Ethiopia Digital Foundations Project (EDFP) (P171034)
Electrical and Electronic waste Management Plan (EEWMP)

Ethiopia Digital Foundations Project
Project Implementation Unit (PIU)

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Addis Ababa, Ethiopia

Acronyms

CRTs	plastic casings, cathode-ray tubes
ECA	Ethiopian Communications Authority
EDFP	The Ethiopian Digital Foundation Project (P171034)
EEE	Electrical and Electronic Equipment
EEPA	Ethiopian Environmental Protection Authority
EHSG	Environmental, Health, and Safety Guidelines
EIA	Environmental Impact Assessment
EPEAT	Electronic Product Environmental Assessment Tool.
ESS	Environmental and Social Standards
EthERNet	Ethiopian Education and Research Network
EV	Electric Vehicle
EEWMP	Electrical and Electronic Waste Management Plan
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
HID	High-Intensity Discharge
IBRD	International Bank for Reconstruction and Development
ICT	Information and Communication Technology
IDA	International Development Association
IEG	Independent Evaluation Group
IFC	International Finance Corporation
IPF	Investment Project Financing
ISRs	Implementation Status and Results Reports
LCD	Liquid Crystal Display
LPIs	key performance indicators
MinT	Ministry of Innovation and Technology
MoF	Ministry of Finance
MoLS	Ministry of Labour and Skills
MoSHE	Ministry of Science and Higher Education
Mt	Metric tons
NIST SP	National Institute of Standards and Technology Special Publication
PCBs	printed circuit boards
PD	Public disclosure
PDO	Project Development Objective
PMO	Prime Minister's Office
POM	placed on market
REEs	Rare Earth Elements
RFID	Radio Frequency Identification
SDGs	Sustainable Development Goals
WBG	World Bank Group
WEEE	Waste Electrical and Electronic Equipment

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1. Introduction

1.1. Overview of the EDFP and its components

The Ethiopian Digital Foundation Project (EDFP) (P171034) has five components and eight sub components out of which sub-projects management is the fourth component and includes Environmental, Social and gender Safeguards. The Project Implementing Unit (PIU) of Ethiopia Digital Foundation Projects (EDFP) administered by the Ministry of Innovation and Technology (MinT) also manages Environmental and Social Safeguards. The PIU manages environmental and social risks and impacts of the projects under its mandate throughout the project life cycle in a systematic manner, proportionate to the nature and scale of the project and to the potential risks and impacts. The components are shown in Table 1.

The main beneficiary agencies of the EDFP are the Ministry of Innovation and Technology (MinT), Ministry of Finance (MoF), Ethiopian Communications Authority (ECA), the Ethiopian Education and Research Network (EthERNet) within the Ministry of Education (MoE), the Ministry of Labour and Skills (MoLS) and the National ID Program (NIDP) within the Prime Minister's Office (PMO). The program extends to regions and city administrations via each ministry. This entails that the EDFP is actually a national project.

1.2. E-waste definition and general considerations

Based on the Basel Convention, a global treaty that controls the movement of hazardous waste across borders, e-waste also abbreviated as "Waste Electrical and Electronic Equipment (WEEE)", is defined as electrical or electronic equipment that is waste, including all components, sub-assemblies and consumables that are part of the equipment at the time the equipment becomes waste.[1] The convention also adds that e-waste is one of the fastest growing waste streams in the world. E-waste can be categorized as hazardous or non-hazardous waste under the Basel Convention. The Basel Convention classifies e-waste as hazardous and non-hazardous. When in

[1] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. https://goto.now/U3Wzg

e-waste there is presence of toxic materials such as mercury, lead or brominated flame retardants, e-waste is classified as hazardous. E-waste may also contain precious metals such as gold, copper and nickel and rare materials of strategic value such as indium and palladium. These precious and heavy metals could be recovered, recycled and used as valuable source of secondary raw materials.

E-waste can be generated from devices such as old computers, laptops, smartphones, printers, monitors, phones, and other IT equipment. Components of electric and electronic equipment (EEE), such as batteries, electric cables from end-of-life vehicles (ELVs), printed circuit boards (PCBs), plastic casings, cathode-ray tubes (CRTs), activated glass, and lead capacitors are also classified as e-waste. Possible WEEE to be covered by this project may include computers, scanners, printers, servers, copiers, electric cables, data centers, laptops, backup generators, including EVs that come with the project etc.

E-waste contains materials that, if mishandled, can be hazardous to human health and the environment, but, most importantly, also materials that are valuable and scarce. Secondary raw materials including copper, steel, plastic, and similar materials that may be recovered and recycled also contribute significant amount to e-waste.

1.3. RATIONALE OF THE EEWMP

Electrical and Electronic Wastes (e-Wastes) are known to be generated from projects during the planning, construction, implementation, commissioning and decommissioning phases, where the risks should be avoided, minimized, recycled, reused or mitigated, based on the sustainable waste management hierarchy[2]. This waste management plan deals, specifically, with e-wastes that are expected to be generated from EDFP project. Expected e-wastes span from small pieces of wires, to old computers, worn-out laptops, batters, data centers etc., which should be dealt with according to the national and international legal provisions.

[2] United Nations Environment Programme, & International Solid Waste Association. (2015). *Global Waste Management Outlook*. United Nations Environment Programme. https://www.unep.org/resources/report/global-waste-management-outlook

Considering all these, we can imagine that Ethiopia stands at a crossroads. As one of sub-Saharan Africa's fastest-growing economies, our nation's progress is undeniable—new technologies light up homes, cities expand, and innovation fuels dreams. Yet, this growth carries a hidden burden: mountains of discarded phones, broken appliances, and forgotten electronics piling up in our communities. Today, Ethiopia generates 88 million kilograms of e-waste annually—a silent crisis threatening the health of our people, the fertility of our land, and the legacy we leave for future generations.

This crisis is born from our very progress. Urbanization brings opportunity but also exposes families to outdated gadgets and unchecked waste. Informal collectors, like the hardworking *Minalesh Tera*, step in where systems fail, but their heroic efforts often come at a cost: children playing near leaking batteries, farmers tending soil laced with toxins, and families breathing air tainted by burning cables. Meanwhile, precious metals like copper and gold—resources that could fuel new industries—are lost to landfills or shipped abroad, stripping Ethiopia of its potential.

The stakes could not be higher. Without action, e-waste will double by 2030, poisoning rivers like Akaki in Addis Ababa, sickening communities in regional cities, and undermining the promise of Ethiopia's Green Legacy Initiative. Respiratory illnesses from toxic fumes, radiation exposure from discarded hospital equipment, and barren fields in once-fertile regions are not abstract threats—they are tomorrow's reality if we wait.

This e-Waste Management Plan is more than a policy—it is a pact with our land and people. Rooted in Ethiopia's Climate-Resilient Green Economy and Home-Grown Economic Reform Agenda, it turns crisis into opportunity by:

- formalizing the labor of *Min Alesh Tera*, we protect their livelihoods *and* their health.
- recommending building recycling hubs in Addis Ababa, we honor the city's dynamism while healing its soil.
- raising awareness about radiation risks, we shield mothers, farmers, and children from invisible dangers.

- reclaiming gold from old phones and copper from discarded wires, we fuel jobs and innovation.

This plan is also a promise to the world. By aligning with the Basel Convention and Ethiopia's own e-waste laws, we affirm EDFP's role as steward of a shared planet. The time to act is now—not just because treaties demand it, but because our children deserve clean water, our farmers deserve fertile soil, and our nation deserves a future where growth does not come at the cost of life itself. By developing such a plan, and accommodating stakeholders' concerns, the EDFP celebrates its obligation to our constitution "all persons have the right to a clean and healthy environment".

1.4. OVERVIEW OF E-WASTE GENERATION TRENDS AND ASSOCIATED RISKS

Globally, the amount of EEE placed on market (POM) grew from 62 billion kg in 2010 to 96 billion kg in 2022. It is projected to increase to 120 billion kg in 2030. During the same period, the amount of e-waste generated annually grew from 34 billion kg to a record 62 billion kg. It is projected to increase to 82 billion kg by 2030.[3] The report emphasizes that recycling infrastructure and policies lag far behind the growth of e-waste.

In 2019, approximately 53.6 million metric tons (Mt) of e-waste was generated globally, but only 17.4% was documented to be collected and recycled. The vast majority of e-waste is either landfilled, incinerated, or managed informally, leading to significant environmental and health risks. [4]

One of the main mitigation methods of e-waste is recycling. However, the rate of e-waste recycling is significantly lower compared to the rate of generation.[5]

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[3] Baldé, Cornelis P., Kuehr Ruediger; Yamamoto, Tales et al (2024). The Global E-Waste Monitor. International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). Global E-waste Monitor 2024. Geneva/Bonn.

[4] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). *The Global E-Waste Monitor 2020: Quantities, flows, and the circular economy potential*. United Nations University (UNU)/International Telecommunication Union (ITU)/International Solid Waste Association (ISWA). https://www.itu.int/en/ITU-D/Environment/Pages/Global-Ewaste-Monitor-2020.aspx

[5] Forti et al. (2020). Ibid.

While the market demand for production of WEEE is continuously increasing, the life span or replacement interval of such products continues to decline in the course of technological development. Proper handling and treatment of e-waste and maximizing the benefits thereof will result in a better tradeoff between the negative impacts of e-waste and its benefits. If not handled properly, e-waste can contaminate soil and water with harmful substances. E-waste, if not properly treated, can have negative impacts, both on human health and on the environment. However, sustainable treatment of e-waste avoids these negative impacts.

As it is in most solid waste treatments in Ethiopia, open air burning is accustomed. However, in the case of e-waste, it will be devastating. Accordingly, it is highly recommended that e-wastes must not enter into traditional domestic dumpsites. Open burning of e-waste significantly pollutes the air by releasing toxic fumes, including dioxins, heavy metals like lead and mercury, and other hazardous chemicals, which can cause respiratory issues, damage human health, and contribute to broader environmental problems for people living near the burning site, especially when done in informal recycling operations; this is considered one of the most harmful ways to dispose of e-waste due to the widespread contamination it generates.[6]

It should be noted that open burning may implicate wildlife and domestic animals that usually scavenge on or near the waste disposing sites. In most African cities, including Addis Ababa, children scavenge on dumpsites also called as "waste pickers", are in danger of health risks.[7]

1.5. OBJECTIVES AND PURPOSES OF THE E-WASTE MANAGEMENT PLAN

The general objective of the e-waste management plan is to develop and implement a sustainable and effective electronic waste management system that minimizes environmental and public health risks, promotes resource efficiency, ensures regulatory compliance, and support the long-term goals of the Ethiopia Digital Foundations Project.

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[6] UN. (2021). Children and digital dumpsites: e-waste exposure and child health. Geneva: World Health Organization. License: CC BY-NC-SA 3.0 IGO.

[7] Deribe Abera. (2006). The situation of scavenging children on the waste dumping sites of Addis Ababa. M.Sc. Thesis. Addis Ababa University. 89 pages.

An effective e-Waste Management Plan addresses environmental, social, and economic challenges by setting clear objectives and purposes. By achieving these goals, stakeholders can ensure that e-waste is managed responsibly, contributing to a healthier planet and sustainable development (Table 1).

Table 1 Summary Table of Objectives and Purposes of e-waste management.

Objective	**Purpose**
1. Minimize Environmental Impact	Prevent pollution and protect ecosystems.
2. Promote Resource Recovery	Support a circular economy and conserve resources.
3. Ensure Safe Handling and Disposal	Protect human health and the environment from toxic substances.
4. Reduce E-Waste Generation	Address the root cause of e-waste through sustainable practices.
5. Protect Human Health and Safety	Safeguard workers and communities from health risks.
6. Comply with Regulations	Avoid legal penalties and ensure responsible practices.
7. Raise Public Awareness	Encourage responsible e-waste disposal and recycling.
8. Support SDGs	Contribute to global sustainability goals.
9. Foster Stakeholder Collaboration	Ensure a coordinated and inclusive approach.
10. Monitor and Evaluate Performance	Track progress and identify areas for improvement.

2. METHODOLOGIES

The finalization of the EDFP e-waste management plan followed a structured, participatory, and evidence-based approach. The key steps undertaken are as follows:

1. **Global Review of E-Waste Management Practices**
   A desk-based review was conducted to analyze international trends, best practices, and innovations in e-waste management. This provided a comparative framework and informed the selection of context-appropriate solutions for Ethiopia.

2. **Review of Ethiopia's Regulatory Framework for E-Waste**
   Ethiopia's existing ministerial-level regulation on e-waste management was reviewed. The analysis highlighted significant regulatory gaps, particularly the absence of a comprehensive national strategy and the failure to include radioactive components of electronic or electrical waste. This issue was raised during stakeholder discussions, with participants recommending the expansion and revision of the current policy framework to address such critical omissions.

3. **Baseline Data and Situational Analysis**
   Baseline data was reviewed to assess contextual factors relevant to e-waste management, including:

   - Topography and climate considerations affecting waste logistics
   - National digital connectivity and technological infrastructure
   - Current volumes, types, and distribution of e-waste
   - Institutional and technical capacities at various administrative levels

4. **Subproject Analysis**
   An assessment of EDFP subprojects was undertaken to evaluate potential e-waste generation and to determine the integration needs of specific mitigation and management measures across subcomponents.

5. **Alignment with Project Safeguard Instruments (ESMP and ESCP)**

   The e-waste management plan was reviewed for coherence with the project's Environmental and Social Management Plan (ESMP) and Environmental and Social Commitment Plan (ESCP), ensuring harmonization of environmental and social risk mitigation measures.

6. **Review of Legal and International Frameworks**

   Relevant national legal provisions and international frameworks were examined, including:

   - Ethiopian environmental and waste-related legislation
   - Global agreements (e.g., Basel Convention on hazardous wastes)
   - Comparative insights from legal systems in other countries

7. **Compliance with World Bank Environmental and Social Standards (ESSs)**

   The plan was aligned with applicable World Bank Environmental and Social Standards, particularly those concerning waste management (ESS3), environmental health and safety, stakeholder engagement, and institutional accountability.

8. **Stakeholder Mapping and Analysis**

   A detailed stakeholder mapping was conducted to identify and categorize key actors, including government institutions, private e-waste handlers, NGOs, consumers, and development partners. Their roles and influence were analyzed to guide the engagement strategy.

9. **Experience Sharing by Sectoral Stakeholders**

   Representatives from key sectors were invited to share their experiences, practices, and challenges regarding e-waste management in Ethiopia. These sessions enriched the discussion and highlighted both opportunities and systemic constraints.

10. **Multi-Stakeholder Consultation Workshop**

    A three-day national workshop was organized for the disclosure and review of the draft e-waste management plan. Activities included:

- Breakout group discussions focused on thematic and sectoral perspectives
- Plenary sessions for presentation, feedback, and clarification
- Open-floor consultations to gather broad-based concerns and suggestions

11. **Integration of Feedback and Policy Recommendations**

    Inputs from the workshop were systematically analyzed. Key concerns, such as the exclusion of radioactive e-waste in existing regulations, were addressed with recommendations for future policy reforms. Stakeholder inputs were incorporated into the document to enhance clarity, feasibility, and inclusiveness.

12. **Consensus and Finalization of the Document**

    At the conclusion of the consultation process, a unanimous consensus was reached among stakeholders that the revised e-waste management plan was complete, practical, and ready for implementation. The plan was finalized and consolidated into a comprehensive document that reflects both technical rigor and stakeholder ownership.

3. SCOPE OF THE E-WASTE MANAGEMENT PLAN

The scope of E-Waste Management Plan covers multiple facets of the EDFP landscape, including digital economy, digital government, and digital entrepreneurship, reflecting a holistic approach to national digital development. The scope of EDFP subprojects include managing e-waste from new digital infrastructure (e.g., data centers, devices), enforcing recycling partnerships, and advocating for national e-Waste policies. The source of e-waste in EDFP projects originate from each project activities. It was clearly indicated in the ESMP of EDFP projects that overall, the subproject activities involved with EDFP will be site specific and generating impacts that are of moderate significance which can be mitigated. The E & S risk assessment carried as part of the present EDFP ESMF has also confirmed that the risk rating is "Moderate" for both E & S risks with the overall risk rating being the same "Moderate".[8]

The scope of E-waste management plan includes, but not limited to, the following:

- **Information and Communication Technology (ICT) Equipment:** includes desktops, laptops, tablets; mobile phones, smartphones, and accessories; servers, routers, modems, and networking equipment; printers, scanners, and copiers. These equipment process Circuit boards (containing lead, gold, copper); batteries (lithium-ion, nickel-cadmium); Screens (LCD/LED panels with mercury or indium). They also contain heavy metals and flame retardants.
- **Lighting Equipment:** These include fluorescent lamps (tube lights, CFLs); LED bulbs and fixtures and high-intensity discharge (HID) lamps.
- **Electrical Tools: these include all network tools:** These tools include drills, saws, sanders and welding equipment. Components of these machines include Nickel-cadmium or lithium-ion batteries and electric motors (copper windings) that either create waste or emit heat.

[8] Environmental and Social Management Framework (ESMF) For EDFP. Retrieved from: https://dfp.gov.et/resource/type/3?file=6

- **Batteries:** Batteries are serious polluters if not handled carefully. They include Rechargeable (lithium-ion, Ni-Cd, Ni-MH); Single-use (alkaline, button cells); automotive batteries (lead-acid) and EV batteries.
- **EV batteries:** Transportation for networking and network management can be via using fuel based or EV batteries. Both have hazardous wastes if not mitigated. While fossil fuel is well known to the world, the new technology of EV battery waste management is new to Ethiopia. EV Battery degradation over time leads to replacement needs, generating waste. Improper disposal of lithium-ion batteries risks leaching hazardous chemicals (e.g., cobalt, nickel) into soil and water. Current recycling infrastructure is underdeveloped, with <5% of lithium-ion batteries recycled globally. Efficient recovery of materials like lithium and cobalt remains a challenge. This is almost impossible in Ethiopia. With Ethiopia totally resorting to EV motors, the challenge of EV batteries management is of paramount importance. The use of these vehicles in transporting and management digital development is, however, unavoidable. The complete life cycle of the EV batteries from mining to waste management calls for more attention, since pollution is not only an issue of one country but the whole world from the global village concept. The EDFP projects that are covered under this EEWMP are shown in Table 2. Details of the project are found in the Project Appraisal Document Pad (PAD).

4. Benefits of Sustainable E-Waste Management Practices

There is a plethora of benefits from sustainable e-waste management. The following benefits, but not limited, to can be generated from e-waste management practices:

1. **Environmental Protection**
    - Prevents toxic substances (e.g., lead, mercury) from contaminating soil, water, and air.
    - Recovers valuable materials (gold, copper, rare earth metals), reducing the need for mining and preserving natural habitats.
    - Lowers greenhouse gas (GHG) emissions by minimizing energy-intensive extraction and manufacturing processes.
2. **Health Benefits**
    - Protects workers and communities from harmful chemicals released during informal recycling (e.g., burning electronics) by reducing exposure to toxins by reducing pollution.
3. **Economic Advantages**

Effective e-waste management not only generates employment in recycling, refurbishing, and waste management sectors—particularly empowering informal waste pickers and micro-enterprises in Addis Ababa and Ethiopia's urban centers—but also enables the profitable extraction of precious metals and reusable materials from discarded electronics. This resource recovery fosters economic value while reducing environmental harm. Additionally, the refurbishment of affordable devices from reclaimed components enhances access to technology, helping bridge the digital divide by lowering costs for underserved communities.

4. **Energy Efficiency**

Recycling metals like aluminum consumes significantly less energy than processing raw ores because it bypasses energy-intensive steps such as mining, refining, and electrolysis. For instance, recycling aluminum requires only **5% of the energy** (≈750 kWh per ton) compared to primary production (≈13,500 kWh per ton), as melting scrap metal eliminates the need to extract and

process bauxite.[9,10] This drastic reduction lowers greenhouse gas emissions, conserves finite resources (e.g., bauxite), and reduces habitat destruction linked to mining. Globally, recycling one ton of aluminum saves ≈14,000 kWh of energy—enough to power a household for a year—demonstrating how recycling advances energy efficiency, cuts industrial carbon footprints, and supports circular economy goals.

5. **Data Security**

Sustainable e-waste management ensures secure data destruction by employing systematic protocols such as certified data erasure (e.g., NIST-standard software wiping or physical destruction of storage media[11]) and rigorous chain-of-custody tracking to prevent unauthorized access. Certified recyclers (e.g., R2, e-Stewards) adhere to strict data security practices and comply with regulations like GDPR[12] or HIPAA, ensuring sensitive information is irreversibly destroyed. This mitigates risks of identity theft, corporate breaches, and unauthorized data recovery, while transparent reporting builds consumer trust. By integrating robust data security into recycling workflows, these practices protect privacy and advance both environmental sustainability and ethical e-waste handling.

6. **Regulatory and Corporate Benefits**

Sustainable e-waste management practices meet legal requirements for e-waste disposal, avoiding fines by enhancing corporate image through eco-friendly practices, boosting consumer trust and competitiveness.

7. **Circular Economy Support**

Sustainable e-waste management extends product lifecycles by prioritizing practices like refurbishing, repairing, and repurposing electronics instead of discarding them. Reuse and

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[9] International Aluminium Institute. (2022). *Aluminium recycling*. https://international-aluminium.org/statistics/recycling/

[1010] U.S. Department of Energy. (2021). *Energy savings from metal recycling*. https://www.energy.gov/eere/amo/metal-recycling

[11] National Institute of Standards and Technology (NIST). (2014). *NIST Special Publication 800-88: Guidelines for media sanitization*. https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-88r1.pdf

[12] European Commission. (2016). *General Data Protection Regulation (GDPR)*. https://gdpr-info.eu/

recycling reduce the need to extract virgin materials (newly mined or synthesized resources), lowering environmental harm from mining and production. By closing the loop between disposal and production, it minimizes waste and fosters a circular economy—where resources are reused indefinitely, not dumped after single use.

8. **Innovation and Design**

Eco-design encourages manufacturers to create modular, easily recyclable products by prioritizing sustainability throughout a product's lifecycle.[13,14,15] Through innovation in materials science and engineering—such as using standardized components, biodegradable materials, and disassembly-friendly designs—companies can reduce waste and resource consumption. This shift is driven by regulatory pressures (e.g., Right to Repair laws), consumer demand for eco-conscious products, and economic incentives like cost savings from material recovery and new revenue streams in the circular economy. By fostering collaboration across supply chains and integrating eco-design principles, manufacturers not only meet environmental goals but also enhance product longevity, reduce electronic waste, and align with global sustainability frameworks like the UN SDGs, ultimately balancing profitability with planetary health.

9. **Social Impact**

An effective e-waste management plan fosters social impact by educating communities on responsible consumption and disposal, raising awareness about sustainability and reducing harmful practices. Simultaneously, it promotes digital inclusion by refurbishing discarded electronics into affordable devices, enabling underserved populations—such as low-income households, students, and rural communities—to access critical technology tools. This dual approach not only empowers individuals with digital literacy and opportunities but also bridges socioeconomic gaps, aligning environmental stewardship with equitable progress.

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[13] Ellen MacArthur Foundation. (2019). *Completing the picture: How the circular economy tackles climate change*. https://www.ellenmacarthurfoundation.org/publications

[14] European Commission. (2020). *Circular economy action plan: For a cleaner and more competitive Europe*. https://ec.europa.eu/environment/circular-economy/

[15] United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. https://sdgs.un.org/2030agenda

10. **Global Equity**

Sustainable e-waste management addresses the unequal burden of e-waste by stopping wealthier nations from exploiting poorer countries as dumping grounds. By reducing e-waste exports, it ensures hazardous waste is managed responsibly at its source, promoting fair environmental practices and protecting vulnerable communities from health and ecological harm.

11. **Landfill Reduction**

Diverting e-waste from landfills through recycling, refurbishment, and reuse reduces the volume of toxic materials (e.g., lead, mercury) and non-biodegradable waste buried in the ground. This alleviates pressure on landfill capacity, prevents soil/water contamination, and minimizes methane emissions from decomposing waste. By curbing e-waste generation and promoting circular practices, it tackles both environmental degradation and resource scarcity.

5. PROJECT DESCRIPTION

The Ethiopia Digital Foundations Project (EDFP), funded by a $200 million IDA credit, aims to enhance digital inclusivity, affordability, and job creation in Ethiopia. It aligns with Ethiopia's Homegrown Economic Reform Agenda and the African Union's digital transformation goals, targeting universal broadband access by 2030. The main objectives of the EDFP are increase access to affordable digital services (e.g., internet, e-government); Boost digital job creation through entrepreneurship and private-sector growth; Strengthen regulatory frameworks for a competitive telecom sector and respond to emergencies (e.g., COVID-19, climate crises) via digital resilience. The components and subcomponents are shown in Table 2 with detailed description. In brief, the Project Development Objective (PDO) of EDFP is to increase the inclusiveness and affordability of digital services and digital job creation in Ethiopia. Details of the project components and subcomponents can be accessed from the Project Appraisal Document (PAD)[16].

[16] World Bank. (2021). *Ethiopia digital foundations project*. https://documents1.worldbank.org/curated/en/421681619316030132/pdf/Ethiopia-Ethiopia-Digital-Foundations-Project.pdf

Table 2 EDFP Project components, subcomponents and main activities.

Component	Subcomponent	Funding Allocation (US$)	Key Activities	Environmental & Health Impact
1. Digital Economy Enabling Legal/Regulatory Environment		20 million	Hire transaction advisors to privatize 40% of Ethio Telecom and prepare for market competition.	Increased telecom infrastructure (e.g., cell towers, data centers) may raise energy consumption (non-renewable sources) and e-waste from obsolete equipment.
	1.1. Partial Privatization of Ethio Telecom	4.3 million	Hire transaction advisors to privatize 40% of Ethio Telecom and prepare for market competition.	Increased telecom infrastructure (e.g., cell towers, data centers) may raise energy consumption (non-renewable sources) and e-waste from obsolete equipment.
	1.2. Strengthening Independent ICT Regulation	11 million	Build capacity for ECA (spectrum management, cybersecurity, licensing).	Spectrum management could reduce interference but requires energy-intensive monitoring systems.
	1.3. Digital Economy Development	4.7 million	Support digital ID systems, data protection laws, and regional digital integration.	Data centers may increase energy use. Centralized data storage risks if cooling systems/energy sources are unsustainable.
2. Digital Government & Connectivity		133 million		
	2.1 Digital Government & COVID-19 Response	50 million	Develop e-government portals, remote work infrastructure, and cybersecurity upgrades.	Data centers for government cloud services could increase carbon footprint. E-waste from outdated servers/IT equipment.
	2.2 Public Institution Connectivity	65 million	Pre-purchase broadband for 200+ government offices and hospitals.	Fiber-optic cable deployment may disrupt ecosystems (e.g., trenching in sensitive areas); Improper disposal of network equipment (e.g., routers, switches) contributes to e-waste.

	2.3 Educational Connectivity	18 million	Connect universities, TVETs, and research institutions.	Energy-intensive campus networks and data centers. E-waste from obsolete lab equipment/computers.
3. Digital Business & Entrepreneurship		40 million		
	3.1 Grants for Startups & Businesses	35 million	Grants for tech startups and digital businesses.	Startups may use low-cost, non-recyclable hardware. Scaling digital platforms could increase server energy demand.
	3.2 Technical Assistance to MinT	5 million	Strengthen policy harmonization and innovation ecosystems.	Indirect risk if policies neglect green ICT standards.
4. Project Management		7 million	Establish a Project Implementation Unit (PIU).	Environmental: Office operations (e.g., paper use, energy).
5. Contingent Emergency Response		0 (flexible)	Reserve funds for crises.	Environmental: Emergency ICT kits (e.g., solar-powered devices) could reduce harm, but rushed deployments risk improper e-waste disposal.

6. ENVIRONMENTAL AND SOCIAL BASELINE

6.1. ENVIRONMENTAL BASELINE

Situated in East Africa, Ethiopia spans over 1.1 million km² and features a striking diversity of landscapes shaped by its tropical climate and altitudinal variations. The country's topography ranges from rugged highlands (45% of land above 1,500 meters) to vast lowlands (55% below 1,500 meters), encompassing mountains, plateaus, river valleys, and plains. This geographic and climatic diversity fosters 10 distinct ecosystems and 67 agro-ecological zones, supporting rich biodiversity, including unique plant, animal, and microbial species. Ethiopia has established 52 protected conservation areas, including 20 national parks, wildlife reserves, and community-managed zones, to safeguard its natural heritage. The nation's hydrology is defined by 12 major river basins grouped into four drainage systems (Nile, Rift Valley, Shebelle-Juba, and North-East Coast), which sustain both rural and urban regions.

6.2. SOCIAL BASELINE

With a population of 110 million, Ethiopia is Sub-Saharan Africa's second-most populous nation, characterized by a youthful demographic (46% under age 15) and near-equal gender distribution (51% women in urban areas). Households average 4.6 members, and the country is home to over 90 ethnic groups, reflecting its vibrant multicultural identity.

6.3. DIGITAL CONNECTIVITY BASELINE

Ethiopia remains one of the world's least digitally connected nations, though recent reforms are driving progress. As of 2023, 25% of the population (30.1 million) uses the internet, while 51% (63 million) access mobile services. Despite a 25% increase in internet users since 2020, rural areas—home to 78% of Ethiopians—lag severely, with only 12% connectivity due to sparse infrastructure and unreliable electricity.

Trends have changed from early 25 onwards. As of 2025, Ethiopia's digital landscape reflects gradual yet uneven progress. Approximately 28.6 million individuals (23.3% of the population)

use the internet, while 8.90 million (7.3%) engage with social media platforms. Mobile connectivity remains the primary access point, with 71.5 million cellular connections (58.3% penetration). However, a stark urban-rural divide persists: urban internet adoption reaches 40.1%, compared to just 10.7% in rural areas, where limited infrastructure and affordability hinder equitable access. These figures underscore the need for targeted interventions to bridge digital divides and align growth with national development goals.[17]

6.4. BASELINE DATA OF E-WASTE GENERATION IN ETHIOPIA

Data is lacking or too old[18] concerning specific details of e-waste generation in Ethiopia. However, one study reports that urban waste generation in Ethiopia ranges from 0.28 to 0.83 kg per capita per day. Globally, this figure varies from 0.11 to 4.54 kg per person per day[19]. Specifically, Addis Ababa sees a solid waste generation rate of 0.45 kg per person per day, with a total of over 754,236 tons per year. This waste generation increases by approximately 5% annually. [20]

The "Min Alesh Tera" in Merkato is highly involved in such practices, where people dismantle, burn, and smelt to dismantle scraps from electronics and electrical materials with no PPE. Out of the 754,236 tons of waste produced per year 70% is collected through the formal solid waste management system that is administered by the city government while the remaining 30% gets dumped into rivers, kept in informal local dumps or lost in the inefficiency of the waste management system.[21] This raises considerable health and environmental pollution.

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[17] DataReportal. (2025). *Digital 2025: Ethiopia*. https://datareportal.com/reports/digital-2025-ethiopia

[18] United Nations University. (2019). *E-waste: A global hazard*. StEP Initiative. https://step-initiative.org

[19] **Central Statistical Agency (CSA)**. (2020). *Ethiopia demographic and health survey: Urban waste generation indicators*. Central Statistical Agency.

[20] World Bank. (2020). Ethiopia urban development review: Waste management challenges. World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/328271589734903294/ethiopia-urban-development-review

[21] UNDP (2020). Minalesh Tera: How Addis Ababa's informal recycling and reusing market supports formal waste management. Retrieved from: **https://www.undp.org/ethiopia/blog/minalesh-tera-how-addis-ababas-informal-recycling-and-reusing-market-supports-formal-waste-management**

Concerning the e-waste another study points out that Ethiopia generates an estimated 88 million kilograms of e-waste per year, placing it among the highest e-waste producers in East Africa.[22]

In Ethiopia, informal waste collection systems involve individuals gathering materials from households, businesses, or designated collection spots. Microenterprises and young collectors, often referred to as *"Quraleo,"* roam neighborhoods, loudly calling out to residents. Those with discarded items like scrap metal, computer components, or obsolete electronics respond, either selling or bartering these materials. The collectors then transport the gathered items to *Merkato* (Africa's largest open-air market), where a section called *"Minalesh Tera"* (roughly meaning "What do you have to offer?") serves as a hub. Here, materials are resold to buyers, handed over to informal welders, or processed by small-scale recyclers. Despite this network, formal recycling infrastructure is virtually nonexistent, with only plastic recycling operating at a minimal scale. According to a GIZ report, Ethiopia's expanding consumer economy has driven a notable surge in electronic waste (e-waste) generation. The study details that most e-waste is mismanaged via unsafe practices like open-air burning to extract valuable metals (e.g., copper) and haphazard storage of dismantled components. It emphasizes that only a small fraction, including devices like laptops and mobile phones, undergoes formal refurbishment or recycling.[23]

6.5. MAIN CHALLENGES OF E-WASTE MANAGEMENT IN ETHIOPIA

As of 2023, Ethiopia's e-waste generation remains poorly quantified due to the absence of a national inventory, though estimates suggest an annual per capita output of **0.1 kg**—far below the global average of 7.3 kg—with total volumes projected to reach **13,000 metric tons by 2025** (UNEP, 2023; Global E-waste Monitor, 2020). Challenges in accurate baselining arise from reliance on informal recycling practices, such as unsafe cable burning, which evade formal reporting. Rising mobile connectivity (63 million users in 2023) and digital infrastructure expansion under initiatives like the *Ethiopia Digital Foundations Project* are accelerating e-waste

[22] Ibid.
[23] Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2023). SECTOR BRIEF ETHIOPIA: Waste management and recycling. German Federal Ministry for Economic Cooperation and Development (BMZ). Division 110 . Cooperation with the private sector, sustainable economic policy, Berlin.[23]

generation. Compounding these issues, Ethiopia lacks a formal e-waste management framework, despite recognizing the need for action in its 2021 National Environmental Policy[24].

[24] Ethiopian Environment, Forest and Climate Change Commission. (2021). *National Environmental Policy*.

7. E-WASTE MANAGEMENT LEGAL FRAMEWORKS

7.1. ETHIOPIAN LAWS

Ethiopia has no comprehensive e-waste management plan, yet. However, progress is rising through recognition of the problem and creating international relationships. The rise of digital development amongst the absence of proper e-waste management plan makes Ethiopia vulnerable. This calls for the preparation of e-waste management plan and strict adherence to it for the success of EDFP. In the following sections major Ethiopian laws dealing with waste management including e-wastes are mentioned and detailed.

7.1.1. The Constitution of Ethiopia

The umbrella laws from which all Ethiopian laws originate, the Constitution of Ethiopia, states under Article 44 states that all people have the right to a clean and healthy environment.

7.1.2. Proclamation No. 300/2002

Ethiopia has also developed and issued Environmental Pollution Control Proclamation" (No. 300/2002). Article 3 of the proclamation stipulates general rules regarding control or prevention of pollution including use of clean technologies and the polluter pays principle. Article 4 concerns hazardous waste, chemical substances and radioactive substance. Article 5 provides for collection, transportation, treatment (including recycling) of municipal waste.

The objectives of Proclamation No. 300/2002 are to prevent and Control Pollution by regulating activities that may cause environmental pollution.

- Protect Human Health and the Environment by safeguarding public health and ecosystems from the adverse effects of pollution.
- Promote Sustainable Development by ensuring that economic development does not compromise environmental quality.

The proclamation applies to all natural and legal persons engaged in activities that may cause environmental pollution. It covers air, water, and soil pollution, as well as noise and waste management. The vast provisions of the proclamation is summarized in Table 3.

Table 3 Summary provisions and descriptions of Proclamation No. 300/2002

Provision	Description
Objectives	Prevent pollution, protect health and environment, promote sustainability.
Scope	Applies to all activities causing air, water, soil, noise, or waste pollution.
Permit Requirement	Mandatory permits for pollution-causing activities.
Emission Standards	Sets limits on pollutant discharges.
Waste Management	Requires proper handling and disposal of waste.
Environmental Impact Assessment	Mandatory EIA for significant projects, with public participation.
Monitoring and Enforcement	Inspections, monitoring, and penalties for non-compliance.
Institutional Framework	EPA as the primary implementing body.
Public Awareness and Education	Promotes information dissemination and environmental education.
Penalties and Sanctions	Fines, permit suspension/revocation, and legal action for violations.

7.1.3. Proclamation No.1090/2018

Ethiopia has also issued Proclamation No.1090/2018 which deals with Hazardous Waste Management and Disposal Control Proclamation. This proclamation concerns all hazardous wastes. The Hazardous Waste Management and Disposal Control Proclamation No. 1090 was implemented in 2018 to prevent the unsafe disposal of hazardous waste into rivers or dumps by stipulating penalties for individuals and businesses. The importation of hazardous waste is prohibited. However, this Proclamation did not spell out e-waste, though some e-wastes have been classified as hazardous wastes. In Article 92/1, it was also stated that Government shall endeavor to ensure that all Ethiopians live in a clean and healthy environment (environmental duty and objective). These articles give rights to citizens and assign duties and objectives to the government. Accordingly, the government has the duty to enforce these laws.

7.1.4. Proclamation No. 299/2002

Proclamation No. 29912002 “Environmental Impact Assessment Proclamation” provides for the inclusion of Environmental and Social Impact Assessment Report for any new project before its implementation. The proclamation requires the extent of pollution and mitigation mechanisms to be in place. Digital development projects are not exceptions.

7.1.5. Council of Ministers Regulation No. 425/2018

Council of Ministers Regulation No. 425/2018 governs the environmentally sound management of electrical and electronic waste (e-waste) in Ethiopia. The regulation defines e-waste as all discarded electrical and electronic equipment (EEE) powered by electric current or electromagnetic fields, excluding radioactive materials. It applies broadly to producers, importers, distributors, consumers, and recyclers, placing specific obligations on each stakeholder group. A cornerstone of the regulation is the Extended Producer Responsibility (EPR), which mandates that producers and importers establish take-back systems, fund recycling programs, and ensure safe disposal of their products (Table 4).

Table 4 Summary provisions and description of Council of Ministers Regulations No. 425/2018.

Provision	Description
Objectives	Improve waste management, protect health and environment, promote recycling.
Scope	Applies to urban areas and covers all types of solid waste, including e-waste.
Waste Classification	Categorizes waste into biodegradable, non-biodegradable, recyclable, hazardous.
Responsibilities	Municipalities, waste generators, and private sector have defined roles.
Waste Collection and Transportation	Segregation at source, efficient collection systems, covered transportation.
Waste Treatment and Disposal	Guidelines for landfills, recycling, and hazardous waste management.
Environmental and Health Standards	Pollution control and worker safety measures.
Monitoring and Enforcement	Inspections, penalties, and legal action for non-compliance.
Public Awareness and Participation	Education campaigns and community involvement in waste management.
Institutional Framework	EPA, municipalities, private sector, and NGOs collaborate on implementation.
Penalties and Sanctions	Fines, suspension of operations, and legal action for violations.

For the Ethiopia Digital Foundation Project (EDFP), this means prioritizing procurement of EEE from vendors that comply with EPR, such as those offering take-back agreements or certified recycling partnerships. As a consumer, EDFP is legally obligated to hand over all generated e-waste (e.g., obsolete computers, servers, batteries) to EPA-registered collection centers, which must hold a Certificate of Competence issued by the Council of Ministers. Informal disposal practices, such as open burning or mixing e-waste with municipal solid waste, are strictly prohibited.

To ensure compliance, EDFP will maintain records of e-waste transfers to certified recyclers (e.g., volumes, types, dates) and submit quarterly reports to the Ethiopian Environmental Protection Authority (EPA). Non-compliance risks penalties and operational suspensions. By aligning procurement, disposal, and monitoring practices with this regulation, EDFP not only adheres to national law but also advances its commitment to sustainable digital transformation. Summary provisions of Proclamation No. 425/2018 is shown in Table 3.

In line with Regulation No. 425/2018 with EDFP Activities the EDFP will operationalize its e-waste management commitments through three pillars:

1. **Procurement**: EDFP will mandate Extended Producer Responsibility (EPR) compliance in tender documents, requiring vendors to (a) partner with EPA-certified recyclers, (b) provide evidence of take-back programs or recycling agreements, and (c) prioritize eco-design certifications (e.g., Energy Star, EPEAT).

2. **Stakeholder Collaboration**: EDFP will partner with EPA-registered collection centers (to be identified in coordination with the Ethiopian EPA) for safe e-waste disposal, collaborate with EthERNet to raise awareness in academic institutions, and engage the Ministry of Labour and Skills (MoLS) to train informal recyclers on safe practices.

3. **Monitoring & Compliance**: The PIU will biannually audit disposal records (Table 10), verify recycler certifications against the EPA's registry, and submit quarterly reports to the EPA detailing e-waste volumes, types, and disposal routes.

It should be noted that while informal hubs like *Minalesh Tera* are active in Addis Ababa, they lack EPA certification and engage in non-compliant practices. EDFP will instead prioritize

partnerships with formally certified recyclers or collaborate with the EPA to formalize informal actors through Regulation No. 425/2018 training programs.

7.1.6. FEFCCC (2020). Environmental and Social Impact Assessment (ESIA) Guideline with Respect to Integrated Risk Management (IRM)[25]

This guideline focuses on the Environmental Impact Assessment (EIA) process for development projects. It provides a robust framework for conducting EIAs in Ethiopia, ensuring that development projects, including those related to e-waste management, are environmentally sustainable and socially responsible.

The guideline categorizes projects into three categories depending on the severity of their impacts as:

- **Schedule 1**: Projects with significant environmental impacts, requiring a full EIA.
- **Schedule 2**: Projects with moderate environmental impacts, requiring an initial environmental examination (IEE).
- **Schedule 3**: Projects with minimal or no environmental impacts, exempt from EIA requirements.

7.1.7. Proclamation No.1090/2018

Hazardous Waste Management and Disposal Control Proclamation No. 1090/2018 provides a comprehensive legal framework for managing hazardous waste in Ethiopia, including e-waste. It emphasizes proper classification, safe handling, and environmentally sound disposal while promoting public awareness and stakeholder participation (Table 5).

[25] FDRE Environment, Forest and Climate Change Commission (2020). Environmental and Social Impact Assessment (ESIA) Guideline with Respect to Integrated Risk Management (IRM). Environmental and Social Impact Assessment Directorate. Addis Ababa, Ethiopia.

Table 5 Main provisions and descriptions of Proclamation No. 1090/2018

Provision	Description
Objectives	Regulate hazardous waste, protect health and environment, promote sustainability.
Scope	Applies to all activities involving hazardous waste, including e-waste.
Waste Classification	Classifies hazardous waste based on properties and sources.
Responsibilities	Defines roles for waste generators, transporters, and treatment facilities.
Permits and Authorizations	Requires permits for hazardous waste activities and sets conditions.
Waste Management Practices	Guidelines for segregation, storage, transportation, treatment, and disposal.
Environmental Impact Assessment	Mandatory EIA for hazardous waste projects, with public participation.
Monitoring and Enforcement	Inspections, audits, and penalties for non-compliance.
Institutional Framework	EPA as the primary implementing body, with coordination among agencies.
Public Awareness and Education	Promotes information dissemination and training programs.
Penalties and Sanctions	Fines, permit suspension/revocation, and legal action for violations.

7.1.8. Proclamation No. 1333/2024 (The Federal Public Procurement and Property Administration Proclamation)

Proclamation No. 1333/2024 of Ethiopia emphasizes sustainable procurement through several key provisions aimed at integrating environmental, economic, and social considerations into public procurement and property administration. The main elements related to sustainability include:

1. **Environmental Protection**:
    - Public procurement and property disposal processes must avoid harmful environmental impacts (Art. 4.4).
    - Life Cycle Cost Analysis (LCCA) is mandated to assess the economic, environmental, and social costs of property acquisition, use, and disposal (Art. 30).
    - Procurement must promote recycling and reuse of materials (Art. 4.4).
2. **Ethical and Efficient Resource Use**:
    - Procurement must ensure value for money while adhering to principles of transparency, fairness, and non-discrimination (Art. 4.1–4.3).

- Technological innovations are encouraged to enhance efficiency and reduce waste (Art. 4.8).

3. **Local Content and Social Inclusion**:
    - Preference margins are granted to local goods, Ethiopian service providers, and job-creating enterprises to boost domestic industries and reduce carbon footprints (Art. 21).
    - Special consideration is given to micro/small enterprises, women-owned businesses, and persons with disabilities (Art. 21.1d).
4. **Electronic Procurement System**:
    - A modern electronic system is established to streamline processes, reduce paperwork, and ensure transparency, indirectly supporting sustainability through efficiency (Art. 27).
5. **Accountability and Compliance**:
    - Public bodies and officials are held accountable for decisions violating procurement laws, ensuring adherence to sustainability principles (Art. 8).

2. Other regulations follow:

There is no shortage of laws and regulations in Ethiopia. Problems arise from lack of strict enforcement. The following are some of them:

- The Council of Ministers Regulation No. 159/2008 is a regulation that aims to prevent industrial pollution. It was issued under the Environmental Pollution Control Proclamation of 2002.
- National Environmental Policy (1997) – It provides a policy framework for environmental protection and sustainable development. Emphasizes the importance of managing hazardous waste to protect human health and the environment.
- National Waste Management Strategy (2017) - Outlines Ethiopia's strategic approach to waste management, including hazardous waste. It identifies e-waste as a priority area and promotes the development of recycling infrastructure and public awareness campaigns.
- Proclamation No. 299/2002 establishes the Environmental Protection Authority (EPA) and its mandate.
- Proclamation No. 804/2013 (Industrial Pollution Control Proclamation)

It regulates industrial pollution, including waste generated by industrial activities. The proclamation applies to industries that generate e-waste as part of their operations.

7.2. WORLD BANK'S ENVIRONMENTAL AND SOCIAL STANDARDS (ESSS)

The Ethiopian Digital Foundation Project (EDFP) is a project financed by the World Bank. The World Bank positions e-waste regulation as a cross-cutting issue linking environmental sustainability, public health, economic opportunity, and climate action. Its core principle is that integrated, inclusive, and well-funded systems are needed to turn the e-waste crisis into a resource opportunity.

The world Bank has proved its commitment to environmental sustainability via its 10 Environmental and Social Standards (ESS). Adopted in 2018, the ESF ensures that all World Bank-funded projects meet stringent environmental and social standards. It must be noted that all the following nine WB's ESS, except ESS9, are applicable as part of implementation of the EDFP:

- ESS1: Environmental and Social Assessment and Management.
- ESS2 Labor and Working ConditionsESS3: Resource Efficiency and Pollution Prevention.
- ESS4 Community Health and Safety,
- ESS5 Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- ESS7 Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
- ESS8 Cultural Heritage,
- ESS10 Stakeholder Engagement and Information Disclosure

The project will also follow the WBG EHS Guidelines to ensure that these works would be subject to compliance with relevant WBG Environment, Health and Safety Guidelines and ESF Standards. The World Bank's Safeguards are designed to prevent harm to ecosystems, forests, and indigenous communities.[26]

[26] World Bank. (2017). *Environmental and Social Framework*. https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

7.3. WORLD BANK'S PROCUREMENT REGULATIONS FOR IPF BORROWERS.

The World Bank's *Procurement Regulations for IPF Borrowers* (Fourth Edition, November 2020)[27] establish a framework for procurement in Investment Project Financing (IPF) to ensure transparency, efficiency, and value for money. The regulations mandate competitive and transparent processes for acquiring goods, works, and services, emphasizing fair treatment of bidders, conflict-of-interest prevention, and anti-corruption measures. They require borrowers to align procurement plans with project goals, apply appropriate methods (e.g., open bidding, competitive dialogue), and adhere to sustainability principles, including environmental and social safeguards. The rules also outline procedures for handling complaints, managing risks, and ensuring accountability through documentation and compliance with World Bank standards. Exceptions for non-competitive procurement (e.g., direct contracting) are permitted only under strict justifications, prioritizing development impact and fiduciary responsibility.

Sustainable Procurement (SP) is the process of acquiring goods, services, and works in a way that achieves value for money while maximizing social, economic, and environmental benefits over the entire lifecycle. It involves integrating sustainability criteria into procurement decisions to ensure that the outcomes contribute to long-term development goals, such as reducing carbon emissions, promoting fair labor practices, and supporting local economies. SP aligns with global frameworks like the United Nations Sustainable Development Goals (SDGs) which emphasizes transparency, ethical sourcing, and stakeholder engagement.[28]

Sustainable Procurement broadens the focus to include social equity, economic resilience, and environmental stewardship across supply chains. It ensures that procurement decisions support fair labor practices, human rights, local economies, and long-term ecological balance.

Procurement under the EDFP should be carried out in accordance with this Procurement Regulations for IPF Borrowers (Borrowers Regulations), dated November 2020; the guidelines on

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[27] World Bank. (2020). *Procurement regulations for IPF borrowers: Procurement in investment project financing goods, works, non-consulting and consulting services* (4th ed.)

[28] United Nations Environment Programme (UNEP). (2022). ***Sustainable Public Procurement: 2022 Global Review (Parts I and II).*** https://www.oneplanetnetwork.org/knowledge-centre/resources/sustainable-public-procurement-2022-global-review-parts-i-and-ii

Preventing and Combating Fraud and Corruption in projects financed by IBRD Loans and IDA credits and grants, revised July 1, 2016; and the provisions stipulated in the financing agreement.[29] This procurement regulation also considers sustainable procurement procedures in Appendix VII.

7.4. THE ROLE OF SUSTAINABLE PROCUREMENT IN E-WASTE MANAGEMENT

Sustainable Procurement (SP) can address these challenges by integrating environmental, social, and economic considerations into the procurement of electrical and electronic items.

7.4.1. Environmental Considerations

Extended Producer Responsibility (EPR): SP can encourage manufacturers to take responsibility for the entire lifecycle of their products, including end-of-life disposal. Ethiopia imports electrical and electronic equipment and items from abroad and has little or no power on manufacturers, which are the global high-profile corporations. However, it has the right to choose from companies that take such responsibilities and avoid those who decline to do so. Ethiopia can introduce regulations on procuring electronics from companies that offer take-back programs or recycling services.

Eco-Design: Government procurement agencies can prioritize procurement of electronics designed for durability, repairability, and recyclability. For example, choosing modular laptops or phones with replaceable parts.

Avoiding buying any used electronics or irresponsible donations: Some donors use third world countries as dumpsites by the name of donation. There are several case studies on this issue. Few examples are shown below:

- **Agbogbloshie, Ghana**: Often referred to as one of the world's largest e-waste dumps, Agbogbloshie receives thousands of tons of used electronics from developed countries, including Europe and North America. Many of these items are

[29] World Bank. (2020). *Procurement regulations for IPF borrowers*. Retrieved from https://thedocs.worldbank.org/en/doc/178331533065871195-0290022020/original/ProcurementRegulations.pdf

non-functional or near the end of their lifecycle, but they are shipped under the label of "donations" or "second-hand goods."[30]

- **Lagos, Nigeria**: Nigeria receives large quantities of used electronics, often labeled as donations, from developed countries. A significant portion of these items are non-functional and end up in informal recycling sectors, where they are dismantled under hazardous conditions.[31]
- **India and Pakistan**: Both countries have been recipients of used electronics from developed nations, often under the pretext of bridging the digital divide. However, a large percentage of these items are unusable and contribute to the growing e-waste problem.[32]

Despite the fact that there are no studies on irresponsible donations, it cannot ruled out that equipment are donated to Ethiopia. There are several instances of internal donations. Some organizations donate when they introduce new equipment for themselves and use such institutions like high schools as dumpsites. Ethiopia can avoid such kind of donations be it interna or external, relying on its own mechanism of new supplies to serve its needs.

7.4.2. Social Considerations

Unsafe Recycling Practices: Non-functional electronics often end up in informal recycling sectors, where they are dismantled using unsafe methods (e.g., burning cables to extract copper), exposing workers and the environment to toxic substances.

Lack of awareness and Capacity Building: In Ethiopia there is little or no awareness on sustainable procurement. Particularly, government procurement system is based on bid and Educating procurement officers and the public on proper e-waste disposal and recycling.

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[30] Prakash, S., Manhart, A., Amoyaw-Osei, Y., & Agyekum, O. (2010). *Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana*. Öko-Institut e.V.

[31] Schluep, M., Hagelüken, C., Kuehr, R., Magalini, F., Maurer, C., Meskers, C., ... & Wang, F. (2009). Recycling: From e-waste to resources. United Nations Environment Programme (UNEP).

[32] Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., & Böni, H. (2005). Global perspectives on e-waste. Environmental Impact Assessment Review, 25(5), 436-458.

Irregular Procurement System: Ethiopia's procurement system is governed by the Public Procurement and Property Administration Proclamation (Procurement Proclamation No. 1207/2020). This law establishes the rules for public procurement, including the principles of transparency, competition, and economy. Like many developing countries, Ethiopia's procurement system often awards contracts to the lowest bidder, with limited consideration for quality, sustainability, or lifecycle costs. Accordingly, the situation created several challenges. The system faces issues such as corruption, lack of capacity, and weak enforcement of regulations, which exacerbate the problems associated with low-price bidding. This kind of procurement often poses serious consequences on the environment. These include, Environmental and Social Impacts:

- Unsustainable Procurement: The focus on low prices often leads to the selection of environmentally harmful products and services, such as non-energy-efficient equipment or non-recyclable materials.
- Social Inequities: Low-price bidding can disadvantage local businesses and small enterprises that cannot compete with larger, low-cost suppliers.

Despite all challenges, Ethiopia has tried to improve its procurement process by introducing some corrective measures. These include, training programs for procurement officers which have been introduced to improve their ability to evaluate bids based on quality and sustainability. Some examples are, The Public Procurement and Property Administration Agency (PPPAA) that partnered with international organizations to provide training on best practices.[33] Ethiopia has also introduced e-Procurement System (e-GP) which improved the efficiency and accountability of procurement processes.[34] While Ethiopia's procurement system has made progress in recent years, the reliance on low-price bidding continues to pose significant challenges. By adopting best value procurement, strengthening oversight, and promoting sustainability, EDFP can improve the quality and efficiency of its procurement processes.

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[33] Public Procurement and Property Administration Agency (PPPAA). (2021). Capacity building initiatives. https://www.pppaa.gov.et

[3434] World Bank. (2020). *Ethiopia's e-Procurement System*. https://www.worldbank.org

The EDFP projects procuring important equipment and establishing infrastructures like modular data centers and other important digital infrastructures will rely on sustainable procurement that centers the environment, human health, and value-for-money. The EDFP project implementing unit will provide trainings on sustainable procurement to its beneficiaries.

7.5. THE WORLD BANK'S ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES (EHSG)

The Environmental, Health, and Safety Guidelines (EHSG) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The document contains detail guidelines under environmental, occupational health and safety, community health and safety, construction and decommissioning.[35]

The EHSG provide a framework for managing environmental, health, and safety risks across various industries, including e-waste management. When contextualized to e-waste management, these guidelines emphasize safe handling, recycling, and disposal practices to minimize environmental and health impacts.

While the EHSG does not have specifically of e-waste, it provides for the general guideline for all hazardous waste management listed below:

- **Waste Minimization**: Prioritizing reducing e-waste generation through product design, reuse, and refurbishment.
- **Safe Handling**: Ensuring proper storage, transportation, and dismantling of e-waste to prevent exposure to hazardous materials.
- **Worker Protection**: Providing personal protective equipment (PPE) and training to safeguard workers from toxic substances like lead, mercury, and cadmium.
- **Spill Prevention**: Implementing measures to contain and manage spills of hazardous materials during e-waste processing.

[35] WBG (2007). Environmental, Health, and Safety General Guidelines. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf

The general **"Environmental, Health, and Safety (EHS) Guidelines" of the** International Finance Corporation (IFC), does not specifically focus on e-waste management. It is, however, possible to contextualize the guidelines to e-waste management guideline, by extracting those which are crosscutting to all waste management procedures. Key sections to e-waste management include the following:

- **Identifying Hazardous Components**: Recognizing e-waste as a source of hazardous materials (e.g., batteries, circuit boards) and applying the guidelines for safe handling.
- **Implementing Recycling Practices**: Using the waste management guidelines to establish safe and environmentally sound recycling processes.
- **Protecting Workers**: Applying occupational health and safety measures to protect workers from exposure to toxic substances during e-waste dismantling and recycling.

7.6. WORLD BANK (WB) ENVIRONMENTAL AND SOCIAL STANDARDS (ESS)

EDFP projects will follow the WB's Nine Environmental and Social Standards (ESSs), except ESS9, WBG ESHG, and GIIP. However, ESS1, 2 and 3 are more relevant as part of management of the E-Waste substances.

ESS1: "Assessment and Management of Environmental and Social Risks and Impacts," which means that when it comes to waste management, it essentially requires projects funded by the World Bank to thoroughly assess the potential environmental and social risks associated with waste generation and disposal, and to implement appropriate mitigation measures to manage those risks throughout the project lifecycle.

ESS3: "Resource Efficiency and Pollution Prevention and Management", recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services, and the environment at the local, regional, and global levels. The current and projected atmospheric concentration of greenhouse gases (GHG) threatens the welfare of current and future generations. At the same time, more efficient and effective resource use, pollution prevention, and GHG emission avoidance, and mitigation technologies and practices have become more accessible and achievable.

ESS3 sets out the requirements to address resource efficiency and pollution1 prevention and management throughout the project life cycle consistent with Global International Industry Practice (GIIP).

ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. ESS6 recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development. Biodiversity is defined as the variability among living organisms from all sources, including inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems. Biodiversity often underpins ecosystem services valued by humans. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services. According to this ESS no hazardous wastes are allowed to be released to ecosystem without being treated. The applicability of ESS6 is established during the environmental and social assessment described in ESS1.

7.7. GOOD INTERNATIONAL INDUSTRY PRACTICE (GIIP) CONCERNING E-WASTE MANAGEMENT

Good International Industry Practice (GIIP) in the context of e-waste refers to globally recognized standards and methodologies for managing electronic waste in an environmentally sound, socially responsible, and economically viable manner. These practices emphasize reducing hazardous impacts, promoting recycling, ensuring safe disposal, and complying with international agreements like the Basel Convention. GIIP often aligns with guidelines from organizations such as the International Finance Corporation (IFC) [36] and the Basel Convention Secretariat.[37] It often highlight that distributors are encouraged to offer customers free, accessible options for returning old electronics—whether through in-store drop-offs when purchasing new items or at designated

[36] International Finance Corporation. (2012). Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts. Retrieved from https://www.ifc.org/performancestandards

[37] Basel Convention Secretariat. (2011). Technical guidelines on the environmentally sound management of used and end-of-life mobile phones. Retrieved from http://www.basel.int

collection centers. This system, is designed not just as a convenience but as a moral duty: to ensure toxic materials from discarded devices don't harm families, children playing near waste sites, or farmers' livelihoods. In fact, there is no single GIIP which is world wide accepted.

Dedicated studies aligned with international standards (e.g., UN Step Initiative) are critical to inform future policy and infrastructure development.

The waste recycling process in Ethiopia roughly coincides with that of Brazil (Figure 1), though there are no clear ways of visualizing e-waste recycling in Ethiopia. The main challenge lies at the processing stage where sophisticated machineries are required to separate materials into their categories. Most developing countries, including Ethiopia, do not afford such facilities. Accordingly, they ship to abroad, making the cost of disposal unaffordable.

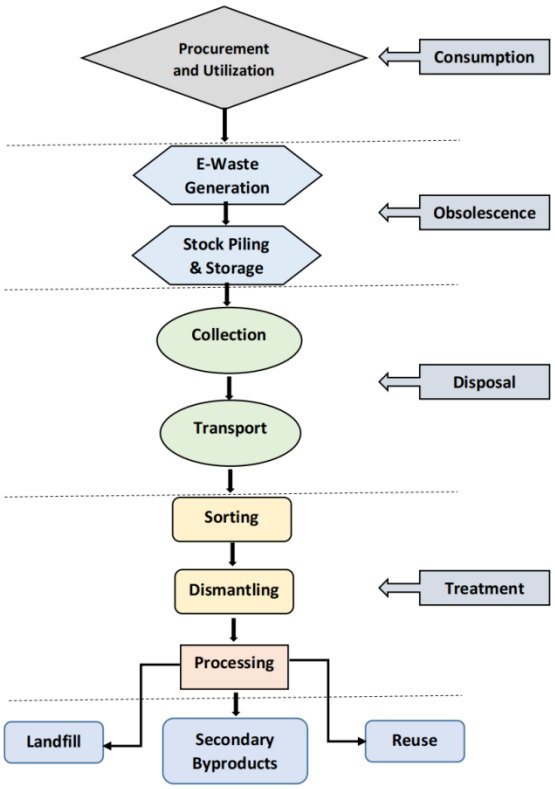

Figure 1 E-waste processing.[38]

7.8. INTERNATIONAL CONVENTIONS

Ethiopia has entered into conventions and ratified most of them. In the following sections, major international conventions were listed and discussed.

7.8.1. The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes, in which Ethiopia is a party, was ratified in 1989 and entered into force in 1992. The core agreements in the Basel convention were:

[38] World Bank Group (2012). Wasting No Opportunity: The case for managing. Brazil's electronic waste.

- **Reducing waste generation**: Parties must reduce the amount of hazardous waste generated.
- **Managing waste environmentally**: Parties must manage and dispose of waste in an environmentally sound way.
- **Controlling transboundary movements**: Parties must control the movement of hazardous waste across borders.
- **Establishing a list of hazardous wastes**: Parties must establish a list of hazardous wastes, including toxic, poisonous, explosive, corrosive, flammable, and infectious wastes.
- **Preventing illegal traffic**: Parties must prevent and punish the illegal traffic of hazardous waste.

The Basel Convention has had multiple amendments, including amendments to control electrical and electronic waste (e-waste) and to control plastic waste[39]. At its fifteenth meeting in 2022, the Conference of the Parties to the Basel Convention adopted amendments to Annexes II, VIII, and IX to the Basel Convention in its decision BC-15/18, which are known as the E-waste Amendments. The E-waste Amendments enlarge the scope of control over electrical and electronic waste (e-waste) by making all transboundary movements of e-waste subject to the Convention's prior informed consent (PIC) procedure. E-waste, with the exception of some wastes, is classified as hazardous waste under the Basel Convention due to its toxic components (e.g., lead, mercury). Some toxic e-waste components are shown in Table 6.

According to the Basel Convention, Waste electrical and electronic equipment (WEEE) often has components that contain hazardous substances or persistent organic pollutants (POPs). These could include:

- printed circuit boards
- plastic casings, cables and other components
- insulation foam
- cooling agents
- flame retardants
- activated glass and screen phosphors
- cathode ray tubes
- capacitors

[39] UNEP. *The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.* https://www.basel.int/.

- Ni-Cd batteries

Some of these chemicals are toxic to human and animal health and have been listed separately (Table 6). These chemicals may cause several health problems to human and the environment. In Human, health risks vary from cancer to skin irritation and damage to different organ systems. The degrees vary from chemical to chemical.

Table 6 Toxic Substances in E-waste.

Substance	Occurrence in E-waste
Halogenated compounds	
PCB (polychlorinated biphenyls)	Condensers, Transformers
TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation) TBBA is presently the most widely used flame retardant in printed circuit boards
Chlorofluorocarbon (CFC)	Cooling unit, Insulation foam
PVC (polyvinyl chloride)	Cable insulation
Heavy metals and other metals:	
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
Barium	Getters in cathode ray tubes (CRTs)
Beryllium	Power supply boxes which contain silicon-controlled rectifiers and x-ray lenses
Cadmium	Rechargeable computer batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)
Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards, television sets, PC monitors, light bulbs, lamps
Lithium	Li-batteries
Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
Selenium	Older photocopying-machines (photo drums)
Zinc sulphide	Interior of CRT screens, mixed with rare earth metals

POPs-containing wastes, including e-wastes, should be managed in such a way that the POPs content is destroyed or irreversibly transformed. Recycling or reuse of such wastes should only be allowed after decontamination.[40]

[40] Basel Convention, Technical Guidelines on E-Waste (Paragraph 27).

7.8.2. Bamako Convention

Bamako Convention was ratified in 1991 and entered into force in 1998. The purpose of the convention was to Ban the import of hazardous waste into Africa and regulate its management within the continent. Prohibits the import of hazardous waste, including e-waste, from non-member countries. The convention promotes the environmentally sound management of hazardous waste. Its Relevance to E-Waste is that it addresses the issue of e-waste dumping in African countries. The Bamako Convention plays a critical role in protecting Africa from the adverse effects of e-waste by prohibiting hazardous waste imports, promoting sustainable management practices, and fostering regional cooperation. It provides a strong legal and policy framework for addressing e-waste challenges while aligning with global standards.

While the Bamako Convention provides a strong legal framework for addressing hazardous waste management in Africa, its effectiveness is hindered by challenges such as limited ratification, weak enforcement, insufficient infrastructure, and economic pressures. Addressing these challenges requires increased political commitment, regional cooperation, capacity building, and public awareness campaigns.

Ethiopia has not signed or ratified the Bamako Convention, meaning it is not legally bound by its provisions. Joining the agreement could enhance its efforts to address hazardous waste challenges, including e-waste, and align with regional and global sustainability goals.

7.8.3. Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention was ratified in the year 2001 and entered into force in 2004. The **Purpose** of the convention was to eliminate or restrict the production and use of persistent organic pollutants, which are often found in e-waste. Key provisions include Targeting chemicals like polychlorinated biphenyls (PCBs) and brominated flame retardants used in electronics and promoting safe disposal and destruction of POPs-containing waste. It is relevant to e-waste because many electronic devices contain POPs, making their safe disposal critical. Ethiopia is signatory to this convention.

7.8.4. The Rotterdam Convention

The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade was ratified in the year 1998 and entered into force in 2004. Its purpose was to regulate the international trade of hazardous chemicals, including those found in e-waste. It provides for exporters to obtain prior informed consent from importing countries. It also promotes transparency and shared responsibility in the trade of hazardous substances. It is relevant to e-waste because it ensures that hazardous components of e-waste are managed responsibly during international trade.

7.8.5. Minamata Convention on Mercury

The convention was ratified in the year 2013 and entered into force in 2017. The purpose of the Minamata Convention was to protect human health and the environment from mercury emissions and releases, which are prevalent in e-waste. The main provisions of the convention were to phase out the use of mercury in products and processes and to promote safe handling and disposal of mercury-containing wastes, including e-waste. Mercury is commonly found in devices like fluorescent lamps and batteries.

7.8.6. Sustainable Development Goals (SDGs)

The SDGs were formally adopted by all 193 member states of the United Nations during the UN Sustainable Development Summit in New York. This was part of the 2030 Agenda for Sustainable Development.

The SDGs were ratified in 2015 and enforced starting January 1, 2016. They provide a comprehensive framework for addressing global challenges, including e-waste management, through sustainable development. The SDGs address global challenges such as poverty, inequality, climate change, environmental degradation, peace, and justice. Unlike the earlier Millennium Development Goals (MDGs), the SDGs apply to all countries, not just developing nations. Relevant to e-was are:

- **SDG 12 (Responsible Consumption and Production)**: Directly addresses waste management, including e-waste, by promoting sustainable practices, recycling, and reducing waste generation.
- **SDG 3 (Good Health and Well-Being)**: Focuses on reducing health risks from hazardous waste, including e-waste.
- **SDG 13 (Climate Action)**: Encourages reducing emissions from waste management activities.
- **SDG 17 (Partnerships for the Goals)**: Promotes global cooperation to achieve sustainable development, including addressing e-waste challenges.

7.9. IMPORTANCE OF MANAGING E-WASTE SUSTAINABLY

E-waste contains toxic substances that can contaminate soil, water, and air if improperly disposed of. E-waste management helps prevent the release of hazardous materials into the environment, reducing pollution and safeguarding ecosystems. Besides, electronic devices contain valuable resources like gold, silver, copper, and rare earth materials to be recovered and reused, reducing the need for mining and preserving precious resources.[41]

E-waste management is critically important for Ethiopia due to the potential for severe environmental and health risks associated with improperly disposing of electronic waste, which contains hazardous chemicals that can contaminate soil, water, and air when not managed correctly, particularly, given the growing use of electronic devices in the country and limited waste recycling infrastructures.

Implementing proper e-waste management plan, the country can protect the health and safety of both humans and the environment.

8. E-WASTE MANAGEMENT PLAN

The e-waste management plan presented below (Table 7), outlines a comprehensive, lifecycle-based approach to handling electronic and electrical waste generated throughout the design, implementation, operation, and decommissioning phases of EDFP-supported subprojects. Developed in alignment with national regulations, international best practices, and stakeholder recommendations gathered during the national consultation workshop, this plan prioritizes environmental sustainability, regulatory compliance, and stakeholder inclusion.

The table captures each key project component along with its associated activities, potential risks or impacts, and the corresponding mitigation methods. These methods are further elaborated in terms of technical approach, legal compliance, responsible parties, and estimated implementation costs.

Key enhancements reflected in this plan include:

- Emphasis on **eco-design and lifecycle analysis** during the procurement phase;
- Application of Radio-Frequency Identification (RFID) based asset tracking and vendor take-back schemes during implementation;
- Adoption of certified recycling and data sanitization standards at end-of-life stages;
- Integration of stakeholder training and awareness activities targeting informal sectors and public institutions;
- Provisions for continuous improvement through research, innovation, and alignment with circular economy principles.

Special attention was given to the identification of existing regulatory gaps, such as the exclusion of radioactive components from the current definition of e-waste in Ethiopia's legal framework. Stakeholders reached a unanimous consensus during the final consultation that this plan is both technically sound and ready for implementation, with clear compliance references including Regulation No. 425/2018, the Basel and Minamata Conventions, and the World Bank Environmental and Social Standards.

This table serves not only as a planning and accountability tool but also as a living framework adaptable to future policy developments and technological advances in e-waste management.

The five major phases of the project are designing, construction, implementation, commissioning and decommissioning. Stakeholder engagement and continuous improvement were also added as important stages in the project lifecycle. A brief description of each stage in infrastructure are discussed.

8.1. DESIGN PHASE

The Ethiopia Digital Foundation Project (EDFP) embeds sustainability at the design stage to minimize future e-waste generation. Equipment such as servers, routers, and data center components are selected based on eco-design principles, prioritizing modularity, energy efficiency, and compliance with international certifications like Energy Star and EPEAT. Hazardous substances such as lead and mercury are excluded in adherence to the Basel Convention and Ethiopia's Regulation No. 425/2018, which restricts toxic materials in electronic products. A lifecycle assessment (LCA) evaluates the environmental impacts of design choices, ensuring alignment with Proclamation No. 1333/2024 on sustainable procurement and lifecycle cost analysis. These efforts are overseen by the Ministry of Innovation and Technology (MinT) Procurement Team and PIU Environmental Specialists to guarantee compliance from inception.

8.2. CONSTRUCTION/DEPLOYMENT PHASE

During infrastructure setup, the project mitigates e-waste risks through stringent waste segregation and contractor training. Temporary tools such as testing devices and cables are tracked using ISO 14001 environmental management guidelines, while reusable packaging reduces single-use waste. Partnerships with EPA-certified recyclers ensure safe disposal of construction-related e-waste, such as damaged components or excess wiring, in compliance with Regulation No. 425/2018 for storage and transportation. Municipal authorities collaborate with the PIU to monitor practices and prevent informal sector interference, safeguarding environmental and worker health.

8.3. IMPLEMENTATION/OPERATIONAL PHASE

Operational e-waste is managed through RFID-based asset tracking systems, which monitors equipment lifespan and schedule timely replacements. Vendors like Dell and Cisco are contractually bound to retrieve end-of-life devices under Extended Producer Responsibility (EPR) mandates, while on-site collection bins at data centers and offices streamline disposal. Quarterly reports submitted to the Ethiopian Environmental Protection Authority (EPA) detail e-waste volumes and recycling rates, adhering to Regulation No. 425/2018 and the World Bank's ESS3 (Resource Efficiency and Pollution Prevention). This phase emphasizes transparency and accountability in resource management.

During the implementation phase the digital foundation projects trigger ESS1, ESS2 and ESS3 of the World Bank Environmental and Social Standards (ESSs). Accordingly, EEWMP will be implemented. The plan is required to be applied during the installation and operation (implementation) phase while the procurement process will either replace, upgrade or dispose old, obsolete or outdated computers, data centers, backup generators, coolers, servers, cables, printers, copiers, etc. These generate volumes of e-waste. The EEWMP must comply with the WBG's guidelines, ESSs, national waste and e-waste regulations, international laws and conventions such as the Basel Convention. To reduce environmental load materials should be recycled. Three general processes occur during the recycling process. These are:

1. **Collection & Transportation**

E-waste is collected from households, businesses, or dedicated drop-off points and be transported to where several processes will be applied.

2. **Manual Sorting & Dismantling**

After transportation devices (e.g., computers, phones) are manually disassembled to separate components. These include batteries, circuit boards, screens, plastics, cables, etc. Hazardous components (e.g., mercury-containing backlights, capacitors) are removed for safe disposal.

3. **Mechanical Processing**

This involves shredding into small pieces for easier material separation. The methods include magnetic separation to removes ferrous metals (e.g., iron, steel).

4. **Material-Specific Recycling Processes**

Under this step, specific materials are recovered using different advanced methods, that might have not happened in Ethiopia. These methods are listed below.

i. **Metals Recovery: Copper, Gold, Silver, Palladium:**

- Smelting: Shredded circuit boards or wires are melted in furnaces to extract precious metals. E.g., Copper is recovered from cables; gold is extracted from connectors.
- Hydrometallurgy: Uses chemical solutions (e.g., acids, cyanide) to dissolve metals from e-waste.
- Electrolysis: Recovers pure metals from dissolved solutions.
- Aluminum: Separated via eddy currents, melted, and recast into new products.
- Steel/Iron: Recovered via magnets, melted, and reused in construction or automotive industries.

ii. **Plastics Recycling**

- Plastics are sorted by type (e.g., ABS, polystyrene) using infrared spectroscopy or density separation.
- By Washing & Pelletizing contaminated plastics are cleaned, shredded, and melted into pellets for reuse.

iii. **Chemical Recycling**:

- **Pyrolysis**: Breaks down plastics into hydrocarbons for fuel or new plastic production.
- **Solvent-based purification**: Removes additives (e.g., flame retardants) for cleaner plastic output.

iv. **Glass Recycling**

- **Cathode Ray Tube (CRT) Glass**: Leaded glass from old monitors/TVs is crushed, and lead is extracted via smelting. Cleaned glass is reused in new CRT production or construction materials.
- **LCD Panel Glass**: Mercury-containing backlights are removed; glass is recycled into tiles or fiberglass.

v. **Printed Circuit Boards (PCBs): PCBs are separated by two methods.**

- **Thermal Processing**:
  - **Incineration**: Burns off organic materials, leaving metal-rich ash for recovery.
  - **Vacuum pyrolysis**: Heats PCBs in oxygen-free environments to recover metals and gases.
- **Mechanical Recycling**:
  - PCBs are crushed, and metals are separated via electrostatic or gravity methods.

vi. **Batteries**

- **Lithium-ion Batteries**: Shredded and processed to recover lithium, cobalt, nickel, and graphite.
- **Hydrometallurgical methods**: Acids dissolve metals for purification.
- **Lead-Acid Batteries**: Lead is smelted, and sulfuric acid is neutralized or reused.

vii. **Critical & Rare Materials**

- **Rare Earth Elements (REEs)**: Magnets (e.g., neodymium) from hard drives are dissolved in acid, and REEs are precipitated.
- **Indium (from LCD screens)**: Extracted via acid leaching or electrochemical processes.

viii. **Hazardous Material Management**

- **Mercury** is recovered from switches/backlights and stabilized for safe disposal.
- **Flame Retardants (e.g., PBDEs)** are removed via solvent washing or thermal decomposition.

- **CFCs/HCFCs (from cooling systems)** are captured and destroyed to prevent ozone depletion.

ix. **Advanced & Emerging Technologies**

- New method called bioleaching is becoming promising. In this method specific metal reducing bacteria/fungi are used to extract metals from e-waste (e.g., copper, gold).
- In some metropolitan cities of developed countries, AI-driven robots automate sorting and dismantling of e-waste. This will nullify toxicity to employees while it makes the work fast and simple. Based on the future development status, Ais may be used.
- In some countries, plastics are being used for 3D Printing. In such a way, recycled plastics/metals are used as feed-stock for additive manufacturing.

8.4. COMMISSIONING PHASE

Before system handover, commissioning activities include rigorous **e-waste audits** to verify compliance with national and international disposal protocols. Recycling certificates and material recovery reports are compiled to validate environmentally sound practices, while training programs for end-users (e.g., universities, government offices) ensure long-term adherence to e-waste protocols. The PIU Monitoring Team cross-checks recycler certifications against the EPA's public registry, aligning with the IFC Environmental, Health, and Safety (EHS) Guidelines for commissioning integrity.

8.5. DECOMMISSIONING PHASE

At infrastructure end-of-life, certified technicians dismantle equipment such as servers and EV batteries, recovering valuable materials like copper and rare earth metals through EPA-approved recyclers. NIST SP 800-88 standards ensure sensitive data is irreversibly erased, while hazardous components like lithium-ion batteries are disposed of per the Minamata Convention. A final

decommissioning report submitted to the EPA and World Bank documents compliance with Regulation No. 425/2018, closing the loop on sustainable lifecycle management.

Table 7 E-waste management plan.

Component Activity	Potential Risks / Impacts	Mitigation Methods	Description of Mitigation Methods	Compliance Reference	Responsible Parties	Timeline	Estimated Cost (USD)
1. Design Phase	• Legal non-compliance • High costs for sustainable design	Align with environmental design standards and policies	Prioritize eco-design; select modular, recyclable equipment; conduct lifecycle assessments (LCAs)	Regulation No. 425/2018Basel Convention Proclamation No. 1333/2024	PIU Safeguard team, Procurement Team→ MiNT oversight post-handover	Project initiation	50,000 – 100,000
2. Construction Phase	• Improper e-waste segregation • Informal sector interference	Certified recycling partnerships; enforce training	Train contractors; track and manage reusable tools; implement segregation protocols	Regulation No. 425/2018IFC EHS Guidelines	PIU Construction Supervisors, Contractors→ MiNT oversight post-handover	Construction period	100,000 – 200,000
3. **Implementation Phase**	• Poor data tracking • High recycling costs	RFID tracking; vendor take-back enforcement	Use RFID/barcode systems; monitor equipment lifecycle; ensure take-back agreements with suppliers	World Bank ESS3Regulation No. 425/2018 (EPR)	PIU Operations Team, Vendors→ MiNT + Beneficiary Institutions	Implementation phase	200,000 – 500,000

4. **Commissioning Phase**	• Incomplete documentation• Untrained end-users	Disposal audits; targeted stakeholder training	Validate vendor certifications; document disposal compliance; train institutions on e-waste handling	IFC EHS Guidelines EPA Certification Registry	PIU Monitoring & Handover Team, EPA→ MiNT + Final Users (e.g., universities, agencies)	Pre-handover	40,000 – 100,000
5. Decommissioning Phase	•Environmental contamination • Data security breaches	Use certified recyclers; apply NIST standards	Dismantle equipment safely; sanitize data; ensure safe recovery of materials	Minamata Convention Regulation No. 425/2018	MiNT IT & Security Unit, Certified Recyclers, Beneficiary Institutions	End-of-life	150,000 – 300,000
6. Stakeholder Engagement	• Low awareness • Resistance from informal actors	Public awareness; inclusive engagement strategies	Media campaigns; school outreach; stakeholder workshops with MoLS, NGOs, EthERNet	UNEP E-Waste Coalition IFC Stakeholder Guidelines	PIU Safeguard Team→ MiNT Communication Team, NGOs, Media, MoLS	Throughout + 18 months	30,000 – 80,000
7. Continuous Improvement	• Slow tech adoption • Limited innovation capacity	AI integration; periodic review with R&D institutions	Collaborate with local R&D centers; adopt GIIP-aligned innovations; update protocols biannually	Circular Economy Principles (Ellen MacArthur Foundation)	PIU R&D Team (until project end)→ MiNT Innovation Dept., R&D Partners	Biannual	80,000 – 150,000

9. E-WASTE MANAGEMENT COSTS

The rate of e-waste generation in a certain project is influenced by several factors. Accordingly, costs were provided in ranges in the e-waste management plan (Table 7) in consideration with these factors. Few of the factors include, but not limited to, the following:

1. **Project Scope and Scale**: Larger projects with more devices and equipment will inherently generate more e-waste which cannot be predicted at the outset of the project.
2. **Technology Lifespan**: Shorter lifespans of electronic devices due to rapid technological advancements lead to faster turnover and higher e-waste generation.
3. **Usage Intensity**: High-intensity use of electronic devices can lead to quicker wear and tear, resulting in more frequent replacements.
4. **Maintenance and Repair Practices**: Poor maintenance can shorten the lifespan of devices, while effective repair practices can extend it, affecting the rate of e-waste generation.
5. **Regulatory and Compliance Requirements**: Stricter regulations may require more frequent upgrades or replacements of equipment to meet new standards.
6. **Project Duration**: Longer projects may see more technological updates and replacements, increasing e-waste.
7. **Budget Constraints**: Limited budgets might lead to the purchase of lower-quality devices that have shorter lifespans, increasing e-waste.
8. **Environmental Policies**: Projects with strong environmental policies may focus on sustainability, potentially reducing e-waste through better recycling and reuse practices.
9. **Stakeholder Requirements**: Requirements from stakeholders for the latest technology can drive frequent upgrades and replacements.
10. **End-of-Life Management**: Effective e-waste management strategies, such as recycling and refurbishing, can mitigate the rate of e-waste generation.

Therefore, in this e-waste management plan, the cost includes the cost of public disclosure, awareness creation and monitoring and evaluation. It is to be noted that the PAD[42] shows project milestones as follows:

- **Year 1-2 (2021-2023)**: Initial setup, stakeholder engagement, and commencement of infrastructure projects.
- **Year 3-4 (2023-2025)**: Intensive implementation of digital infrastructure and capacity-building activities.
- **Year 5 (2025-2026)**: Finalization of project activities, comprehensive evaluation, and preparation of the project closure report.

The project is at implementation stage (2025-2026) and producing e-waste at its highest capacity. Accordingly, there should be active awareness campaign and public disclosure, if not too late. The stakeholders include project affected and those interested in the project. Costs are indicated in Table 8.

Table 8 E-waste Management key components and Costs.

Phase	**Key Cost Components**	**Estimated Cost (USD)**
Design	Life Cycle Assessments (LCA), eco-design audits	$50,000–$100,000
Construction	Contractor training, safe disposal systems	$100,000–$200,000
Implementation	RFID tracking tech, vendor enforcement	$200,000–$500,000
Commissioning	Stakeholder training, recycling audits	$40,000–$100,000
Decommissioning	Data sanitization, certified recyclers	$150,000–$300,000
Stakeholder Engagement	Media campaigns, training for informal sector	$30,000–$80,000
Continuous Improvement	R&D partnerships, AI sorting tech	$80,000–$150,000

[42] World Bank. (2021). Ethiopia Digital Foundations Project (PAD 174848). Retrieved from https://documents1.worldbank.org/curated/en/421681619316030132/pdf/Ethiopia-Ethiopia-Digital-Foundations-Project.pdf

9.1. E-WASTE MITIGATION MEASURES AND MANAGEMENT

Basically, e-waste management follows the same principle as popular waste management hierarchy (Figure 2, Table 10). In this inverted pyramid, the highest priority is preventing the creation of waste.

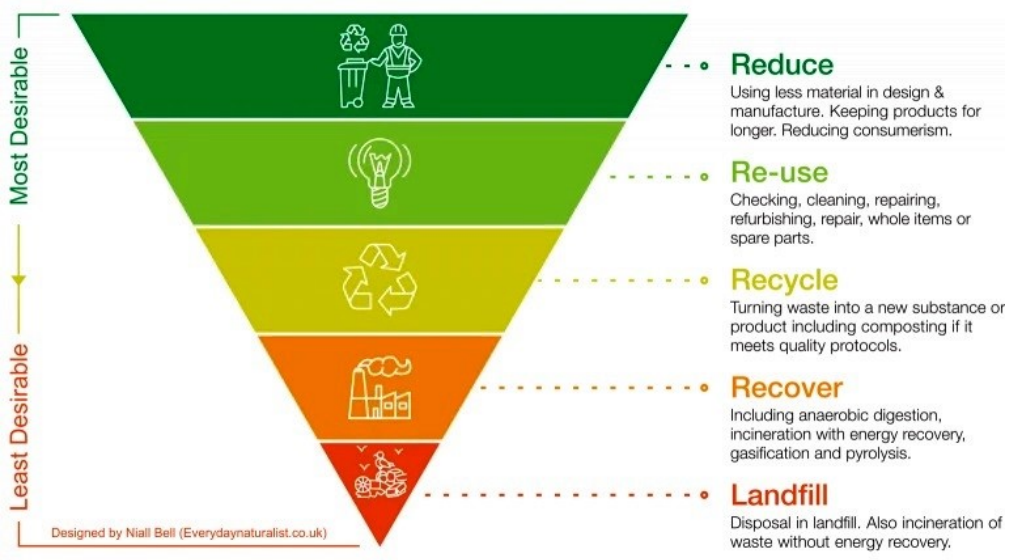

Figure 2 Sustainable Waste management hierarchy.[43]

[43] European Parliament and the Council of the European Union. (2008). *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives*. Official Journal of the European Union, L 312, 3–30. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

Table 9 Explanations of e-waste hierarchy.

Hierarchy Tier	Definition & E-Waste Context	Examples/Strategies	Key Regulations/Standards
1. **Prevention**	Avoiding e-waste generation through sustainable design, reduced consumption, and extended product lifespans.	o Modular electronics (e.g., Fairphone's repairable phones; Data Centers). o Legislation banning planned obsolescence. o Cloud computing to reduce hardware demand.	WBG Solid Waste Management Strategy.
2. **Preparing for Reuse**	Refurbishing or upgrading devices for their original purpose.	- Refurbishment programs (e.g., Apple Renew, Dell Reconnect). - Donating functional devices to schools/NGOs. - Leasing models (e.g., enterprise IT equipment).	EU WEEE Directive (2012); IFC's Resource Efficiency Guidelines.
3. **Recycling**	Recovering materials (metals, plastics, glass) from end-of-life electronics.	- Urban mining (extracting gold, copper, rare earths). - Certified recyclers dismantling devices (e.g., Sims Recycling). - Battery recycling for EVs and gadgets.	Basel Convention Annex IX (2019); R2/RIOS or e-Stewards certifications.
4. **Other Recovery**	Energy recovery from non-recyclable e-waste components (last resort before disposal).	- Incineration of non-toxic plastics in waste-to-energy plants. - Pyrolysis of circuit boards to recover energy.	Stockholm Convention (restricts POPs emissions); IFC EHS Guidelines.
5. **Disposal**	Safe landfilling of inert e-waste residues that cannot be treated by higher tiers.	- Secure landfills for treated CRT glass or non-leachable metals. - Banning illegal dumping (e.g., e-waste exports to developing countries).	Basel Ban Amendment (1995); UNEP Guidelines on E-Waste Management.

10. Limitations on the E-Waste Management

The following considerations are major limitations in the e-waste management:

1. **Toxic Materials**: According to the Basel Convention, heavy metals (lead, mercury) and brominated flame retardants require specialized handling during recycling/disposal. These specialized handling mechanisms are not available in Ethiopia.

2. **Informal Recycling**: ~80% of e-waste is processed informally in developing nations, risking health and environment. This includes Ethiopia. The Koshe dumpsite in Reppi is a living witness. It should be noted that while formal solid waste treatment exists at Koshe, informal e-waste recycling still occurs in its proximity and remains largely unregulated. Based on current available information, the facility is designed primarily for general municipal solid waste (MSW), and not specifically for the treatment of electronic and electrical waste (e-waste). While e-waste is technically a subset of solid waste, it is internationally — and increasingly in Ethiopia, per Council of Ministers Regulation No. 425/2018 — treated as a distinct category due to:

    - the **presence of hazardous substances** (like lead, mercury, and cadmium),
    - the need for **specialized dismantling and recovery procedures**, and
    - the applicability of **Extended Producer Responsibility (EPR)** policies.

The separation of e-waste from the general waste stream is crucial to prevent environmental contamination and to recover valuable components. **Municipal solid waste plants typically lack the technical capacity to handle these materials safely and in compliance with regulatory standards.**

3. **Data Security**: Reuse/recycling must include data sanitization (e.g., NIST SP 800-88 standards).[44]

4. **Rapid Technological Adoption**: Increasing use of electronics (e.g., mobile phones, computers) without proper disposal systems.

5. **Limited Infrastructure**: Lack of formal e-waste recycling facilities and collection systems.

[44] Kissel, R., Regenscheid, A., Scholl, M., Stine, K. (2014). **Guidelines for Media Sanitization. NIST SP 800-88 Rev. 1. Retrieved from:** https://doi.org/10.6028/NIST.SP.800-88r1

6. **Health and Environmental Risks**: Informal recycling practices (e.g., burning cables for copper) release toxic substances like lead and mercury, harming workers and ecosystems.
7. **Policy Gaps**: Weak enforcement of e-waste regulations and limited awareness among stakeholders.

11. MONITORING PLAN AND EVALUATION METHODS

11.1. OBJECTIVE AND PURPOSE

The main objectives of e-waste monitoring are to ensure effective, safe, and environmentally sound management of electronic waste throughout its lifecycle. These objectives align with regulatory compliance, environmental protection, public health, and sustainable development goals. Below are the key objectives and the purpose they serve in e-waste management.

11.2. KEY PERFORMANCE INDICATORS (KPIS) FOR E-WASTE MANAGEMENT

To ensure the effective implementation of the *Electrical and Electronic Waste Management Plan*, a series of key performance indicators (KPIs) have been defined. These indicators provide a structured framework for tracking progress, evaluating system efficiency, identifying challenges, and informing adaptive management. They address environmental, social, economic, and operational dimensions of e-waste management, offering a holistic view of performance across the system (Table 11).

Table 10 Objectives and purposes of e-waste management.

Objective	Purpose
1. Regulatory Compliance	Meet legal and international standards.
2. Track E-Waste Flows	Ensure proper handling and prevent illegal dumping.
3. Protect Human Health and Safety	Safeguard workers and communities from hazardous materials.
4. Minimize Environmental Impact	Prevent pollution of air, water, and soil.
5. Promote Resource Recovery	Maximize recycling and reuse of materials.
6. Evaluate Performance	Improve e-waste management practices.
7. Ensure Transparency	Build trust and accountability among stakeholders.
8. Support SDGs	Contribute to global sustainability goals.
9. Prevent Illegal Activities	Stop illegal exports and informal recycling.
10. Raise Awareness	Educate stakeholders on responsible e-waste management.

11.3. MONITORING AND EVALUATION (M & E) FRAMEWORK FOR E-WASTE MANAGEMENT

Effective implementation of the *E-Waste Management Plan* requires a structured and results-oriented monitoring and evaluation (M&E) framework. This framework integrates routine monitoring activities with key performance indicators (KPIs) to ensure systematic tracking of

progress, early identification of gaps, and informed decision-making throughout the project lifecycle and beyond.

Table 12 outlines the core monitoring activities aligned with specific KPIs, responsible parties, data collection methods, evaluation purposes, and estimated monitoring costs. It provides a practical tool for stakeholders—particularly MiNT and implementing beneficiaries—to assess performance, ensure regulatory compliance, and continuously improve the e-waste management system.

Table 11 Monitoring Plan, Evaluation Methods, Key Performance Indicators (KPIs) and costs.

Activity	Description	Frequency	Responsible Party	Tools / Methods	Relevant KPI	KPI Description	Purpose of Evaluation	Estimated Monitoring Cost (USD)
E-Waste Collection Tracking	Record volume, type, and source of e-waste collected.	Weekly	Contractors	Supervision; digital tracking (barcodes, RFID tags)	E-Waste Collection Rate	% of e-waste collected vs. generated	Assess effectiveness of collection systems	5,000.00
Material Recovery Tracking	Monitor quantity and type of materials recovered (e.g., metals, plastics).	Weekly / Monthly	Contractors; Beneficiaries	Inventory systems; recovery logs	Recycling Rate	% of e-waste recycled vs. landfilled/incinerated	Evaluate recycling efficiency and waste diversion	6,000.00
Hazardous Waste Management	Track safe handling and disposal of hazardous components (e.g., batteries).	Weekly / Monthly	Contractors; Beneficiaries; Recycling Facilities	Hazardous waste logs; compliance reports	Hazardous Material Recovery	Quantity of hazardous materials safely recovered	Monitor safe handling of toxic components	7,000.00
Facility Audits	Inspect recycling facilities for environmental and safety compliance.	Quarterly	EEPA; Beneficiaries	Inspection checklists; site visits	Worker Safety Incidents	Number of accidents or health issues	Evaluate occupational health and safety practices	4,000.00
Air Quality Testing	Measure toxic emissions (e.g., dioxins, furans) from e-waste processing.	Biannually	MiNT; Independent Contractors	Air sensors; lab analysis	Environmental Contamination	Levels of air, water, and soil pollution near facilities	Assess environmental impact of e-waste management	8,000.00
Water Quality Testing	Test wastewater for	Biannually	MiNT; Beneficiaries	Water sampling; lab analysis	Environmental Contamination	Same as above	Same as above	8,000.00

	heavy metals and pollutants.							
Soil Testing	Monitor soil contamination near e-waste facilities.	Annually	MiNT; Beneficiaries	Soil sampling; lab analysis	Environmental Contamination	Same as above	Same as above	6,000.00
Worker Health Checks	Conduct health screenings for exposed workers.	Annually	MiNT; Beneficiaries	Medical exams; health records	Worker Safety Incidents	Same as above	Same as above	5,000.00
Stakeholder Reporting	Share reports on e-waste management performance.	Annually	All Stakeholders	Dashboards; sustainability reports	Stakeholder Satisfaction	Feedback from communities, regulators, workers	Assess social and community impact	4,000.00
Corrective Actions	Address gaps/issues identified during monitoring.	As needed	MiNT; Beneficiaries	Action plans; training programs	N/A	N/A	Strengthen system responsiveness	3,000**.00**

12. INSTITUTIONAL FRAMEWORK

12.1. IMPLEMENTING AGENCIES

The lead responsibility for the overall coordination and implementation of the EDFP lies on the Ministry of Innovation and Technology (MInT) under which a Project Implementation Unit (PIU) was established. The PIU is staffed adequately with environmental and social risk management specialist who will be spearheading the implementation of the e-waste management process throughout the project life. The PIU and its environment and social risk management staff will be in charge of implementing the e-waste management plan similar to the ESMF process in all applicable EDFP financed subprojects.

The PIU environmental and social risk management specialists will also be responsible to oversee the environmental and social risk management issues in relation to all EDFP financed sub projects. The PIU will work in close collaboration with the procurement department of the EDFP, the technical committee and other partner as well as beneficiary institutions.

The PIU will also work in close collaboration with the beneficiaries which are project owners in essence. Accordingly, the projects are monitored by both the PIU and the beneficiaries. Each beneficiary monitors its own project. The beneficiaries include Ministry of Innovation and Technology (MinT), Ministry of Finance (MoF), Ethiopian Communications Authority (ECA), the Ethiopian Education and Research Network (EthERNet) within the Ministry of Education (MoE), the Ministry of Labour and Skills (MoLS) and the National ID Program (NIDP) within the Prime Minister's Office (PMO). The PIU oversee the monitoring activity by each beneficiary. Each beneficiary reports to PIU.[45] (See Table 12 for list of implementors).

The agencies include both the implementing agency and implementing partners for the different

[45] International Development Association Project Appraisal Document on A Proposed Credit in the Amount of SDR138.9 million (Us$200 million Equivalent) to The Federal Democratic Republic of Ethiopia for an Ethiopia Digital Foundations Project, March 24, 2021. Retrieved from: https://documents1.worldbank.org/curated/en/421681619316030132/pdf/Ethiopia-Ethiopia-Digital-Foundations-Project.pdf

components of the project at a national level. The respective sub-regional counterparts of ministries and agencies will play a supportive role.

Ministry of Innovation and Technology (MInT) is the implementing agency for the project. MInT was established following the proclamation No.1097/2018, definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia. The mandates of the ministry include the preparation and execution of innovation and technology research and development programs, provides professional and technical support and capacity building for regional innovation and technology institutions.

Ethiopian Communication Agency (ECA) is a regulatory body established in 2019 with the mandate as a regulatory authority for Communications Services in Ethiopia. Its scope of regulation covers both Telecommunications Services and Postal Services. ECA is responsible for issuing licenses in the

communications services sector, and supervise operators of communications service; specifying technical standards for the provision of communications service; regulating tariffs relating to communications service;

Ministry of Science and Higher Education (MoSHE) is responsible to lead the development of science, higher education and technical and vocational education and training. These include Universities, Colleges and research institutes.

Ministry of Trade and Industry was organized in 1995 is responsible for promoting trade and industry, ensure sustained competitive ness in trade and industry, regulation and licensing of trade and industry.

Job Creation Commission was established in 2018 and is mandated with to lead the job creation agenda, coordinate stakeholders, monitor and evaluate performance.

Table 12 Summary of Implementation Arrangement by Component.[46]

Implementing agency/partner	Component	Key role
MoF	Sub-component 1.1	Lead project preparation, implement component 1.1
MInT	Components 1.3, 2.1,2.2,3.1	Implementing agency, Manages PIU and chairs PSC, establish technical advisor for component 3
ECA	Component 1.2	Implement capacity building for ECA
MoSHE/EthERNet	Component 2.3	Implement
Regional counterparts	All components	Facilitate implementation

12.2. THE BANK'S MONITORING SUPPORT

The Bank supports the client to improve measurement systems that help them track progress, learn lessons, and make timely corrections to achieve their development goals. The Bank strives to refine its operations and practices to be more responsive to country needs, based on solid evidence.[47] The World Bank uses a results-based approach to monitor and report on project performance. Key methods include:

1. Results Framework: - is a structured tool to define, monitor, and measure project outcomes and outputs. Components of the framework include:
    - Indicators: Specific, measurable metrics to track progress.
    - Baselines: Initial data to measure changes over time.
    - Targets: Desired levels of achievement for each indicator.
    - Data Sources: Methods and tools for collecting data.

Results framework is used to ensures alignment between project activities and development objectives.

2. Implementation Status and Results Reports (ISRs): - The purpose of the ISRs is to gather periodic reports to track project progress and performance. This can be quarterly,

[46]World Bank. (2021). *Stakeholder engagement plan (SEP): Ethiopia Digital Foundations Project (P171034)* (p. 6). Retrieved from: https://documents1.worldbank.org/curated/en/585221611760553095/pdf/Stakeholder-Engagement-Plan-SEP-Ethiopia-Digital-Foundations-Project-P171034.pdf).

[47] WBG. Measuring & Reporting Results in The World Bank Factsheets. https://thedocs.worldbank.org/en/doc/7b776fece25d919127d83a8a6a396da2-0290032021/original/Measuring-and-reporting-results-factsheet.pdf

biannually and annually. The report includes updates on activities, financial disbursements, and achievement of results.

3. Project Completion Reports (PCRs): - The PCRs is a final evaluation to assess whether projects achieved their intended outcomes. PCRs includes an assessment of development outcomes, sustainability, and lessons learned.
4. Independent Evaluation Group (IEG): - IEG provides independent assessments of project performance and impact. Its role is evaluating completed projects to ensure accountability and learning.

The World Bank monitors projects at three levels—project, country, and corporate—to ensure comprehensive oversight and alignment with development goals. This multi-level approach allows the Bank to track progress, identify challenges, and ensure accountability at every stage of its operations. [48]

12.3. CAPACITY BUILDING

In recognition of Ethiopia's currently limited institutional capacity for e-waste management, a detailed capacity building and training matrix has been developed as part of this E-Waste Management Plan (EEWMP). This matrix outlines key training areas, responsible institutions, target participants, and indicative costs—based on the assumption that such activities will be financed under the Ethiopia Digital Foundation Project (EDFP), which is fully funded by the World Bank.

While formal allocation of funds for capacity building is yet to be explicitly confirmed, it is believed that resources for environmental and social safeguard implementation—including training—are embedded within the EDFP financing structure. The matrix is therefore designed as a realistic and actionable roadmap that can guide implementation teams in planning and delivering targeted capacity development activities.

The proposed training program prioritizes critical areas such as:

[48] World Bank. (2021). *Measuring and reporting results: Factsheet*. https://thedocs.worldbank.org/en/doc/7b776fece25d919127d83a8a6a396da2-0290032021/original/Measuring-and-reporting-results-factsheet.pdf

- safe handling and dismantling of e-waste,
- Extended Producer Responsibility (EPR),
- sustainable procurement,
- RFID-based asset tracking and data destruction,
- and social safeguards including gender inclusion and child labor prevention.

Special attention is given to informal e-waste handlers, public institutions, and emerging recyclers, while also proposing international exposure visits for safeguard and gender officers to learn from global best practices.

All training activities are envisioned to be coordinated by the Project Implementation Unit (PIU), and designed to be adaptive across all past, ongoing, and future EDFP interventions nationwide.

The matrix that follows provides a structured overview of these activities, with cost estimates expressed in USD for consistency with World Bank-financed project documentation (Table 14).

Table 13 e-Waste Management Plan capacity building matrix.

No.	Training Participants	Areas of Training	Responsible Body	Timeframe	Financed By	Estimated Cost (USD)
1	**Safeguard & Gender Specialists** (PIU, MoLS, MinT, MoF)	*International exposure visit* (e.g., Rwanda, Austria, Norway, Sweden, Denmark); Basel Convention, EPR, GIIP	PIU with WB support	Month 1–5	EDFP/World Bank	13,395.00
2	**Informal recyclers** (*Minalesh Tera*, women, youth)	Safe dismantling, PPE use, gender roles, *child labor prevention*	MoLS & EPA (via PIU)	Month 2–4	EDFP/World Bank	2,978.00
3	**Procurement Officers** (public institutions)	EPR compliance, sustainable ICT procurement, lifecycle cost analysis	Public Procurement Agency & PIU	Month 2–3	EDFP/World Bank	1,862.00

4	**IT & Asset Managers** (EthERNet, Ministries)	RFID tracking, secure data wiping (NIST 800-88)	PIU & EthERNet	Month 3–4	EDFP/World Bank	1,489.00
5	**Municipal Waste Authorities**	Reg. No. 425/2018 enforcement, landfill exclusion, e-waste segregation	EPA (via PIU)	Month 3–4	EDFP/World Bank	1,117.00
6	**Future recyclers / entrepreneurs**	Recycling business models, compliance, e-waste logistics	MoLS & Chamber of Commerce (via PIU)	Month 4–5	EDFP/World Bank	1,340. .00
7	**Public groups & schools**	Awareness on safe e-waste handling, radiation risks, child protection	MoLS, NGOs (via PIU)	Continuous	EDFP/World Bank	3,722.00
8	**Recycler applicants (EPA certification)**	Competence certificate process, Basel/Stockholm obligations	EPA (via PIU)	Month 4–6	EDFP/World Bank	893.00
9	**Gender & Social Development Officers**	Gender-responsive e-waste training design, social inclusion	MoLS Gender Unit (via PIU)	Month 2–4	EDFP/World Bank	1,191.00

13. Public disclosure (PD) of an E-Waste Management Plan

Public disclosure of an E-Waste Management Plan is a critical component of ensuring transparency, accountability, and stakeholder engagement. It involves making the plan accessible to the public, including government agencies, private sector actors, civil society organizations, and local communities. Below is a detailed description of how public disclosure of an e-waste management plan typically works, along with its importance and key elements:

13.1. Objectives of Public Disclosure and the Workshop

The main objective of public disclose of the e-waste management plan was to provide detailed presentation of the plan and gather feedbacks for the finalization of the plan. Detail objectives are **of the public disclosure were to enhance and foster:**

- **Transparency**: Public disclosure ensures that the e-waste management plan is open to scrutiny by stakeholders.
- **Accountability**: Public disclosure holds responsible parties accountable for implementing the plan.
- **Stakeholder Engagement**: Public Disclosure encourages participation and feedback from affected communities and stakeholders.
- **Awareness and Education**: Public Disclosure informs the public about proper e-waste disposal and recycling practices.

13.2. Key Elements of Public Disclosure with Emphasis on Accessibility

Effective public disclosure is essential for transparency, stakeholder engagement, and accountability in the implementation of the e-waste management plan. Accessibility plays a central role in ensuring that all stakeholders—including marginalized, remote, or non-digital populations—can access, understand, and respond to the information. The following are the key elements of an accessible public disclosure process:

1. Publication in Accessible Formats

To maximize accessibility, the e-waste management plan must be made available in multiple user-friendly formats, catering to diverse literacy levels, physical abilities, and technological access:

- **Digital formats** such as PDF, HTML web pages, and mobile-friendly documents that are easily downloadable, searchable, and screen-reader compatible for visually impaired users.
- **Printed materials** that can be distributed in hard copy to institutions such as public libraries, schools, and local administrative offices, ensuring access for individuals with limited or no internet connectivity.
- **Infographics or simplified summaries** to support comprehension for audiences with varying educational backgrounds, particularly in rural or underserved areas.

2. Language Accessibility

Language is a critical factor in ensuring inclusive communication. The plan must be translated into local and regional languages spoken by communities affected by or interested in the project:

- At a minimum, versions should be available in Amharic and relevant regional languages (e.g., Afaan Oromo, Tigrinya, Somali), depending on the geographic scope of the project.
- Simplified or plain-language versions should be developed to increase accessibility for non-technical audiences, youth, and elders.
- Where feasible, audio or video explanations in local languages can further enhance comprehension, particularly in low-literacy communities.

3. Distribution Through Multiple Channels

To reach the widest possible audience, the plan must be distributed via **diverse, accessible, and inclusive channels**, both digital and physical:

- **Official websites** of implementing agencies (e.g., Ministry of Innovation and Technology, Ministry of Environment, etc.) with clearly marked access points to download or view the documents.
- **Local government offices and kebele administrations**, where printed copies can be accessed or read by the public.
- **Community centers, public libraries, universities, and NGOs**, especially those engaged with environmental issues, youth empowerment, and digital inclusion.
- **Mass media platforms** (radio, television, newspapers) for announcements and public education about where and how to access the document.

- **Social media and messaging apps** (e.g., Facebook, Telegram) to reach tech-savvy and mobile-first users with updates and summaries.

4. Timing and Continuity of Access

- The disclosure should occur **early enough** in the project cycle to allow meaningful input before decisions are finalized.
- The information should remain **publicly accessible throughout the life of the project**, with updates or revisions clearly communicated.
- For vulnerable or traditionally excluded groups (e.g., people with disabilities, women-headed households, informal recyclers), **special outreach measures** may be necessary to ensure inclusion.

5. Feedback Mechanisms

- The disclosure process must include **accessible channels for feedback**, such as online forms, community suggestion boxes, SMS-based surveys, or facilitated community meetings.
- These mechanisms must be monitored and integrated into decision-making processes to reinforce stakeholder trust.

In conclusion, public disclosure is not just about releasing information—it's about ensuring that everyone has equitable access to understand, question, and contribute to the plan. By adopting these accessibility-focused practices, the project ensures transparency, builds trust, and enhances the legitimacy and sustainability of its e-waste management strategy.

13.3. STAKEHOLDER ENGAGEMENT

As part of the Ethiopia Digital Foundation Project (EDFP), stakeholder engagement was a core component of the development and validation process for the *Electrical and Electronic Waste Management Plan*. Stakeholders were systematically mapped throughout the lifespan of the EDFP to ensure that all relevant sectors and interest groups were identified and included. Formal invitations to the validation workshop were issued 15 days in advance, ensuring adequate time for preparation and review. A total of more than 100 individuals participated in the workshop, representing a wide array of institutions including government ministries, regulatory agencies, private sector actors, civil society organizations, academic institutions, and international partners (see Table 15).

The workshop was designed not only to validate the plan, but also to deepen shared understanding of the broader issues related to e-waste. To this end, five thematic papers were presented during the event, covering key topics such as general waste management frameworks, the current status of e-waste in Addis Ababa, radiation risks associated with e-waste, and the health and environmental impacts of improper e-waste handling. These presentations provided critical context and stimulated informed discussion among participants.

Following the technical presentations, the draft e-waste management plan was introduced in detail. Participants were then divided into breakout groups for focused discussion sessions. Each group was tasked with reviewing the plan, identifying gaps, raising concerns, and proposing refinements based on their sectoral perspectives and expertise. After in-depth deliberation, each group presented its findings and recommendations to the full plenary.

All concerns and suggestions raised during the group discussions were meticulously documented and systematically incorporated into the final version of the management plan. This inclusive and iterative approach ensured that the plan reflects a genuine consensus and is grounded in the realities, priorities, and expectations of Ethiopia's diverse stakeholder landscape (Appendix 1).

Table 14 List of stakeholders

No.	Participants	No. of participants invited
1	Regional and City Administration EPA	14
2	Regional Bureau of Innovation and Technology	14
3	Regional Environment and Social Focal points	14
4	Contractors/ sub-contractors	10
5	Beneficiary institutions	5
6	Beneficiary institutions E&S Focal points	5
7	Federal EPA	4
8	Ministry of Women and Social Affairs	2
9	Ministry of Innovation and Technology	10
10	Federal Public Procurement and Property Authority	2
11	Addis Ababa Cleaning Management Agency (CMA)	2
12	World Bank	3
13	PIU staff	20
14	Ethiopia standards Institute	2
15	Ethiopia Technology Authority	2
16	Media	5
17	NGOs, Civil Society members, Guests	11
	Total	125

14. Workshop Activities: A Comprehensive and Participatory Process

The validation workshop for the *Electrical and Electronic Waste Management Plan* under the Ethiopia Digital Foundation Project was structured to ensure meaningful engagement, knowledge exchange, and consensus-building among a wide and diverse set of stakeholders. The activities were carefully designed to foster both technical understanding and collaborative dialogue, with the goal of producing a refined, implementable, and collectively owned final document.

1. Stakeholder Mapping and Invitation Process

Leading up to the workshop, a systematic stakeholder mapping exercise was conducted to identify all relevant actors involved in or affected by e-waste management. This included representatives from key government ministries and agencies (such as environment, health, and ICT), municipal authorities, private sector companies, recyclers, academia, civil society organizations, and development partners. Based on this mapping, targeted invitations were issued 15 days in advance of the workshop, allowing ample time for participants to review the draft plan and prepare their inputs. This deliberate inclusiveness ensured balanced representation and comprehensive sectoral insights.

2. Opening Session and Keynote Addresses

The workshop opened with welcoming remarks and keynote speeches from senior officials, setting the tone for the event and emphasizing the critical importance of e-waste management in the context of Ethiopia's digital transformation and environmental sustainability goals. Opening statements highlighted the policy relevance of the plan, its alignment with national development strategies, and the government's commitment to stakeholder-driven processes.

3. Technical Presentations to Provide Context

To frame the discussions and enhance technical understanding, five expert-led presentations were delivered on related topics:

- An overview of general solid waste management systems in Ethiopia,
- A situational analysis of e-waste generation and handling in Addis Ababa,

- Scientific insights into radiation risks associated with e-waste,
- A public health perspective on the impact of e-waste exposure on human health, and
- A review of international best practices and regulatory trends in e-waste management.

These presentations provided critical context, deepened participant understanding, and established a common knowledge base for all stakeholders.

4. Presentation of the Draft E-Waste Management Plan

The draft *Electrical and Electronic Waste Management Plan* was then presented in detail by the lead authoring team. The presentation highlighted the key components of the plan, including its objectives, policy and legal alignment, proposed institutional arrangements, technical strategies, financing mechanisms, and implementation roadmap. Special attention was given to how the plan responds to existing challenges and incorporates global best practices adapted to the Ethiopian context.

5. Breakout Group Discussions and Deliberations

Following the main presentation, participants were divided into thematic breakout groups. Each group was assigned specific sections or thematic areas of the plan to review. Within these groups, participants engaged in open discussions, assessed the practicality and clarity of proposed actions, and raised any concerns or suggestions. This format allowed for in-depth examination and encouraged active participation from all attendees, regardless of institutional affiliation or seniority.

6. Group Presentations and Plenary Discussion

Each group presented their findings, recommendations, and identified gaps to the entire workshop in a plenary session. These presentations formed the basis for facilitated discussions aimed at reaching consensus on how to revise and improve the plan. All feedback—both oral and written, including those submitted through track changes prior to the workshop—was documented in detail.

7. Integration and Finalization of Inputs

After the plenary discussions, the facilitation team and technical experts synthesized all inputs and comments. Every concern and recommendation was carefully reviewed for inclusion in the revised

document. The updated plan thus reflected the collective input of all stakeholders, ensuring its relevance, feasibility, and shared ownership.

8. Consensus and Formal Validation

The workshop was concluded with a consensus session in which stakeholders were asked to formally endorse the final version of the plan. All participants unanimously agreed that the revised e-waste management plan was comprehensive, technically sound, and ready for implementation. This endorsement marked the successful validation of the plan and the beginning of the implementation phase.

15. Conclusion

The validation workshop for the *EDFP Electrical and Electronic Waste Management Plan (e-Waste Management Plan)*, developed under the Ethiopia Digital Foundation Project, concluded with full consensus and endorsement by all participating stakeholders. This marks a significant milestone toward the implementation of a robust and sustainable e-waste management system in Ethiopia for EDFP projects.

Prior to the workshop, the draft plan was distributed well in advance to all stakeholders to allow for thorough review, reflection, and preparation of comments. This early distribution enabled stakeholders to engage meaningfully with the document and arrive at the workshop ready for substantive dialogue.

Over the course of the three-day workshop, stakeholders—representing a wide array of institutions including government agencies, regulatory bodies, the private sector, civil society, academia, and development partners—participated in focused group discussions. These groups presented their analyses, shared concerns, and offered constructive recommendations for improvement. Additionally, individual comments and suggestions submitted via tracked changes were reviewed and integrated into the final version.

The validation process was characterized by inclusive participation, in-depth debate, and a shared commitment to environmental sustainability and digital transformation. The discussions addressed critical elements such as regulatory frameworks, institutional responsibilities, public awareness strategies, infrastructure for collection and recycling, financing mechanisms, and alignment with both national policies and global best practices.

Following this collaborative and transparent review process, all stakeholders unanimously agreed that the plan is comprehensive, actionable, and tailored to Ethiopia's current and future needs. The final document, reflecting collective input and consensus, was formally validated and approved for implementation.

The validated *Electrical and Electronic Waste Management Plan* now stands as a strategic framework guiding Ethiopia's efforts to responsibly manage electrical and electronic waste, protect public health, foster green innovation, and promote a circular economy.

All stakeholders are encouraged to maintain active engagement throughout the implementation phase, ensuring the plan's success through ongoing coordination, monitoring, and adaptive learning.

APPENDIX 1. LIST OF WORKSHOP PARTICIPANTS

No.	Name	Institution
1	Mr. Tessema Geda	MiNT, PIU, Director
2	Mr. Taye Estifanos	MiNT
3	Dr. Habte Jebessa Debella	PIU, EIA Consultant
4	Mr. Tamrat Selamu	PIU, SIA Consultant
5	Ms. Munit Mekuriya	PIU, Gender Consultant
6	Mrs. Meklit Degu	PIU, EARDIP EIA Consultant
7	Mr. Genzeb Ayaye	PIU, SIA Consultant
8	Mr. Nurelign Koku	MiNT
9	Mrs. Yemisrach Fantaye	PIU
10	Mr. Egata Hemo	Sidama Region Science and Technology
11	Mr. Berhanu Tesfaye	Dire Dawa Science and Technology
12	Mr. Abayneh Teshome	South Ethiopia Region EPA
13	Mr. Firew Admasu	South Ethiopia Region Science and Technology
14	Mr. Tewodros Kassas	South Ethiopia Region Science and Technology
15	Mr. Yitayal Belay	Benishangul Gumuz Region Science and Technology
16	Mr. Eliyas Wodisha	Benishangul Gumuz Science and Technology
17	Mr. Yohannes Terefe	MiNT
18	Ms. Asnakech Melak	Media
19	Mr. Temesgen Etansa	Oromia EPA
20	Mr. Thachuor Biel	Gambela Region EPA
21	Mr. Abdo Mohammed Seid	Afar Region Innovation and Technology
22	Mr. Worku Uga	Sidama Region EPA
23	Mr. Gatiso Ganamio	Sidama Region EPA
24	Mr. Mohammed Ahmed	Harari Region EPA
25	Mr. Ahmed Abdikedir Muhumed	Somali Region Science and Technology
26	Mr. Yemane Berhe	Tigray Region EPA
27	Ms. Aterefech Kefe	Benishangul Gumuz EPA
28	Dr. Gebremeskel Gebremariam	Tigray Region EPA
29	Mr. Fikresillasie Teklay	Tigray Region Science and Technology
30	Ms. Abeba Tadesse	Gambella Innovation and Technology
31	Mr. Chuna Lero	Gambella Region Innovation and Technology
32	Mr. Tewoldebrehan G/Hiwot	Afar Innovation and Technology
33	Mr. Mohammed Abdi Ahmed	Harari Region EPA
34	Mr. Zelalem Misganaw	Dire Dawa EPA
35	Ms. Samrawit Berhane	Harari Region Science and Technology
36	Mr. Siber Andualem	MiNT
37	Mr. Zenebe Teka	Institute of Ethiopian Standards
38	Mr. Daniel Eshetu	MiNT
39	Mr. Azmach Desalegn	MiNT
40	Mr. Gebregerais Assefa	MiNT

41	Mr. Babesha Kenaw	MiNT
42	Mr. Maereg Mekonen	Ministry of Women and Social Affairs
43	Mr. Molla Ejigu	Refugee & Returnee Service (RRS)
44	Mr. Yonatan Ayalew	Refugee & Returnee Service (RRS)
45	Ms. Syte Kifle	MiNT
46	Mr. Seyoum M engesha	MiNT
47	Mr. Mesfin Shiferaw	MiNT
48	Mr. Sisay Shiferaw	MiNT
49	Ms. Semira Hussein	MiNT
50	Mr. Belayneh Sewnet	MiNT
51	Mr. Dagim Adal	MiNT
52	Ms. Selamawit Mazengia	MiNT
53	Mr. Habtamu Yusuf	Ethiopian Communication Authority (ECA)
54	Mr. Abdire Seid	FDRE EPA
55	Mr. Bilisuma Gutema	MiNT
56	Mr. Ayalew Tilahun	MiNT
57	Mr. Ayalew Tilahun	MiNT
58	Mr. Brehanemeskel Chewaka	MiNT
59	Mr. Dagne Assefa	MiNT
60	Mr. Bekuletsion ???	MiNT
61	Mr. Yohannes Haile	Sinobridge, Private Contractor
62	Mr. Henok Tesfay	Sinobridge, Private Contractor
63	Ms. Samrawit Ayalneh	EARDIP, Contractor
64	Mr. Abenezer Zerinon	EARDIP, Contractor
65	Mr. Tadesse Hunduma	Oromia EPA
66	Mr. MesaH/Mariam	MiNT
67	Mr. Khalid Mohammednur	Ethiopian Technology Authority (ETA)
68	Mr. Wondwosen Kebede	Ethiopian Technology Authority (ETA)
69	Mr. Geletaye Basazin	Addis Ababa EPA
70	Mr. Garhome Aragaw	Fanna Media Corporation
71	W/Amanuel Yrddaw	Fanna Media Corporation
72	Mr. Aron Woldu	ECA
73	Mr. Mengistu Balcha	MiNT
74	Ms. Seblewongel Mitiku	Ministry of Women and Social Affairs
75	Mr. Solmon Yifru	Federal Public Procurement and Property Authority (FPPA)
76	Mrs. Adanech Tujo	MiNT
77	Mrs. Gete Tadesse	Maleda Maleda Private Media
78	H. E. Dr. Bayissa Bedada	MiNT, State Minster
79	Ms. Meklit Teshome	MiNT
80	Mr. Maru Seyoum	MiNT
81	Mr. Alemayehu Yohannes	Fana Broadcasting Corporation
82	Mr. Temesgen Abussie	Federal Public Procurement and Property Authority (FPPA)

83	Mr. Asegidew Fitawok	ECA
84	Mr. Denber Getahun	MiNT
85	Mr. Yidnekachew Teshome	MiNT
86	Ms. Asnakech Melaku	Radio Meneharia FM
87	Mr. Abebe Tolcha	FDRE EPA
88	Mr. Yosep Kebede	National ID Program of Ethiopia
89	Mr. Gebrehiwot Mekonnen	PIU, EARDIP
90	Mr. Wondwossen Yemane	EARDIP
91	Dr. Abebe Mola	MiNT
92	Mr. Getaneh Yilma	MiNT
93	Mr. Ketema Tolessa	Institute of Ethiopian Standards
94	Mr. Takele Desisa	Addis Ababa Cleansing Management Agency
95	Mr. Batre Basa	MiNT/PIU
96	Mrs. Meklit Degu	MiNT/PIU
97	Ms. Rediet Alemayehu	MiNT/PIU
98	Mr. Abraham Kibret	MiNT/PIU
99	Mr. Tesfaye Alemnew	MiNT
100	Mr. Lemessa Demie	MiNT/PIU
101	Mr. Eshetu Tilahun	ETA
102	Mr. Tesfaye	MiNT
103	Ms. Elsa Gebresilassie	MiNT
104	Mr. Tewodros Sisay	HEFLIE, Private waste recycling company
105	Mr. Tesfye Alemnew	MiNT, Public Relations