SUSTAINABLE RECYCLING INDUSTRIES

Small-Scale E-waste Facility (SSEF) Framework

FRAMEWORK REPORT

SEPTEMBER 2025

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs
Education and Research EAER
State Secretariat for Economic Affairs SECO

Empa
Materials Science and Technology

WORLD RESOURCES FORUM

Authors : Paul Jones, Dea Wehrli, Kelly Pearson, Aysha Lotter, Susanne Karcher

Publication year: 2025

ISBN: 978-3-906177-67-0

Acknowledgment: This report has been developed by SRI project team members from the following organisations:

LUMEC Volutio.

Layout: Wolfram Egert (atelier-egert.de)

Licence: Unless marked otherwise, this work is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported (CC-BY-SA 3.0) license. Additional rights clearance may be necessary for the elements that do not fall under the CC-BY-SA 3.0 license.

Disclaimer: This document has been produced without formal SECO editing. The designations employed and presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of SECO concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries or its economic system or degree of development. Mention of firm names or commercial production does not constitute any endorsement by SECO.

All images © the authors (unless specified)

Table of contents

Acronyms 4
Definitions 4
List of tables 5
List of figures 5
Executive summary 6

1 Introduction 7
1.1 Background 7
1.2 Problem Statement 7
1.3 Purpose of the Report 8
1.4 Approach and Methodology 8

2 Policy and Legislative Framework in South Africa 9
2.1 Operational Requirements for SSEFs 9
2.2 Financial Implications 10
2.3 Licensing and Compliance 10
2.4 National Policy and Strategies of Relevance to SSEFs 10

3 Market Analysis 12
3.1 Industry Assessment 12
3.2 Stakeholder Analysis 14

4 Business Models 16
4.1 Institutional Models 16
4.2 Operational Aspects 17
4.3 Informal Sector 18

5 Human Resource Requirements 21
5.1 Organisational Structure and Responsibilities 21
5.2 Training and Skill Requirements 21
5.3 Available Programmes and Opportunities 21

6 Financial Considerations 23
6.1 Capital and Operational Costs 23
6.2 Revenue Streams 24
6.3 Available Funding and Support Mechanisms 24

7 PESTEL Analysis 26

8 Recommendations 27

Bibliography 29

Acronyms

ARO	African Reclaimers Organisation
CEO	Chief Executive Officer
DFFE	Department of Forestry, Fisheries and the Environment
Empa	Swiss Federal Laboratories for Materials Science and Technology
EPR	Extended Producer Responsibility
ERA	E-Waste Recycling Authority
CEO	eWASA EPR Waste Association of South Africa
FPO	For-Profit Organisation
ICT	Information and Communication Technology
ID	Identity Document
ISO	International Organization for Standardization
IT	IInformation Technology
NGO	Non-Governmental Organisations
NPC	Non-Profit Companies
NPOs	Not-for-Profit Organisations
PPE	Personal Protective Equipment
PPP	Public-Private Partnership
PROs	Producer Responsibility Organisations
R2E2	Recycle Reuse Electrical Electronic
SECO	Swiss State Secretariat for Economic Affairs
SMME	Small, Medium and Micro Enterprises
SRI	Sustainable Recycling Industries
SSEFs	Small-scale E-waste Facilities
StEP	Solving the E-waste Problem
UNITAR	United Nations Institute for Training and Research
WEEE	Waste Electrical and Electronic Equipment
WRF	World Resources Forum

Definitions

Small, Medium, and Micro Enterprises (SMMEs)	… are defined as a separate and distinct business entity, including cooperatives, managed by one owner or more, operating in any sector of the economy. They are considered crucial for economic growth, job creation and poverty reduction, especially in developing countries.
Waste pickers or waste reclaimers	… are individuals who make a living by recovering recyclable materials from waste and selling them to the recycling industry. They collect, sort, prepare and sell recyclable materials to be used in new products, contributing to the recycling value chain.
Small-scale e-waste facilities (SSEFs)	… are e-waste handling facilities that collect, store, dismantle, process and/or refurbish e-waste. SSEFs are characterised by limited physical capacity—such as small-area treatment sites or low storage volumes—and/or constrained operational scale, including informal setups, low capital investment, and minimal human resources. SMMEs might have just one or even several SSEFs.

4

Tables

Table 1 Overview of existing regulations outlining operational requirements of SSEFs with regards to WEEE management 9

Table 2 National policies and strategies with relevance to SSEFs 11

Table 3 Stakeholder's key functions and mandates relating to WEEE and roles and responsibilities relating to SSEFs 14

Table 4 Overview of common institutional structures, possible forms, key aspects, benefits and disadvantages 16

Table 5 Overview of key aspects of Non-Profit Organisations and For-Profit Organisations and examples of organisations engaged in e-waste management in South Africa and in other countries 17

Table 6 Types of skills and specific skills requirements for SSEFs 22

Table 7 Various skills programme formats and offerings 22

Figures

Figure 1 WEEE value chain in South Africa. Source: (SRI, 2024) 12

Figure 2 Simplified general process flow of a small scale WEEE facility 17

Executive summary

Small-scale e-waste recycling facilities (SSEFs) operate in a complex operational and technical environment. This research was undertaken to provide an overview of this environment, and to present a framework to guide the development of future SSEFs. The research aims to assist interested parties in navigating factors such as the National WEEE Policy and the growing legislative framework concerned with governing WEEE management aspects. It also assists with understanding the various business models being utilised and the human and financial resource requirements thereof. The integration of waste reclaimers as a collaboration pathway for SSEFs is also presented in this research.

This report comprises Phase 2 of the project, constituting the ***"Framework Report"***, which draws on insights obtained during Phase 1, namely, the ***"Case Study Assessment Report"***. The Case Study Assessment Report used primary and secondary research methods, through interviews with existing SSEFs, and incorporated international good practice combined with desktop research from Ghana, Egypt and India.

Chapter 1 contains a more detailed introduction on the background of the initial study, its objectives and methodology. **Chapter 2** elaborates on the policy and legislative framework in which SSEFs in South Africa operate. The following policy matters are addressed: policy-based operational requirements, policy-related financial considerations, licensing and compliance aspects, and notable national policy and strategies driving or inadvertently hindering SSEF growth. A market analysis is provided in **Chapter 3**, mapping out the context of e-waste nationally, the development of the e-waste industry, and finally, identifies and positions key stakeholders within the local e-waste value chain. **Chapter 4** investigates the business model of SSEFs, examining three key elements: institutional structures, operational models and the level of engagement with the informal sector. The first element demonstrates the common institutional structures of organisations engaged in WEEE management and their respective key aspects, benefits and disadvantages. Secondly, operational aspects are presented including details on operational activities, e-waste volumes and facility size, tools and equipment. Finally, this chapter presents options for engaging with and integrating the informal sector along with considerations, risks and constraints. Human resource requirements are specified in **Chapter 5** of the report. In the first part, key human resources that are required to ensure a successful operational structure are presented. Secondly, the main thematic areas for training and upskilling the necessary staff is unpacked. Finally, available programmes and opportunities for upskilling within an SSEF are shared. Financial considerations are presented in **Chapter 6**, where three primary areas are addressed: capital and operational costs, revenue streams, and the funding and support mechanisms available to SSEFs. The section aims to offer insights into both the financial challenges and potential resources accessible to operators within the sector. A PESTEL analysis is presented in **Chapter 7**, which summarises the key political, economic, social, technical, environmental, and legal insights that have been identified during the research. Together, these insights provide a holistic understanding of challenges and opportunities that SSEFs are facing in South Africa. **Chapter 8** provides a set of recommendations for SSEFs. These broad recommendations are important to consider for the efficient, quality driven and legally compliant operation of SSEFs.

Keywords:
Small-scale e-waste facilities; small, medium and micro enterprises; informal sector; e-waste management.

1 Introduction

1.1 Background

The Sustainable Recycling Industries (SRI) programme is funded by the Swiss State Secretariat for Economic Affairs (SECO) and is jointly implemented by the Swiss Federal Laboratories for Materials Science and Technology (Empa) and the World Resources Forum (WRF). The recycling initiative aims to improve local capacity for sustainable recycling together with private and public institutions, as well as the informal sector in Colombia, Egypt, Ghana, Peru and South Africa.

The South African project started in 2021 as part of Phase II of the SRI Programme and is being implemented until the middle of 2025. The overall development objective of the SRI programme (Phase II) is to contribute to favourable framework conditions that enable the development of a sustainable recycling industry for waste electrical and electronic equipment (WEEE) and related waste streams in SECO partner countries.

Since the inception of the South African project, the local team has undertaken various research projects and engaged broadly with WEEE industry stakeholders. Through this work, it has been identified that the development of small-scale e-waste facilities (SSEFs) is an area that requires significantly more attention and support. In addition, more support is required in researching pathways for better collaboration and integration of informal sector waste pickers/reclaimers into the formal WEEE value chain. SSEFs were identified as an important type of operation that often engage with the informal sector, either directly or indirectly. Their approaches can range from simply acknowledging the sector's existence, to providing indirect support (e.g., granting access to materials), to seeking collaboration (e.g., purchasing materials from informal operators) and even to full integration (e.g., offering a safe work environment, providing on-the-job training, or carrying out dismantling on behalf of the SSEF).

As such, the SSEF Framework Report aims to provide insight into how SSEFs can be supported in growing the WEEE industry in South Africa.

1.2 Problem statement

Both the development of SSEFs and integration of the informal sector into the waste value chain are key national focus areas within waste management in South Africa. Specifically, Producer Responsibility Organisations (PROs), through their Extended Producer Responsibility (EPR) mandate, have an obligation to develop SSEFs and support waste picker integration projects. Within the WEEE industry, the same obligation applies, and WEEE-specific PROs are implementing various projects that seek to support the development of SSEFs and assist waste picker involvement in the WEEE value chain. However, substantial gaps still exist, and many SSEFs are not able to access the support that is being provided by WEEE PROs. This is further limited by funding and capacity constraints of PROs. Additionally, although waste picker integration is being driven by PROs, within the WEEE industry, projects and initiatives are relatively limited and many waste pickers are still excluded from contributing to any activities in the formal WEEE management value chain. This is partially due to the hazardous nature of WEEE, which restricts waste pickers' involvement in activities; therefore, their role primarily focuses on collection services and some pre-dismantling activities – as defined in the draft Norms and Standards – aimed at

concentrating value fractions and performing initial decontamination tasks, such as the manual removal of accessible batteries.

1.3 Purpose of the report

The primary purpose of the report is to share a framework for SSEFs around how to navigate the complex e-waste management value chain in South Africa. In addition, the report provides insights into how to engage, collaborate with and even integrate informal sector stakeholders (waste pickers/reclaimers) into SSEF operations.

This project is structured in two phases. Phase 1 comprised a case study research assessment of existing small-scale e-waste facilities, both locally and internationally, as well as existing informal sector integration projects. This resulted in the development of a ***Case Study Assessment Report***, which can be accessed ***here***. Phase 2 draws on the learnings from Phase 1, as well as insights from other work undertaken by the SRI team. This ***Framework Report*** presents these findings and includes an assessment of the WEEE market and industry in South Africa; relevant industry stakeholders; the existing policy and legislative framework; business model considerations; human resource requirements; and financial considerations. The integration of waste pickers is highlighted as a key element of SSEF operations.

1.4 Approach and methodology

As noted above, the ***Framework Report*** is based on the research conducted in Phase 1, which used both primary and secondary research methods. Primary research was undertaken in the form of interviews with local and international WEEE industry stakeholders. Secondary research was conducted through desk-top studies. The detailed approach and methodology is presented in the Case ***Study Assessment Report***, a summary of which is presented below.

1.4.1 Primary research

Primary research consisted of nine interviews with WEEE recycling facilities and projects. Of these, four interviews were conducted with national organisations, and five with organisations abroad. Engagements were informed by a structured questionnaire. Information was then captured onto a datasheet which is attached as an annexure to the ***Case Study Assessment Report***. Fifty-one questions were developed and split across eight categories. Using a flexible and adaptive approach, the sequence and wording of questions were adjusted based on how each interview progressed, ensuring relevant and in-depth responses where they became available.

1.4.2 Secondary research

Secondary research included desktop studies in four key areas: the roles and responsibilities of PROs; case studies of existing SSEFs and similar projects; indirect support, collaboration and integration approaches to waste pickers and the informal sector at large; and the WEEE market in South Africa. While the geographical focus of the secondary research was South Africa, insights and examples from other countries were included as well. Detailed information regarding the above research areas can be found in the ***Case Study Assessment Report***. This information forms the foundation for the analysis, conclusions and recommendations presented in this ***Framework Report***.

2 Policy & legislative framework in South Africa

The management of WEEE in South Africa takes place within a complex regulatory framework that is based on the environmental rights set out in the Constitution of the Republic of South Africa (Republic of South Africa, 1996) and grants every South African the right to a healthy and safe environment. This section focuses exclusively on e-waste management regulations and related policy and examines the specific requirements that directly impact the operations of SSEFs. It does not include general business, company and health and safety requirements. The principal waste management Act of South Africa is the ***National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA)*** (DEA, 2008). This Act is part of the overarching 'environmental' Act, namely the ***National Environmental Act (No. 107 of 1998) (NEMA)*** (DEA, 1998).

2.1 Operational requirements for SSEFs

Table 1 provides an overview of the operational requirements for SSEFs as outlined in various regulations. SSEFs must adhere to several operational requirements under the NEMWA. Section 16's General Duty Provisions require all waste holders to minimise waste and its toxicity while preventing any endangerment to health and the environment (DEA, 2008). SSEFs must follow the Waste Hierarchy Principles (Section 17), prioritising reduction, reuse, recycling, and recovery of waste over disposal. This means demonstrating that their operations use fewer natural resources and cause less environmental harm than disposal alternatives.

Table 1: *Overview of existing regulations outlining operational requirements of SSEFs with regards to WEEE management*

Regulation/policy	Relev. sections/ instruments	Operational requirements for SSEFs
National Environmental Management: Waste Act (NEMWA) (DEA, 2008)	Section 16 – General Duty of Care	SSEFs must minimise waste generation and its toxicity and prevent harm to human health or the environment.
	Section 17 – Waste Hierarchy	SSEFs must prioritise reduction, reuse, recycling, and recovery over disposal, and show that their operations reduce environmental impact and resource use.
	Section 24 – Waste Collection	Requires written agreements with waste generators and authorisation (potentially from local authorities) for waste collection activities.
	Part 8 – Contaminated Land	SSEFs must implement measures to prevent land contamination, including regular soil testing when handling hazardous components.
Schedule 3 of NEMWA (DEA, 2008)	–	Classifies hazardous components of e-waste as hazardous waste, and non-hazardous components as general waste.
National Waste Information Regulations (DEA, 2012)	HW18/GW18 categories	E-waste must be recorded as hazardous (HW18) if it contains hazardous substances, or as general waste (GW18) if decontaminated. SSEFs must maintain accurate waste reporting.
Waste Classification and Management Regulations	–	Provides technical criteria for e-waste classification and handling. SSEFs must ensure compliance when handling or processing any e-waste.
National Norms and Standards for Storage of Waste (DEA, 2013)	GN 926/ Regulation	All storage containers must be intact and suitable; facilities must prevent leaks, spillage, windblown waste, and nuisances (e.g. odours, visual impact). Temporary storage must meet these standards as well.
National Norms and Standards for Sorting, Shredding, etc. (DEA, 2013)	–	Applies to SSEFs conducting mechanical activities (e.g. crushing, screening). Facilities must comply with technical requirements for handling general waste components safely and responsibly.
List of Waste Management Activities with Environmental Impact (DEA, 2013)	GN 921/ Listed Activities	Identifies which e-waste activities require a waste management licence (e.g., storage, reuse, recycling, disposal). SSEFs must check whether their operations exceed thresholds that trigger licensing or specific environmental standards.

2.2 Financial implications

Operating a compliant SSEF involves several financial implications. Investment into proper storage infrastructure is essential, including appropriate containers that are properly labelled, spill containment systems, and secure storage areas. Transportation costs increase when using vehicles suitable for e-waste transportation and implementing proper load securing mechanisms.

The EPR Scheme for the Electrical and Electronic Equipment Sector (DEFF, 2020) implemented in 2021, creates both obligations and opportunities. While producers bear the primary financial responsibility for e-waste management, SSEFs can benefit by becoming recognised service providers within EPR schemes, potentially accessing funding for collection, dismantling, and processing activities.

Financial planning should include contingency funds for potential land remediation costs, as contamination from hazardous e-waste components could trigger remediation requirements under NEMWA's Contaminated Land provisions (DEA, 2008). Non-compliance penalties represent significant financial risks, with fines reaching up to R10 million for serious offenses and R5 million for less severe violations, plus daily penalties for continuing violations.

2.3 Licensing and compliance

The licensing requirements for SSEFs depend on the nature and scale of operations. Section 43-45 of NEMWA requires licensing for storage, reuse, recycling, recovery, treatment, and disposal of WEEE when specific technical thresholds (e.g. facility size and daily processing volumes) are met (DEA, 2008). The Minister of the National Department of Forestry, Fisheries and the Environment serves as the licensing authority when:

- **facilities handle hazardous waste,**
- **when activities involve international obligations, or**
- **when multiple waste management activities occur at the same facility.**

Compliance with reporting obligations is mandatory. SSEFs are required to submit data to National and Provincial waste information systems under the ***National Waste Information Regulations*** (DEA, 2012). This reporting helps authorities to track e-waste flows and ensures transparency in the sector.

Environmental management inspectors may require waste impact reports if violations are suspected, as outlined in NEMWA's compliance and enforcement provisions (Section 66-68). To mitigate compliance risks, SSEFs should establish strong internal protocols, conduct regular self-audits, and maintain thorough documentation of all waste handling activities.

The evolving regulatory landscape, particularly with the implementation of the EPR scheme, means SSEFs must stay informed about new requirements and opportunities. Participation in industry associations can help SSEFs to navigate these changes and potentially influence future regulations affecting the sector.

2.4 National policy and strategies of relevance to SSEFs

Table 2 provides a broad overview of the key policies and strategies that are relevant and the key considerations for SSEFs.

Table 2: National policies and strategies with relevance to SSEFs

Policy/strategy	Broad overview	Key considerations for SSEFs
National Waste Management Strategy (2020)	Provides a comprehensive framework by establishing hierarchical waste management priorities, emphasising waste minimisation, reuse, recycling, and recovery over disposal.	• Creates operational guidelines that encourage the recovery of valuable materials from electronic waste while promoting environmentally sound management practices • Advocates for inclusive economic growth within the waste sector, creating opportunities for SSEFs to participate in the formal waste economy through skills development programmes and financial support mechanisms • Enables smaller operations to comply with regulatory requirements while contributing to national waste diversion targets
National Policy for the Management of Waste Electrical and Electronic Equipment	Addresses the unique challenges in South Africa regarding e-waste management through systems thinking and laying the foundation for the National Norms and Standards for the Management of WEEE	• Makes regulatory requirements more accessible and understandable than general hazardous waste regulations • Promotes establishment of collection networks and take-back systems that can feed into SSEFs, supporting consistent material input streams
National Pricing Strategy for Waste Management	Introduces economic instruments that significantly influence the viability of SSEFs through mechanisms like waste disposal taxes, material recovery incentives, and deposit refund systems	• Creates competitive advantages for facilities that maximise material recovery, potentially improving profitability by leveraging interventions outlined in the Action Plan
The Guideline and Toolkit for Determination of Extended Producer Responsibility Fees	Establishes frameworks for producer responsibility that directly affect material flows and financial support available to SSEFs through EPR systems.	• The Pricing Strategy and the EPR Guideline should be read together • SSEF would function as service providers to PROs to access EPR fees • Creates transparent fee structures and material tracking systems to help SSEFs participate in formal EPR schemes
Waste Picker Integration Guideline for South Africa	Directly addresses the interface between informal waste collectors and the formal waste management system, with relevance for SSEFs that often rely on these collection networks.	• Provides 10 basic actions to kick-start integration, as well as 7 steps to integrate waste reclaimers • Provides guidance on compensating and contracting waste reclaimers and cooperatives • Provides various templates and useful resources
National Household Hazardous Waste Management Strategy	Has significant implications for SSEFs as e-waste contains numerous hazardous components that require specialised handling.	• Provides a useful outline of household hazardous waste landscape as well as the financing mechanisms in South Africa • Supporting successful pilots and trials is key to innovation and growth within the strategy, so exhibiting good practice could initiate support for a long-running system • Highlights collection options

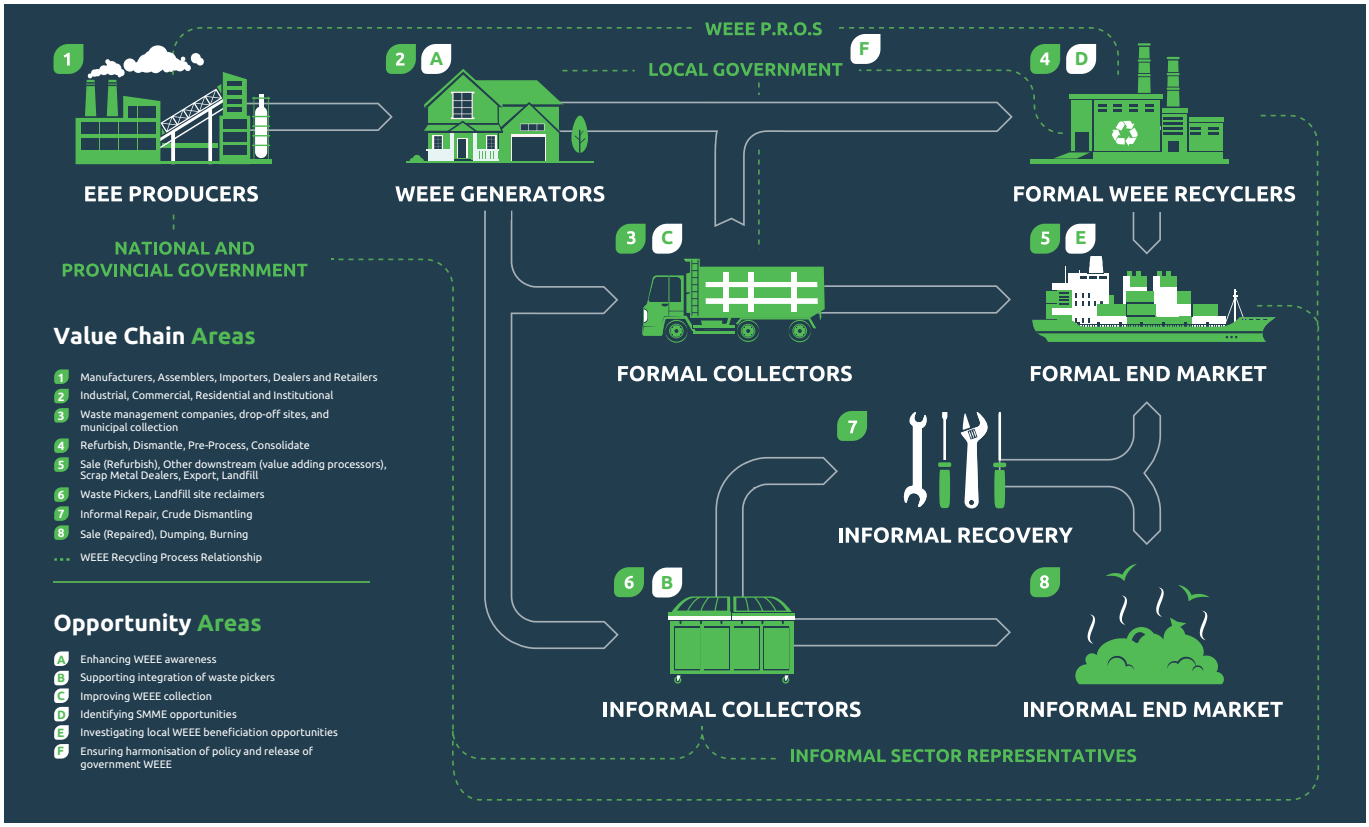
3 Market analysis

3.1 Industry assessment

Like many countries across the world, South Africa's WEEE industry has grown and became increasingly more formalised over the past decade. In 2017, it was estimated in the State of Waste Report that 10% of e-waste was recycled annually (Schoeman & Ramutanda, 2022). Conversely, the Global E-Waste Monitor states that only 4.35% of all e-waste generated in 2022 was formally recycled, which equated to 22,900 tonnes (UNITAR, 2024). It is estimated that from households in urban and rural areas, 2,9% of WEEE is recycled (CSIR, 2016). Beyond these formal efforts, a large share (approximately 25% in 2013) of the remaining e-waste is handled by informal recyclers, who play a key role in South Africa's e-waste recycling landscape (Schoeman & Ramutanda, 2022).

Figure 1 provides a visual overview of the WEEE value chain in South Africa. It illustrates the key stages within the e-waste industry. A more detailed breakdown, including relevant statistics for each stage of the value chain, is provided thereafter.

Figure 1: WEEE value chain in South Africa. Source: (SRI, 2024)



EEE Producers and WEEE generators:

Electrical and Electronic Equipment (EEE) includes equipment such as microwaves, laptops, printers, TVs, batteries and other objects that are powered by either electricity or batteries (SRI, 2024). Once EEE has been used and is discarded it becomes WEEE.

In South Africa, WEEE is generated by three main groups (Lydall et al., 2017):

1. National and provincial governments: accounting for 45%
2. Business: accounting for 35%
3. Households: accounting for 20%

In 2017, it was estimated that 86,4% of the e-waste generated was stockpiled (DEA, 2015). The largest stockpilers are national and provincial government institutions, which face legislative barriers that have so far prevented them from releasing e-waste into the market. ICT and consumer electronics make up the largest portion of this stockpiled waste, accounting for 79% of the total (Lydall et al., 2017).

Formal and informal e-waste collectors:

E-waste is collected through both formal and informal channels.

Formal collection involves over 100 registered companies (Lydall et al., 2017), covering a wide range of activities from collection to recycling. Many of these firms focus on the initial stages of the WEEE value chain (i.e. collection) due to the relatively low barriers to entry. Typically, collection points are set up on the same premises where other WEEE operations are conducted (Lydall et al., 2017). Organised collection drives - led by firms, government entities and PROs - also contribute to the supply of e-waste for formal recyclers. Additionally, e-waste is collected directly from some residential areas and businesses.

Informal collection accounted for 25% of WEEE collected in South Africa in 2013 (Schoeman & Ramutanda, 2022). It is estimated that between 60,000 and 90,000 informal waste pickers operate in the country (CSIR, 2016). Some of these individuals recover WEEE alongside other materials they collect, such as plastics, cardboard, paper, cans and metals. Whether they do so largely depends on the availability of off-take opportunities of WEEE at buyback centres where they sell these secondary resources. E-waste is collected from various locations including landfills, dustbins, shopping malls, industrial areas and residential suburbs (Schoeman & Ramutanda, 2022). For many vulnerable groups, informal waste picking serves as an important source of income (Schoeman & Ramutanda, 2022).

Formal and informal WEEE recycling:

WEEE is processed through both formal and informal recycling channels. The majority of formal WEEE recycling takes place in Gauteng. In 2015, the Gauteng province handled roughly 55% of the country's total WEEE volumes (Lydall et al., 2017). Other key provinces include the Western Cape, KwaZulu-Natal and the Eastern Cape, which also serve as important hubs.

Formal WEEE recyclers in South Africa perform various activities, including dismantling, refurbishment, processing or pre-processing of WEEE fractions. Informal WEEE recyclers often specialise in the early treatment stages of WEEE recycling, such as dismantling, due to low investment requirements and low barriers to entry. These businesses must often diversify their business model in order to create a sustainable business (Lydall et al., 2017). Refurbishment, for example, can increase profits by up to 60% (Lydall et al., 2017).

The more advanced processing and pre-processing stages are managed by a few specialised firms, who have the necessary technology to handle hazardous and complex WEEE fractions. In 2015, just 27 formal recycling companies were responsible for processing 17,733 tonnes of WEEE (Lydall et al., 2017).

WEEE that is collected by informal waste pickers is often first repaired informally where possible. Irreparable items are informally dismantled to extract valuable materials (mainly metal). The dismantling processes usually involves physically breaking apart the equipment, which poses health and environmental risks especially when handling e-waste with hazardous substances. Waste pickers may also sell WEEE or dismantled fractions to buy-back centres, to formal recyclers or scrap metal dealers.

Formal and informal end market:

After processing, output fractions are sold to formal end markets within the country or exported to countries with the technical capabilities to handle them. In 2015, WEEE output fractions consisted of 47% ferrous metals, 16% non-ferrous metals, and 16% printed circuit boards (the most valuable fraction) (Lydall et al., 2017). Due to limited local capacity to process certain materials, such as glass and plastics, a portion of the South Africa's e-waste is exported. According to the State of Waste Report, 2,124 tonnes of e-waste was exported in 2015 (DEA, 2015), primarily to Asia and Europe (Lydall et al., 2017). More recently, there has been a growing trend of intra-African e-waste trade, particularly between South Africa, Nigeria and Tunisia (UNITAR, 2024).

3.2 Stakeholder analysis

Table 3: Stakeholder's key functions & mandates relating to WEEE and roles & responsibilities relating to SSEFs

Table 3 below identifies key stakeholders involved across the WEEE value chain. It outlines each stakeholder's role and responsibilities in WEEE management, with particular attention to SSEFs and waste picker integration.

Stakeholder name	Key function and mandate related to WEEE	Roles and responsibilities in relation to SSEFs
EEE producers	EEE producers create, distribute and circulate electronic products. They are legally required to be affiliated with a PRO and comply with the regulations set out by the Department of Forestry, Fisheries and the Environment (DFFE). They are responsible for the 'end-of-life' stage of their products and must consider design and systems that enable responsible WEEE management.	• Provide indirect support to both SSEFs and waste pickers via PROs, while some producers even directly fund e-waste recycling initiatives • Are obliged to ensure their products are safe to handle and dismantle, which supports SSEFs
WEEE generators	WEEE generators (such as households, schools or institutions) purchase and use EEE until it no longer meets their needs. Thereafter, they are encouraged to dispose of WEEE responsibly.	• Assist SSEFs by separating their e-waste and disposing of it directly at certified recyclers or drop-off points rather than simply placing it on the kerbside or throwing it away
PROs	PROs are responsible for supporting EEE producers in meeting EPR obligations by monitoring legal compliance, reporting to authorities and promoting the responsible end-of-life management of products.	• Mandated to seize opportunities that support SSEFs, and promote entrepreneurship within the industry • Assist with integration and fair compensation of waste pickers in the WEEE value chain
WEEE recyclers	WEEE recyclers collect, dismantle, recycle, repair or refurbish e-waste. They dispose of or sell fractions and circulate finished products in the second hand market.	• Larger WEEE recyclers provide a formal material market for many SSEFs • Obligated to comply with policies that ensure safe working conditions for dismantlers and fair compensation for waste-pickers
Waste management companies	Waste management companies are contracted by industry and institutions to collect and dispose of various waste streams, of which WEEE is often included.	• Collect WEEE as part of their collection service and pass this on to SSEFs • Sometimes operate in competition with SSEFs and waste pickers
National government	DFFE is responsible for creating legislation, policies and regulations regarding the management of e-waste in the country, including EPR legislation. The DFFE is also tasked with monitoring and enforcing WEEE management activities.	• Outlines the obligations of PROs to both SSEFs and waste pickers as part of the EPR legislation • Responsible for monitoring PRO compliance

Stakeholder name	Key function and mandate related to WEEE	Roles and responsibilities in relation to SSEFs
Provincial government	Provincial governments are responsible for ensuring regional compliance with national policy. This includes aligning WEEE management practices with national guidelines, registering and monitoring recycling facilities, as well as implementing projects such as awareness creation initiatives.	• Monitor activities and assess compliance, including issuing of licences for recycling activities • Assist the DFFE in communicating PROs' responsibilities towards SSEFs and waste pickers within their jurisdictions
Municipalities	Municipalities are responsible for general waste management within their jurisdiction. This includes collection and disposal of general waste, which often includes WEEE. They are also responsible for development of waste management infrastructure such as landfills and drop-off points, some of which include separate WEEE collection. They are also responsible for developing and implementing local polices and by-laws, and monitoring businesses activities. They are required to collaborate with PROs.	• Support and regulate business activity including issuing of licenses and permits which are required by SSEFs, • Enforce by-laws which impacts on both SSEFs and waste picker activities
Financial institutions	Financial institutions play an increasingly important role in ensuring a smooth transition to a circular economy through provision of circular finance.	• Offer funding opportunities for SSEFs; some have specific funding that is targeted at circular economy initiatives
Enterprise support institutions	Enterprise support institutions are responsible for promoting economic development, and the WEEE sector presents an opportunity to achieve this objective.	• Should assist SSEFs through knowledge support, financial assistance, training, networking, and access to markets
NGOs	NGOs act out of concern for the negative environmental impacts of improper disposal of WEEE and are motivated by their concern for the safety of those handling WEEE, particularly waste pickers.	• Might assist SSEFs through financial support, networking, technical support, knowledge-sharing and infrastructure development • Ensure the rights of waste pickers and represent their interests
Research organisations	Research organisations such as universities, research institutions or consultancies play a vital role in studying the impacts of WEEE on the environment and people. They investigate the current structure of WEEE management practices and contribute to solutions by uncovering and testing best practices from around the world.	• Provide SSEFs with information, training, and access to best practices, and facilitate information exchange and connect stakeholders • Assist waste pickers and organisations by identifying best practices and collecting information on waste picker interests and challenges
Waste pickers/ reclaimers	Waste pickers are involved in informal collection of WEEE that is found in general waste and landfill.	• Supply of WEEE as a feedstock to SSEFs in a manner that prevents informal dismantling before WEEE is sold to SSEFs (SSEFs therefore have a role in educating and supporting waste pickers)
Waste picker organisations (SAWPA and ARO)	Waste picker organisations are concerned about how WEEE affects waste pickers from a health perspective as well as income generation.	• Assist SSEFs by clarifying the needs of waste pickers and supporting waste pickers to become formally registered and providing identity documents, vests and personal protective equipment • Assist waste pickers by protecting them, giving them legitimacy and ensuring their financial rights are upheld

4 Business model

4.1 Institutional models

Organisations engaged in WEEE management are typically either Non-Profit Organisations (NPO) (including Non-Profit Associations, Non-Profit Companies [NPC] and Non-Profit Cooperatives) or For-Profit Organisations (FPO) (including Private Enterprises/For-Profit Companies and For-Profit Cooperatives). Table 4 provides an overview including key aspects, advantages and disadvantages of the different legal forms of organisations. The list is non-exhaustive, and other legal forms of NPOs and FPOs are possible (e.g., public company, state-owned company).

An NPO or FPO can be part of a Public-Private Partnership (PPP), that is an overarching collaboration between government and private-sector actors aimed at leveraging private expertise and funding to achieve public goals. Such partnerships may also face challenges like bureaucratic delays and complex contractual arrangements.

Table 4: Overview of common institutional structures, possible forms, key aspects, benefits and disadvantages.

Type	Key aspects	Advantages	Disadvantages
Non-Profit Organisation (NPO). Can be an association, trust, foundation, cooperative or also a company, small or medium-sized enterprise	Focus on social and environmental impact, surplus is reinvested into its mission. In South Africa special registration needed with the Department of Social Development.	Community benefits, reinvestment into social goals	Reliance on grants, financial sustainability challenges
EXAMPLES OF LEGAL FORMS			
Non-Profit Association	Formed to promote common interests or advocate for a cause	Low setup costs, flexibility, tax benefits, low-cost operation, access to funding	Limited access to funding/ investments, in some cases personal liability, potentially governance challenge
Non-Profit Company	Privately owned, independent, profits are reinvested into the mission, not distributed to owners/shareholders	Access to funding, tax benefits, limited liability	Strict regulation, limited profit distribution
Non-Profit Cooperative	Owned and operated by a group of workers or small businesses. No profit distribution. Surpluses are reinvested into the cooperative.	Access to funding (e.g. government support), community-focused, reinvests surplus.	May financially be dependent on grants, no profit distribution, bureaucratic. Decision-making can be slow, risk of internal conflict
For-Profit Organisation (FPO). Can be an SMME, a corporation, or a franchise model	Privately owned, profit-focused, can be small or large scale.	Financial independency, operational efficiency, ability to attract investment	Profit may overshadow environmental/social goals, limited inclusivity, vulnerable to market fluctuations.
EXAMPLES OF LEGAL FORMS			
Private enterprise / For-Profit Company	Privately owned, profit-driven, independent	Efficient decision-making, access to private investment	Profit focus may lead to cutting corners on environmental and social benefits
For-Profit Cooperative	Owned and operated by a group of workers or small businesses. Share profits among themselves, like a business.	Members share profits, financially independent, scalable.	More challenging to receive funding support, market competition, decision-making can be slow, risk of internal conflict

The preferred institutional form depends on the business strategy with regards to funding structure, primary activities, vision and mission of the company. Table 5 provides an overview of the differences between an NPO and an FPO which can help determine the most suitable type of organisation and includes examples of each.

Table 5: Overview of key aspects of Non-Profit Organisations and For-Profit Organisations and examples of organisations engaged in e-waste management in South Africa and in other countries

Type of organisation	Typical preferences	Examples from South Africa, Ghana, Egypt and India
Non-Profit Organisation (NPO)	• finance their activities through grants, donations • create social and/or environmental impact • reinvest their profits into the organisation • share ownership; or • promote common interest	• SA Waste Pickers Association • Taking Care of Business • GreenABLE • African Reclaimers Organisation • Koforidua Scrap Dealers Association (Ghana) • EcoGreen Waste Management (Egypt) • Inclusive Recycling Foundation (Ecowork) (India)
For-Profit Organisation (FPO)	• create financial profit • achieve financial independence • attract financial investment • have efficient decision-making	• Desco Electronic Recyclers • Electronic Cemetery • Nobilis Recycling • AppCyclers (Ghana) • Electro Recycling Ghana (Ghana) • Egyptian Electronic Recycling Company (Egypt)

4.2 Operational aspects

4.2.1 Operational activities

Operational activities of a WEEE dismantling and recycling facilities generally follow the steps outlined in Figure 2.

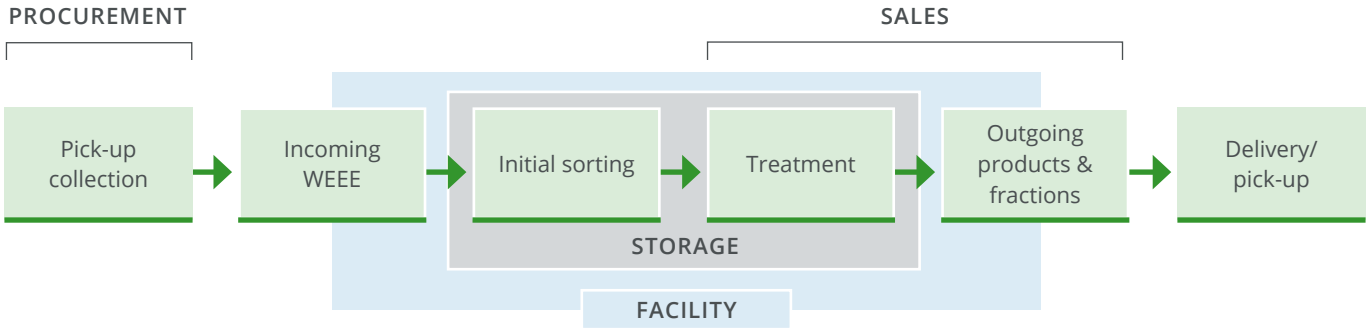


Figure 2: Simplified general process flow of a small scale WEEE facility

The procurement process varies by region and uses different channels and methods. Typical activities include identifying opportunities, validating materials, negotiating terms, and coordinating pick-up, which may be organised by the facility or supplier. Upon arrival, collecting relevant data for compliance, tracking, and business assessment is essential, with each batch assigned a unique reference number for traceability. Initial sorting categorises items by product type, treatment method, and reuse potential.

Materials should be stored by product type and processing stage, with hazardous substances kept in designated safe areas and stored in the relevant properly labelled containments. Batches must be consistently labelled, linking reference numbers to material codes. For outgoing materials, suitable buyers or disposal options must be identified and transportation coordinated, with proper documentation for all reused or processed products.

Documentation can be time-consuming, so developing standard operating procedures and policies helps ensure consistent data collection, regulatory compliance, and efficient inventory management. Software tools can automate tasks and organise data effectively.

4.2.2 E-waste volumes and facility size

The volumes of e-waste processed at SSEFs vary widely, ranging from as little as 6 tons per year in smaller operations to over 400 tons annually in larger ones. Legal compliance and operational costs necessitate a minimum processing volume to achieve financial sustainability – estimated at around 10 tons per month by a South African SSEF. However, the actual viable volume depends on the e-waste composition, as different categories vary significantly in weight and material value. For example, heavier appliances like washing machines help meet tonnage targets faster but typically yield lower profits compared to smaller devices like smartphones. Material recovery values also differ significantly, with metals such as copper fetching much higher prices than plastics. Operational factors such as dismantling complexity, labour costs, rent, and utilities further influence financial viability and economies of scale.

Facility size must align with the minimum e-waste volumes required for financial sustainability, the space needed for treatment processes, and the fixed costs and investment requirements that vary by region, available options, and compliance regulations. SSEFs can range from under 100m² to as large as 2,000m². Alternative models, such as shared processing spaces or associations, can reduce individual space requirements to as little as 15m², enabling smaller operators to operate compliantly by sharing overhead costs.

4.2.3 Tools and equipment

Efficient WEEE processing can benefit from a range of tools and equipment, though pre-processing can also be done with minimal tools. Personal protective equipment (PPE) and adherence to occupational health and safety standards are essential to safeguard workers' health. SSEFs should only accept WEEE types they are equipped to handle safely, especially items requiring specialised treatment, such as mercury-containing lights or refrigerant-based appliances.

Low-tech machinery can improve efficiency, storage, and transport, potentially increasing economic returns. However, before investing in equipment like shredders, facilities must weigh potential drawbacks – such as increased impurities or loss of valuable materials – and ensure local repair and maintenance support. A thorough cost-benefit analysis is critical to justify investment, considering operational and long-term costs.

4.3 Informal sector

The informal sector plays a significant role in WEEE management in South Africa. Most formal organisations involved in the e-waste industry engage with informal workers (such as waster pickers/reclaimers) or businesses to some extent, often by purchasing materials or providing training to improve recycling efficiency and safety. Informal workers are central to waste collection, filling critical gaps in the formal waste management chain. While essential as a feedstock source, the

relationship between formal and informal sectors can be complex and challenging. Organisations must navigate these complexities to ensure responsible and safe e-waste recycling.

Formal organisations have a responsibility to ensure that recycling processes involving the informal sector are conducted safely, ethically, and in compliance with national and international standards. ISO 59014 offers guidelines and requirements for engaging with individuals involved in subsistence work, supporting sustainable and traceable recovery of secondary materials.

4.3.1 Options for engaging with the informal sector

Engagement with the informal sector in South Africa can take on various forms and levels of engagement ranging from mere 'acknowledgement' to 'indirect support', or 'collaboration' up to 'partial or full integration' into the formal business activities, from purchasing e-waste materials to training and compliance collaboration.

- **Purchasing materials:** The informal sector plays a strong role in collecting and aggregating materials. Many recycling companies collaborate with informal workers by establishing formal buying schemes, where materials are delivered directly to recycling facilities. Properly managed, these agreements provide informal workers with reliable market access for their collected e-waste.
- **Training and capacity building:** To enhance the quality and safety of e-waste recycling, formal organisations can offer training programmes covering technical skills like safe dismantling and hazardous material separation, as well as administrative skills such as documentation and regulatory compliance. Since informal micro-entrepreneurs prioritise financial benefits, linking improved practices to monetary incentives can increase participation and impact.
- **Access to equipment and infrastructure:** Some recycling businesses support informal workers by providing access to equipment, such as loaning dismantling tools, or offering safe operating space within facilities, improving processing efficiency and safety.
- **Microfinance and financial support:** To better integrate informal workers into the formal system, organisations can offer microfinancing or partner with microfinance institutions to help workers purchase necessary tools and safety gear. Access to such financial support enables gradual improvements in working conditions and productivity.

Formal organisations have a responsibility to educate informal workers about e-waste risks, provide technical and administrative training, and implement safety measures – such as PPE and safe work environments – to ensure ethical, safe, and compliant recycling.

4.3.2 Considerations and risks

While engaging with the informal sector can yield significant benefits, several challenges and risks need to be considered:

- **Illegal sourcing and criminality:** Valuable products not yet at end-of-life are often stolen, requiring organisations to implement stricter inspections to verify material legitimacy. These precautions increase operational costs and processing time. Some organisations have developed protocols to assess material legitimacy and showing compliance with all relevant aspects as demanded by the Second Hand Goods Act (including capturing ID details of the seller and a temporary storage of a minimum of 28 days before any processing is conducted) are crucial.

- **Intense competition:** Fierce competition exists within the informal sector and between informal and formal sectors, especially in regions where informal processors operate. Informal recyclers may offer higher buying prices by avoiding compliance and safety costs, causing price fluctuations and supply inconsistencies.
- **Non-compliance:** Informal workers may not always adhere to agreements or safety protocols due to lack of understanding or disregard for rules, risking accidents and environmental harm.

4.3.3 Barriers to integration

Despite the clear need and potential benefits of integrating the informal sector into formal e-waste recycling systems, several barriers persist:

- **Lack of incentives:** Many informal workers depend on e-waste collection as their main income and may resist formal agreements that could reduce earnings or impose rules.
- **Training gaps:** Informal workers often lack technical, administrative, and compliance skills needed for formal engagement. They may also undervalue long-term benefits like health and sustainability compared to immediate financial gain.
- **Lack of identification and documentation:** In South Africa, some waste pickers are undocumented and therefore illegally living in South Africa as immigrants. This makes it often impossible from the outset, or (in the case of individuals being South African) still very complicated to draw up formal contracts and reach the required legal levels of compliance around traceability and accountability.
- **Cultural and trust issues:** A culture of self-reliance and informality in the sector creates mistrust toward formal organisations. Building trust requires community engagement, transparency, and mutually beneficial agreements.
- **Regulatory challenges:** South Africa's evolving e-waste regulations lack clear policies and enforcement regarding informal sector integration, complicating compliance and formalisation.

5 Human resource requirements

5.1 Organisational structure and responsibilities

The structure of an SSEF should ensure operational efficiency, regulatory compliance, and business growth. Depending on the facility's size, roles can be combined or further divided. In smaller setups, one person may take on multiple roles. Clear communication and collaboration are essential and the SSEF must uphold good governance in all its operations and avoid any distributions of roles and responsibilities that could cause conflict of interest or open up opportunities for any mismanagement including corruption, etc. Key roles and responsibilities include:

- **CEO/facility manager:** Oversees operations, aligns the team with strategic goals, and drives the vision and mission.
- **Operations manager/training executive:** Manages daily operations, ensures productivity, and implements training on safety and industry standards.
- **Compliance and hazardous waste officer:** Ensures regulatory compliance, manages hazardous waste, audits, and data collection.
- **Procurement and sales officer:** Handles procurement of WEEE, equipment, and manages sales and stakeholder relationships.
- **Finance and admin officer:** Manages budgeting, financial planning, administration, and documentation.
- **Marketing and customer officer:** Promotes services, manages customer relationships and feedback.
- **Operations team:** Conducts dismantling, sorting, and processing of WEEE, following safety and efficiency standards.

5.2 Training and skill requirements

Operating an SSEF requires more than technical know-how. Staff must be trained across technical, operational, financial, compliance, and leadership areas to ensure efficient, safe, and compliant practices.

Inclusive training

Training should also include external stakeholders – such as waste pickers, dismantlers, and transporters – to improve documentation, safety, and collaboration. Their inclusion enhances transparency and traceability across the e-waste value chain.

5.3 Available programmes and opportunities

For existing SSEFs, individuals or groups looking to establish an SSEF, or anyone with an interest in the sector, there are a variety of courses, programs, and opportunities available. Several international platforms offer free online courses that can be completed at an individual's own pace, while universities and technical and vocational education and training (TVET) colleges provide a range of structured training options, which, although not specifically related to WEEE, provide the necessary skills to establish an SSEF. Aspiring founders or those looking to expand their SSEF in South Africa can also benefit from a number of incubator and accelerator programs. Additional support for e-waste entrepreneurs may be available through organisations such as PROs. A list of specific training opportunities, courses, and knowledge platforms that provide a range of offerings are presented in Table 7 (page 22).

Table 6: Types of skills and specific skills requirements for SSEFs

Type of skills	Specific skills requirements
Technical skills	• Safe reception, storage, sorting/classification dismantling, and processing of e-waste including knowledge on the correct downstream treatment requirements for any residuals (typically provided via a third party service provider), for example to fully decontaminate WEEE as required or to provide a final treatment solution in form of legally compliant landfilling or incineration • Identification of hazardous components and reusable items • Use and maintenance of tools and equipment • Classification of material fractions
Safety and environmental compliance	• Handling hazardous substances (e.g., lead, mercury) • PPE usage and workplace safety protocols • Emergency response and first aid • Knowledge of environmental regulations (e.g., Basel Convention)
Reporting and documentation	• Accurate tracking of incoming/outgoing materials • Consistent data collection and compliance reporting • Documentation of training, inspections, and audits
Accounting and financial management	• Budgeting, cost tracking, and revenue monitoring • Tax compliance and proper invoicing • Financial forecasting and reporting
Leadership and management	• Staff coordination and motivation • Risk anticipation and performance monitoring • Strategic planning and stakeholder communication

Table 7: Various skills programme formats and offerings

Format	Type	Specific offering
Independent learning	There are a wealth of online courses and downloadable resources covering topics such as safe dismantling practices, hazardous material handling, circular economy principles, and business management.	The following platforms are leaders in the industry and have a wealth of knowledge available: *WEEE Forum, World Resources Forum, ITU, StEP, SRI, WHO, The Basel Convention, Unitar*
Incubators/ accelerator programmes	Inubators and accelerator programmes provide specialised support for small-scale businesses, including e-waste facilities, offering business development training, mentorship, access to funding, and market linkages to help recyclers scale their operations. Many of these programs, run by NGOs, government agencies, and private sector initiatives, focus on technology adoption, the introduction of circular economy strategies, and sustainable waste management practices. Participants gain access to workshops, networking events, investor connections, and sometimes seed funding in the form of grants or special loans	The following incubators provide support to SSEFs: *SEED Academy, TIA, RaizCorp, The Innovation Hub, Innovate Durban, Black Umbrellas, Fetola, Savant, Rlabs*
Tertiary education	In addition to the usual degree offerings (such as business or environmental mgt.), many universities offer specialised enterprise development programmes or host incubator programmes. These programmes provide valuable skills for SSEF development and even include support in prototype development.	The following universities provide enterprise development and support programmes via specialised centres or incubators: *The University of Johannesburg Technopreneurship Centre, University of Pretoria TuxNovation, Stellenbosch University Launch Lab, UKZN InQubate, Wits University Tshimologong*
PROs	Producer Responsibility Organisations offer technical guidance, compliance support, and financial assistance to SSEFs, helping them to meet EPR regulation related required minimum practices.	The following PROs potentially offer support for e-waste entrepreneurs and recyclers: *eWASA, R2E2, ERA, The Consumer Goods Council of South Africa (CGCSA), Circular Energy*

6 Financial considerations

The Case Study Assessment Report undertaken as Phase 1 of the project provided insight into how SSEFs have managed to raise financing to establish and expand their operations. This section provides a summary of the key financial considerations for SSEFs, specifically related to capital investment and operational costs, revenue streams, and available funding mechanisms.

6.1 Capital and operational costs

Capital costs for SSEFs vary widely and are dependent on the scale of initial operation, the type of facility required, and the type of equipment procured. Many of the SSEFs that were interviewed as part of this research indicated that they began operations with limited initial capital investment. Existing personal assets, such as household premises and vehicles, were leveraged to initiate business activities, which allowed them to avoid having to raise external financing at the start. Many SSEFs also indicated that they used personal savings to purchase initial basic tools and equipment. Thereafter, cash generated from activities such as collection or pre-processing of e-waste allowed them to both scale their operations or raise external funding in order to procure more specialised processing equipment and vehicles and move into formal business premises. A modular type of business growth model is always recommended rather than making large upfront investments.

Managing operational costs, both at the start and while expanding, is considered to be a critical and challenging balancing act for SSEFs. Across a large number of SSEFs that were engaged, the most substantial operational costs were commonly considered to be transport, rental, labour and costs to procure feedstock (where applicable). These factors, but particularly transport costs for South African SSEFs, make it difficult to remain viable. Accordingly, the operational costs identified as important for SSEFs to factor in their business models include:

- Transport costs (of both sourcing feedstock and transporting output fractions)
- Rental costs
- Staff costs, including training
- Feedstock procurement costs (where applicable)
- Equipment maintenance (many SSEFs interviewed identified equipment maintenance as an unforeseen expense)
- Depreciation of assets
- Administration and marketing costs
- Insurance (some SSEFs interviewed identified insurance as an unforeseen expense)

Although not explicitly highlighted by SSEFs, the cost of treatment and disposal of fractions that do not have a market, are hazardous, or are not recyclable, can be a significant cost. E-waste contains various materials, of which only few contain a positive value (as indicated in the next section). Many fractions without an end market, such as certain plastics, glass and other hazardous fractions, often require special treatment before being sent to landfill, or need to be disposed of at a hazardous waste landfill, substantially increasing the cost of recycling activities. To ensure alignment with global good practices, e-waste recyclers need to ensure that all fractions are managed in a compliant manner, avoiding cherry-

picking of valuable fractions only and covering the costs of properly treating or disposing of non-valuable and hazardous fractions. For this to happen, PROs have to play a critical role by directing producer-generated EPR towards the required decontamination activities, rather than just supporting the already existing profits of recyclers processing only value fractions. Hence, there is also a strong recommendation for the DFFE to specify not only collection and recycling targets but also decontamination targets that need to be met.

6.2 Revenue streams

The research has revealed that SSEFs generate revenue primarily through the sale of valuable e-waste fractions and the sale of repaired and refurbished equipment, but also potentially via remuneration for treatment of the non-value fractions from e-waste in the form of EPR levies paid by PROs. As noted above, the very purpose of the levies should be focused on non-value fractions to ensure that proper decontamination and final treatment of the residuals in WEEE recycling are adequately addressed.

Good practices and current market trends show that certain valuable e-waste fractions play a major role in generating revenue for SSEFs. The following fractions contribute significantly to total revenue of SSEFs:

- Printed circuit boards (over half the total value in many cases)
- Processors
- Iron and steel
- Copper
- Aluminium

Many SSEFs indicated that although revenue is generated through the sale of e-waste fractions, this alone is often not sufficient to ensure that they remain viable. Valuable fractions are based on global market prices and are always fluctuating. A lack of markets for some fractions can make this even more difficult. In addition, substantial volumes are required to ensure that the value that is generated from e-waste can cover all other operational costs, such as transport, rental and labour. Depending on the type of e-waste processed, this can be even more challenging, as the cost of treatment and disposal of non-valuable and hazardous fractions can often outweigh the revenues generated from the sale of valuable fractions. As such, most SSEFs noted that diversification of revenue streams is critical for their success. The most common approach to diversify revenue is through repair and refurbishment. This, however, is also dependent on the ability to access sufficient and repairable e-waste feedstock.

An additional consideration for SSEFs is investment into research and development and new technologies. This can assist to mitigate some of the above challenges (such as a lack of markets) and to generate additional value through further processing. This will however require further capital investment, and may require additional skills, increased insurance and higher operational costs.

6.3 Available funding and support mechanisms

Most SSEFs leverage personal finances and assets to assist kickstart their operations. However, if limited personal investment is available, or an SSEF wants to raise additional finances to procure more equipment and/or scale up opera-

tions, this would require accessing funding through external sources. The most common types of funding mechanisms are:

- Loans via commercial banks or development finance institutions
- Grants via donor funding, government programmes, or other related institutions
- Incentives via government programmes
- Financial and non-financial support via incubator and accelerator programmes

In the SRI publication titled *'Mapping of WEEE Incentives in South Africa'*, the financial and non-financial support mechanisms that are available and have some level of applicability to e-waste businesses are presented. Within this report, incentives, accelerators, incubators and related support programmes that are available through government, private sector and NPOs, tertiary education institutions, and international organisations are identified. These mechanisms include financial, technical, and training support. Some of the key considerations that are relevant to SSEFs are:

- It is important to demonstrate that the facility aligns with the social, environmental, developmental or economic goals and requirements of the funding institution. Some institutions for example provide support programmes targeted at specific groups such as previously disadvantaged people, women, youth, persons with disabilities, or community-based enterprises.

- The type of support extends beyond financial incentives, and includes support from training, mentorship, network development, infrastructure and technical assistance. Some programmes offer a full suite, while others have a specific focus. For an SSEF, it is important to ensure alignment with the type of programme that best matches the specific context and its needs.

7 PESTEL analysis

A PESTEL analysis is presented in this section in order to collate all the information that has been presented in this report. The PESTEL analysis presents political, economic (and financial), social, technical, environmental and legal, policy and compliance considerations for SSEFs.

POLITICAL CONSIDERATIONS

- Political and regulatory instability (e.g., protests, tariff changes, and competition in the PRO sector) can disrupt operations and market access for e-waste businesses.
- Corruption and unequal access to support undermine trust in procurement processes and disadvantage small-scale facilities.
- Lack of political awareness about the long-term benefits of proper WEEE management results in limited policy support.

ECONOMIC AND FINANCIAL CONSIDERATIONS

- Key expenses for SSFEs include rent, salaries, transport, safe disposal, and compliance costs. The latter two, in particular, place SSFEs at a disadvantage compared to informal micro-entrepreneurs.
- Low barriers to market entry further add to high competition.
- Fluctuating prices of e-waste materials affect financial sustainability.
- Processing e-waste is often unprofitable for SSFEs due to high technical and scale-related costs, despite containing precious metals.

SOCIAL CONSIDERATIONS

- Illegal dumping or burning is wide-spread in many low-income areas in South Africa that lack proper waste management services.
- Labour laws and unionisation of workers, can create challenges to operate SSEFs efficiently.
- Rapid technological advancement and consumerism are driving e-waste growth.
- High crime and substance abuse in the informal sector render integration efforts challenging.

TECHNICAL CONSIDERATIONS

- Available labour is often unskilled and requires significant training.
- Handling less than 10 t of e-waste per month is considered unsustainable in South Africa.
- Access to material, market knowledge and location are critical success factors.
- Optimised space utilisation and clear structured operating processes, data collection and reporting requirements can support overall work flow.
- The lack of access to necessary spare parts can hinder the ability to undertake repair and refurbishment activities.

ENVIRONMENTAL CONSIDERATIONS

- Environmentally sound e-waste management prevents harmful emissions and contamination, along with their associated negative impacts on health and the environment.
- Recovering functions (reuse) or materials (recycling) reduces landfill use and decreases the demand for primary raw materials, thereby limiting the environmental harm caused by resource extraction.
- Depollution is a critical step in e-waste treatment, essential for preventing the release and spread of hazardous substances and minimizing associated health and environmental risks.

LEGAL, POLICY AND COMPLIANCE CONSIDERATIONS

- The legal framework for e-waste recycling is often complex, with overlapping regulations and numerous licensing requirements.
- Ambiguity around key legal terms can lead to misinterpretation and compliance challenges.
- Navigating the various licensing processes can be costly and time-consuming, posing significant barriers for small-scale e-waste facilities (SSEFs).

8 Recommendations

Based on the findings presented in this report, a range of recommendations for SSEFs are provided below.

1. Diversification is key to economic success. It is recommended to diversify collection mechanisms to mitigate risks. Similarly, revenue sources can be diversified by incorporating repair, refurbishment, potential research work or even the production of new products. Finally, identifying multiple off-take markets is essential for ensuring profitability.

2. A small-scale approach is recommended initially. Focusing on manual dismantling increases the likelihood of compliance, as it is often less complex and requires a lower initial investment compared to other recycling activities. As expertise and networks grow, operations can be scaled incrementally.

3. Identifying a suitable location at an early stage can help avoid the need for relocation once operations expand. It is recommended to look for a location within the required industrial zoning. Well-planned facility layouts that optimise space and account for e-waste flow and fraction storage can enhance overall operational efficiency.

4. An understanding of existing policies and their operational implications is essential. Awareness of legislative requirements and efforts to ensure compliance are important, particularly given the time and resources involved in obtaining and renewing licences and permits.

5. Produce clear and easy-to-understand communications regarding rules and requirements to help reduce confusion and enhance compliance by providing consistent and easily accessible information to employees.

6. Establishing clear data management processes can support transparency, operational efficiency, informed decision-making and ensure operational oversight.

7. Operational efficiency can be supported by building a capable team, establishing clear safety and compliance protocols, implementing robust systems, and appointing dedicated management personnel.

8. Environmental benefits generated from activities can be used to leverage economic value when seeking external funding or as part of a marketing strategy.

9. Waste picker integration is a core component in a successful SSEF. To create successful formal-informal partnerships it is important to engage with local civil society organisations, such as the South African Waste Pickers Association (SWAPA) and the African Reclaimers Organisation (ARO), in order to identify opportunities for how waste pickers can be integrated into the value chain.

10. Establishing a code of ethics that emphasises anti-corruption, environmental responsibility, adherence to best practices for WEEE management, and collaboration with the informal sector can enhance credibility to external stakeholders and foster a positive work culture.

11. Participation in training courses, educational programmes or startup initiatives can be valuable for building capacity, developing skills and expanding networks.

12. Engagement with government is recommended to encourage them to:

a) Simplify administrative procedures which might make it easier for SSEFs, especially smaller ones, to navigate regulatory requirements and focus on operations.

b) Support SSEFs in achieving compliance which could be essential in promoting sector-wide sustainability and fostering growth and business development in the sector.

c) Support with paperwork and regulatory processes which would help ensure that facilities can meet compliance standards without undue administrative challenges.

d) Explore methods to release government stockpiles of e-waste which could support SSEFs in accessing e-waste.

e) Encourage implementation and enforcement of existing rules which would contribute to fair market conditions, reduce competition from the informal sector and improve environmental outcomes.

f) Educate the public on e-waste management and the importance of recycling which could help reduce stockpiling and encourage more responsible disposal practices.

g) Raise awareness about the standard practice of data sanitisation which may reassure individuals about data security, encouraging the disposal of old devices.

13. Engagement with PROs is recommended to encourage them to:

a) Advocate on behalf of SSEFs for clearer and simplified e-waste legislation and regulations to help reduce compliance costs.

b) Advocate on behalf of SSEFs for tax incentives that could lead to valuable support for the e-waste sector, promoting growth and sustainability.

c) Collaborate with policymakers to adjust grant conditions to improve their accessibility and feasibility for organisations in the e-waste industry.

d) Pressure producers to assume greater responsibility for the end-of-life of their products, such as designing items that are easier to dismantle, repair, and reuse, which could enhance sustainability in e-waste management.

Bibliography

CSIR. (2016). Integrating the Informal Sector Into the South African Waste and Recycling Economy in the Context of Extended Producer Responsibility. Council for Scientific and Industrial Research. Retrieved 2025, from *https://www.csir.co.za/sites/default/files/Documents/Policy%20Brief_Informal%20Sector_CSIR%20final.pdf*

DEA, List of waste management activities that have, or are likely to have, a detrimental effect on the environment, GN 921 of 29 November 2013. Republic of South Africa

DEA, National Environmental Management Act No. 107 of 1998

DEA, National Environmental Management: Waste Act. Republic of South Africa, 2008. doi: 102GOU/B

DEA, National norms and standards for the storage of waste, GN 926 of 29 November 2013. Republic of South Africa

DEA, National Waste Information Regulations. 2012

DEA, Waste Classification and Management Regulations, GNR.634 of 23 August 2013. Republic of South Africa

DEA. (2015). Electronic Waste Recycling: A viable business. Department of Agriculture and Environmental Affairs.

DEFF, "Extended Producer Responsibility Scheme for the Electrical and Electronic Equipment Sector," Pretoria, 2020.

DEFF, Regulations regarding Extended Producer Responsibility, vol. GG 43879, no. GN 1184. Republic of South Africa, 2020. [Online]. Available: *http://www.greengazette.co.za/pages/national-gazette-37230-of-17-january-2014-vol-583_20140117-GGN-37230-003*

National Constitutional Assembly, Constitution of the Republic of South Africa, 1996. Republic of South Africa, pp. 545-. doi: 10.5771/0506-7286-1994-4-545

Schoeman, D. C., & Ramutanda, D. M. (2022). Waste Pickers and E-Waste: A Case Study in the Greater Johannesburg Area. Geography, Environmental Management & Energy Studies. Retrieved 2024, from *https://wasteroadmap.co.za/wp-content/uploads/2023/01/38-UJ_Final-Conference_WasteCon-Schoeman-Ramutanda.pdf*

UNITAR. (2024). The Global E-Waste Monitor 2024. Retrieved 2025, from *https://ewastemonitor.info/the-global-e-waste-monitor-2024/*

SRI SUSTAINABLE RECYCLING INDUSTRIES

sustainable-recycling.org

Turning waste into resources for development

SRI builds capacity for sustainable recycling in developing countries. The programme is funded by the Swiss State Secretariat for Economic Affairs (SECO) and is implemented by the Institute for Materials Science & Technology (Empa) and the World Resources Forum (WRF). It builds on the success of implementing e-waste recycling systems together with various developing countries for more than ten years.