| Issue Identified | Corrective Action Required | Responsible Party | Timeline | Status |
|---|---|---|---|---|

Auditor Signature:
Vendor Representative Signature:
Date:

## Annexure-G: Vendor Compliance Declaration (SOP-06)

Purpose:

To obtain a formal commitment from vendors to comply with PCAP SOPs, environmental regulations, and World Bank Environmental and Social Standards.

### Vendor Compliance Declaration

I/We, the undersigned, hereby declare that:

1. We hold valid licenses and approvals required for transport, recycling, or disposal of e-waste.
2. We shall comply with all applicable environmental, occupational health and safety, and waste management regulations.
3. We shall handle e-waste received under PCAP in accordance with:
   - PCAP E-Waste Management SOPs
   - Applicable EPA regulations
   - World Bank Environmental and Social Standards (ESS)
4. We shall not transfer PCAP e-waste to informal recyclers, scrap dealers, or unauthorized facilities.
5. We shall provide Certificates of Recycling or Destruction for all e-waste processed.
6. We shall allow inspection or audit by Implementing Agencies or PCAP representatives when required.

Vendor Name:

Authorized Representative:

Designation:

Signature:

Date:

Company Stamp:

## Annexure-H: Incident Report Form

| |
|---|
| Organization / Implementing Agency:<br>Incident Reference No.:<br>Reported By (Name & Designation): |
| |

### A. Incident Details

| Field | Details |
|---|---|
| Date of Incident | |
| Time of Incident | |
| Location (Office / Store / Transport / Facility) | |
| Type of Incident | |
| Asset ID (AIN) | |
| Equipment Description | |

### B. Immediate Action Taken

| Describe steps taken to control or contain the incident: |
|---|
| |
| |
| |

### C. Impact Assessment

| Impact Category | Description |
|---|---|
| Injuries (if any) | |
| Environmental impact (spill, smoke, contamination, etc.) | |
| Property damage (if any) | |

### D. Corrective Actions

| Action Required | Responsible Person | Timeline | Status |
|---|---|---|---|
| | | | |

| |
|---|
| Prepared By:<br>Signature:<br>Date: |

Verified By (E-Waste Manager / E&S Focal Person):
Signature:
Date:

## Annexure-I: Emergency Contact List

Purpose:
To ensure quick communication with responsible personnel and emergency services during e-waste incidents.

Each Implementing Agency shall maintain and periodically update this list.

### A. Site-Level Contacts

| Designation | Name | Phone Number |
|---|---|---|
| Site In-Charge | | |
| Store Manager | | |
| E-Waste Manager / E&S Focal Person | | |
| OHS / Safety Officer (if available) | | |

### B. Emergency Services

| Service | Contact Number |
|---|---|
| Fire Brigade/Rescue 1122 | |
| Ambulance / Emergency Medical Service | |
| Local Police Station | |

### C. Regulatory and Program Contacts

| **Authority / Office** | Contact Person | Phone / Email |
|---|---|---|
| **Environmental Protection Agency (EPA)** | | |
| **PCAP Coordination Unit** | | |
| **IA Head / Program Director** | | |