



AfricaMaVal

Coordination and Support Action (CSA)

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Project fact sheets and flow analyses outlining African ECRM value chain projects-Template

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Acquisition of reliable data on the ECRM value chain, active ECRM recycling projects, ESG performance of the ECRM value chain stakeholders. A workshop with BGR/Levin Sources to align on the approach towards ASSM value chains. An additional workshop to consider inclusive recycling of secondary RM in the informal sector.

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Horizon Europe Framework Programme (HORIZON)

Deliverables 2.1

Project fact sheets and flow analyses templates

Task 2.1

Gather information source grid and acquisition time

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Abbreviations and Acronyms

Acronym	Description
ASM	Artisanal and Small-scale mining
DEFF	Department of Environment, Forestry and Fisheries, South Africa
ECRM	Extended Critical Raw Minerals
ESG	Environmental, Social and Governance
EU	European Union
KZN	Kwa-Zulu Natal, a province of South Africa
MVCA	Mineral Value Chain Activity
RDI	Research, Development and Innovation
WP	Work Package
WRFA	World Resource Forum Association

Executive Summary

Access to critical mineral resources has become a crucial strategic question for Europe's ambition to deliver and operationalize the Green Deal and the twin transition. Future demand for primary critical raw materials will continue to be largely met by imports. The EU needs to engage in strategic partnerships with resources-rich third countries, such as African countries, covering extraction, processing, and refining, where the EU can help to develop sustainable mineral resource value-chains in a co-development perspective.

The ECRM value chain analysis forms the backbone of the AfricaMaVal project. Task 2.1 has been undertaken by DMT Kai Batla, DMT GmbH & Co. KG and contributors, Levin Sources and World Resources Forum Association (WRFA), and aims to aggregate reliable data on primary and secondary ECRM value chains for the subsequent identification of related opportunities.

The specific actions conducted during Task 2.1 are:

- An information collection sheet was developed initially for the aggregation of qualitative and quantitative facts concerning potential industrial size ECRM projects. The sheet was amended with ESG items by DMT GmbH & Co KG and extended by WRFA to include recycling projects. Currently it is also used to receive input on artisanal small-scale mining (ASM) by Levin Resources.
- A data acquisition source grid was established and data about 262 projects are already aggregated initially from the countries of DRC, South Africa, Zimbabwe, Namibia, Mozambique, Tanzania, Madagascar, Senegal, Gabon, Morocco. It is understood that the scope is all of Africa and more countries will be included in subsequent rounds of investigation.
- A workshop between Levin Sources and DMT was planned for mid-December 2022. However, there was an undisclosed delay in the funding of Levin Sources that resulted in a delay in their ability to commence work on this work package. Nevertheless, a meeting was held to discuss this workshop and an initial workshop is planned on the 14th of December 2022.
- A workshop by WRFA was held broadening our knowledge in the topics of mining waste as a secondary source of ECRMs, recovering valuable materials from electronics, cars, and batteries as well as the informal and inclusive recycling sector.
- An ESG literature review was conducted to provide the proper criteria for the next stages.

As contained in the grant agreement and the inception report the team prepared the following deliverable under Task 2.1:

- An information collection sheet (project fact sheet) for the aggregation of data



- A value chain flowsheet (flowsheet template) as base for the following infrastructure ECRM value chain analysis

Significant statistical key results per country and ECRM commodity are contained in the respective sections of the current report, with the conclusion section indicating current challenges and the way ahead.

Keywords

Information collection sheet, value chain flowsheet, data acquisition, ESG, ASM workshop, Recycling workshop.



1. Introduction and Scope

Access to critical mineral resources has become a crucial strategic question for Europe's ambition to deliver and operationalize the Green Deal and the twin transition. Future demand for primary critical raw materials will continue to be largely met by imports. The EU needs to engage in strategic partnerships with resources-rich third countries such as with African countries covering extraction, processing, and refining, where the EU can help to develop sustainable mineral resource value-chains in a co-development perspective.

The ECRM value chain analysis forms the backbone of the AfricaMaVal project. Task 2.1, which has been undertaken by DMT Kai Batla, DMT GmbH & Co. KG and contributor, Levin Sources and WRFA, aims to compile reliable data on primary and secondary ECRM value chains for the subsequent identification of related opportunities. This includes the acquisition, characterization, and assessment of information on relevant opportunities including the identification of active ECRM recycling projects. This will be achieved by screening existing databases as well as the acquisition of additional information where necessary. The team utilized data from public domain sources, internal project databases (Appendix A), information generated by the partners in the other work packages and survey data acquired directly from the ECRM stakeholders. Concerning the latter, the project will employ only anonymized information, which is voluntarily disclosed from the stakeholders to the public.

Additionally, Task 2.1 includes a literature review with a focus on environmental, social and governance (ESG) performance of ECRM value chain stakeholders (required for Task 2.2). Finally, the DMT Kai Batla and DMT GmbH & Co. KG will lead a workshop with Levin Sources to ASM properly and align on the approach towards ASM value chains. WRFA organized an internal workshop with all the project partners to define the scope of secondary raw materials and recycling ECRM value chains on 14 November 2022.

1.1. Relation to other activities

The following WP is particularly interrelated with the work of Task 2.1: WP7 to coordinate the focus of data acquisition, assessment and methodology for next steps. WP 2 (Infrastructure) supports WP 7 (Investment and ESG) in achieving the respective **KPI 1.2 "10 Factsheets outlining EU-African ECRM value chain projects for each of the ten country case studies according to specific MVCA and recycling value."**



2. Methodology

Start date: M1 (June 2022) End date: M6 (November 2022)

Task Leaders: Nikolaos Christou, Lukas Förster (DMT GmbH & Co. KG), Sodhie Naicker, Hudson Mtegha, Herman Cornelissen (DMT Kai Batla)

Contributors: Rosanna Tufo (Levin Sources), Mathias Schlupep, Robin Gilli, Shahrzad Manoochehri (WRFA)

The scope of task 2.1 has already been introduced in chapter 1. For that purpose, an information collection sheet in the form of a checklist was compiled, reflecting indirectly the quantitative and qualitative screening criteria for the ECRM value chains.

Further to the identification of primary ECRM value chains, the aggregated data attempts to target the identification of active ECRM recycling projects and opportunities, considering the inclusion of the informal sector. A respective workshop on inclusive recycling and the overall sector was conducted by the World Resources Forum (WRFA), discussing the requirements and approaches for inclusive recycling, indicating where shared values are created for all actors in the waste management cycle, and covering the needs for the integration of the informal sector in the secondary ECRM value chains. A second workshop, shortly due by Levin Resources will determine the characteristics of the ASM sector for a proper alignment of our approach towards ASM value chains.

As a last step of the current task, a literature review with a focus on ESG performance of ECRM value chain stakeholders (required for Task 2.2) was conducted.

Task 2.1 is carried out in the framework of **Objective 1.2. “Identify, assess and quantify opportunities and formulate recommendations”** and is a preparatory step for **KPI 1.2 “10 Factsheets outlining EU-African ECRM value chain projects for each of the ten country case studies according to specific MVCA and recycling value.”**



3. Actions

The following actions (Table 1) were conducted during Task 2.1 as defined in the Inception report of deliverable D9.1.

Action	Item	Completion Date	% Completion
1	Development of an information collection sheet to analyse identified ECRM projects	22 September 2022	100%
2	Screening of existing databases, additional information acquisition and compilation of reliable data on ECRM value chain projects	20 November 2022	100% <i>(Work continues in WP 2.2)</i>
3	Workshop with Levin Sources to adapt the information collection sheet for ASM and to identify potential ASM projects	Mid of December	100 %
4 (a.)	Adopt the information collection sheet for secondary raw materials value chain projects by WRFA	5 September 2022	100%
4 (b.)	Identify related recycling projects and opportunities	8 Nov 2022	10% (Work – continues in Task 2.2)
4 (c.)	Prepare for and organize an internal online workshop on the scope of value chains for secondary raw materials and inclusive recycling	14 November 2022	100%
4 (d.)	Literature review of ESG performance		100%

Table 1. List of actions undertaken for WP 2 Task 2.1.

3.1. Action 1: Information collection sheet development

Quantitative criteria include facts like the project name, locations, main commodity, by products, capacities, perspectives, infrastructure, ownership, financial factors, etc. Qualitative criteria will comprise the maturity level of each examined ECRM value chain project, the expected growth potential, compliance issues, ESG performance etc. For a targeted gathering of information, the information collection sheet was distributed to all respective partners for revision and amendments.

The information collection sheet includes fields for recording information about the mineral deposit, the geology and known resource and the location of the project. Additionally, it records the ownership structure of the project and an indication of the placement of the particular project output in the mineral value chain. Another major section of the project information sheet relates to the constraints to development and opportunities for improved

production identified by the project owner. The project information sheet also contains several questions related to ESG awareness of the project owner on management level. These are based on the CERA 4in1 standard, EU principles as well as legal regulations and, in early discussion with the other project partners, was agreed to only constitute a check or gauge of awareness at this project phase. The ESG compliance awareness, though critical for future parts of the AfricaMaVal project, does not constitute a full ESG audit in this project phase.

The project information sheet (Appendix B) that was developed, was refined through several rounds of comments from project partners. In the process, the sheet went through four iterations and a final version was agreed (Version 5) on 22 September 2022. The most significant changes related to ethics declarations that are included in the final versions of the information sheet to ensure that project owners agree to voluntary disclosure of their data and to participate in the project (project participants).

3.2. Action 2: Screening, additional acquisition and compilation of data

The second action of this work package was the information acquisition source grid – a roadmap of where the information required for the next phases of the project would be sourced and how the information would be obtained. All these sources are either open source or open access. Our initial information grid table is contained in Appendix A.

Initially, team members were assigned various commodities to collate project information on across the range of ECRM commodities found in Africa. The initial list of countries was used that included Namibia, South Africa, Mozambique, Senegal, Gabon, Zimbabwe, Democratic Republic of Congo, Tanzania, Madagascar, and Morocco. This process will continue with the other countries across Africa in the course of the project. This strategy was re-evaluated, and the project team members were assigned countries rather than commodities in the later months of WP 2.1. The team used existing databases to compile a final list with the name, location, and commodity of interest of all relevant ECRM raw material projects in these countries. Projects will be assessed within the next WP 2 tasks at the hand of the information sheets developed in WP 2.1, based on their investment potential and likely need for support to address value chain bottlenecks. A list of all the projects highlighted to this end has been compiled and is attached to this document (Appendix C).

3.3. Action 3: Workshop with Levin Sources on ASM

As the ASM sector plays an essential part in Africa, the workshop with Levin Sources shall ensure a proper consideration of ASM in identification and assessment of ECRM mineral value chains. Therefore, three different workshops are planned to identify potential ASM projects that may be added to the value chain flowsheets of CRM. By considering the ASM projects in the work of WP 2, the European Union can further diversify and strengthen resilient supply chains. The first workshop between Levin Sources and DMT was planned for mid-December 2022. However, there was an undisclosed delay in the funding of Levin Sources that resulted



in a delay in their ability to commence work on this task. Nevertheless, a meeting was held to discuss this workshop and an initial workshop is planned on the 14th of December 2022 for two hours covering the following agenda.

Workshop objectives:

- Develop a common understanding of the ASM sector and its main characteristics
- Reflect on value chain analysis for the ASM sector and how the methodology might differ from value chain analysis of LSM
- Share initial insights on countries producing ERCM and highlight questions which need to be addressed in further stages of the project

Workshop content

- Introduction to ASM (focus on the Africa context)
 - Facts and figures (including an initial overview of ASM opportunities)
 - Major characteristics of the sector
 - Legal frameworks and legitimacy
- Value chain analysis of the ASM sector: Levin Sources experience
 - Define major aspects to adapt the information collection sheet for assessing potential ASM projects for EU
- Compliance with environmental, social and governance standards
 - Standards applicable to the ASM sector
 - Typical environmental, social and governance impacts of the ASM sector
 - Known learnings from existing initiatives and Levin Sources work
- ASM and the extended critical raw materials
 - What we know
 - What we do not know
- Questions, discussion and next steps (taking into account DMT's expectations and Levin Sources available level of effort)

3.4. Action 4 (a.): Adoption of information collection sheet by WRFA

The information collection sheet developed in Action 1 of Task 2.1, was specifically designed to compile data on primary mining projects. While the criteria included in this information



collection sheet could be used for mapping projects related to mining waste, it was crucial to adopt these criteria for other types of secondary ECRMs value chains, such as the materials recovered from electrical and electronic equipment (WEEE). For adopting the information collection sheet, the following points were taken into considerations:

- WEEE recycling activities are performed by individual 'companies'. As such, the criteria are adopted to assess a 'company' rather than a 'project'
- The type and amount of input materials for a recycling company are two key indicators crucial for assessment of the performance of a recycling company.
- Despite commonalities, the type of ESG indicators and the risk mitigation measures can be different from primary mining projects.

The adopted information collection sheet is provided in Appendix B. This will be considered a draft version, in order to initiate the mapping process. Depending on the learnings, this draft might be revised to cover the essential criteria relevant for identifying investment opportunities.

3.5. Action 4 (b.): Identify active ECRM recycling projects

A component of the work package 2.1 was also the identification of active recycling projects (Figure 1). This work is planned to proceed into WP 2.2 as project information is collected and more such projects are identified. Several recycling projects have been identified while undertaking WP 2.1, mostly based in South Africa. The same process was used to identify these projects as the primary resources.

A total of 28 recycling companies were found mostly in South Africa, but also in DRC and Zambia. This task is a work in progress and, as such, was heavily skewed towards South Africa, where most information is available. More countries will be included as the work progresses. Most of these are clustered around metropolitan centres, i.e. Cape Town, Johannesburg, Pretoria and Germiston. Individual recycling plants also operate in Mpumalanga and one in Kwa-Zulu Natal (KZN). Most are small-scale and localized, and the SA Metal Group represents the biggest network of metal recycling with multiple divisions (SA Steelworks, SA Copperworks) in Cape Town and Johannesburg.

Copper and steel represent the most widely processed metals in South Africa. Aluminium follows closely behind. Recycled PGMs (specifically platinum, rhodium and palladium) come from catalytic converters. Most companies list steel as a metal they process. However, there is a lack of information in distinguishing the type of steel received and sold. Information is sparse and many companies do not have publicly available information. Of the identified ECRMs, copper is the most widely recycled in South Africa, although tungsten, aluminium, tin, nickel, platinum, palladium, rhodium are all recycled in South Africa. Most of the battery recycling in South Africa is still centred around lead acid batteries, where the lead is main recovered material. As of 2021 there were no facilities in Africa for the recycling of lithium-



ion batteries [1]. This is true despite an estimated 6 tons - 10 tons of LIB waste having been collected in 2019. In South Africa, the 2021 DEFF ban on landfilling lithium-ion batteries may be a catalyst for investment in such facilities [1]. PGMs make up most tailings that are reprocessed for primary mineral extraction. A total of 10 tailings retreatment facilities were found across South Africa (7), DRC (1) and Zambia (2).

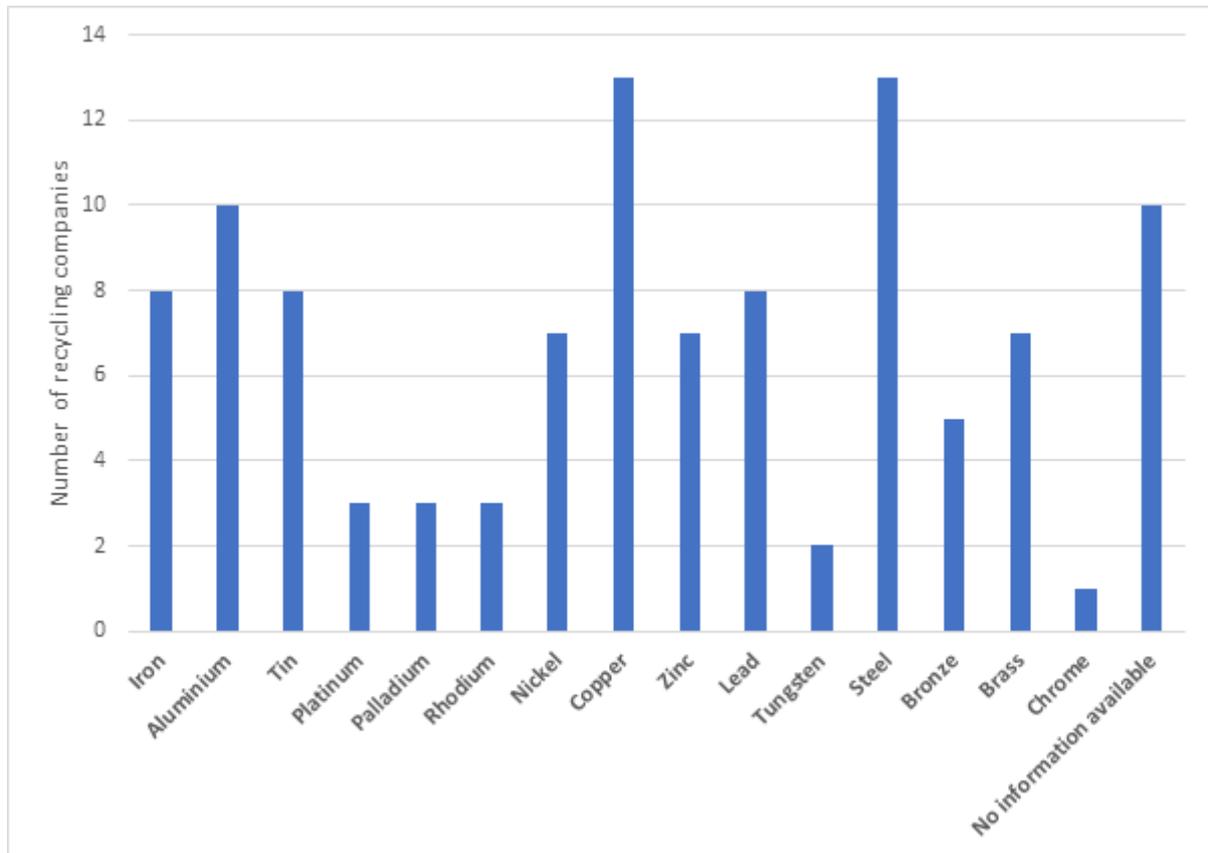


Figure 1 Number of recycling projects identified during WP 2.1 by commodity in South Africa, DRC and Zambia so far, up to November 2022.

It is considered that this is a preliminary list of recycling and reprocessing facilities that will continue to be developed as WP 2.2 continues.

3.6.1. Identify related recycling projects and opportunities by WRFA

Based on the scope defined, a preliminary mapping of relevant projects related to mining waste re-processing as well as recycling companies was conducted. This is an ongoing task to be completed by the end of June 2023. A selection of identified projects and companies are listed in Table 2.

#	Project/ Company name	Type of waste	Step in the value chain (for e-waste recycling)	Type of materials recovered	Operations location
1	DRD Gold	Waste rock and tailings		Au	Weltevredenpark, near Johannesburg
2	ERG Africa	Waste tailings		Cu, Co	Metalkol Roan Tailings Reclamation (RTR), Kolwezi area, DRC
3	Jubilee Metals Group	Waste tailings		PGM, Cr	Inyoni PGM Project, Brits, South Africa
	Jubilee Metals Group	Waste tailings		Co, Cu (soon Pb, Zn, V)	Kawbe, Kitwe, Zambia
4	Enviroserve Rwanda Green Park	E-waste	Collection, pre-processing		Rwanda
5	Reclite SA	E-waste	Collection, pre-processing and end- processing	Phosphor Powder	South Africa

Table 2 Mining waste re-processing as well as recycling projects and companies.

3.6. Action 4 (c.): Workshop on secondary raw materials and inclusive recycling

The workshop was organized as an online event on 14 November 2022, 9:00-11:00 CET, with 24 participants from project's consortium partners.

An important aspect of the value chain of current extended critical raw materials (ECRM) includes obtaining resources from secondary sources, such as from the recycling of waste electrical and electronic equipment (WEEE or e-Wastes), end-of-life vehicles (ELV), batteries, and other scrap metals. Globally and in Africa, there exists also a potential for the utilization of mining waste as a secondary source of ECRMs. In addition, an important aspect to the recycling value chains, especially in the African context, are the informal or artisanal workers, who actively collect waste to earn a wage, but do not receive any social protections. These workers make up what is thus known as the informal sector of the recycling value chain. Their work is slowly being recognized as invaluable for recycling in Africa and abroad. This workshop thus focused on the dissemination of information to project partners, as to how the recycling value chains function, defining the various aspects of recycling of these secondary sources, including the challenges of waste recycling, and provided a special focus on how the inclusion of the informal sector could further help benefit the extensive number of Africans working in this field.

To achieve the above-mentioned objectives, the workshop included the agenda in Table 3.



#	Timing	Topic	Speaker
1	09H00-09H10	Welcome and introduction	Shahrzad Manoochehri (WRFA)
2	09H10-09H35	Presentation: <i>Re-processing Mining Waste - Rethinking the “status quo” of mining waste management</i> Discussion and Q&A	Robin S. Gilli (WRFA)
3	09H35-10H20	Presentation: <i>Recovering valuable material from waste - The case of electronics, cars and batteries</i> Discussion and Q&A	Adrien Specker (WRFA) Herman Cornelissen (DMT)
4	10H20-10H55	Presentation: <i>Informal sector in secondary raw materials value chains – Importance of inclusive recycling</i> Discussion and Q&A	Sonia Valdivia (WRFA)
5	10H55-11H00	Wrap up and closing	Shahrzad Manoochehri

Table 3 Agenda of the recycling workshop.

A short summary of each content session is provided below, and the related presentation is attached to this report.

3.6.1. Session 1: Re-processing Mining Waste - Re-Thinking the “status quo” of Waste Management

In the presentation given by Dr. Robin Gilli of the World Resources Forum Association (WRFA), the topics of mining waste as a secondary source of ECRMs was introduced. Here the objectives were to explain how historic mining wastes are currently being re-examined for economically viable concentrations of valuable ECRMs, define what exactly means to reuse, recycle and reprocess mining waste, to clarify the various types of mining waste where ECRMs may be found, show estimates as to the volumes of waste and the concentrations of some ECRMs, and to show preliminary results of companies that have been identified, that are currently recycling mine wastes in Africa.

3.6.2. Session 2: Recovering valuable materials from waste - The case of electronics, cars and batteries

In the presentation given by Mr. Adrien Specker of the WRFA the characteristics of key types of household wastes that are important for ECRMs recycling were explained. These include electronic and electrical waste, end of life vehicles (ELVs) and batteries. He presented different categories of these waste streams and highlighted that these are sources of various ECRMs, such as manganese, nickel, copper, indium, tin, antimony, cobalt and lithium. The three main steps of the recycling value chains, including collection, pre-processing and end-processing, in the African context were explained and the challenges and opportunities associated with the recycling process were highlighted. Even though the value chain for the recovery of secondary raw materials is somewhat developing in some African countries, there

is still a lot of investments to be made, especially to making the entire process more efficient and more valuable. Investing in mining of these wastes have the huge benefit of being a regenerative investment, in the sense that the materials can be recovered several times.

Complementary to this discussion, Mr. Herman Cornelissen from DMT KB, presented the preliminary result of mapping of the scrap metal and battery recycling companies in South Africa. The results show that copper and steel represent the most widely processed metals in the country, where aluminium follows closely behind. Majority of battery recycling in South Africa is still centred around lead acid batteries, where the lead is primary recovered material. As of 2021, there were no facilities for the recycling of lithium-ion batteries in South Africa and on the African continent [1]. It was highlighted that these preliminary results will continue and be updated in the coming months of the project.

3.6.3. Session 4: Informal Sector – Inclusive Recycling

In the presentation given by Dr. Sonia Valdivia from WRFA, the definition of key terms such as ‘informal sector’ and ‘subsistence activities’ were explained and the importance of these activities as well as the associated, key social and environmental challenges were highlighted. It was mentioned that inclusive recycling is about increasing the transparency and efficiency by recognizing the individuals in subsistence activities, contributing to recycling as an essential link in the chain of value creation. Only then will the recyclers’ labour and human rights be respected, and steps taken to provide fair pay for their services. Lessons learned from good examples, such as the International Waste Pickers Alliance, the technical guidelines on environmentally sound e-waste management developed in 2018 in Ghana and the ISO IWA document on sustainable and inclusive recycling in subsistence activities, can be used to identify opportunities for the AfricaMaVal project.

3.7. Action 4 (d.): Literature review of ESG performance

In the initial phases of the work package, when the project information sheets were compiled, it was considered prudent to include an assessment of the ESG performance of each project as well. It was obvious that not all projects would be compliant with the latest ESG performance indicators, or some smaller operators or project participants may not be compliant at all. However, the need for sound ESG performance to successfully participate in EU markets was acknowledged. For this reason, the intention of the project team was to, at least, get an indication of the status of ESG performance and awareness of each project participant. A list of basic ESG questions was therefore included in the project information sheets for completion by project participants (Table 4). The purpose of this ESG questionnaire is to determine the level of awareness and compliance, without conducting a full audit of ESG performance. In later stages, these ESG performance can be used to develop recommendations for improvement.

ESG indicators (From question 9 h)
<i>For each item, indicate if the operation has this or not, and record details as appropriate</i>
Air quality management plan (<i>Dust, GHG</i>)
Waste management plan (<i>slurries, dump sites</i>)
Surface water / groundwater management plan (<i>contamination, treatment, reuse</i>)
Mine water / sump management plan (<i>contamination, treatment, reuse</i>)
Noise & vibration management plan
Non-destructive exploitation plan
Management plan for energy and material consumption
Biodiversity management plan (<i>ecosystem, protected areas, species, vegetation clearance</i>)
Mine closure plan (<i>land reclamation, decommissioning, remediation</i>)
Workplace management plan (<i>imbalance, discrimination, inequalities</i>)
Social management plan (<i>inclusion of vulnerable groups, indigenous people, human right / land defenders, social-cultural understanding / heritages; community development projects (water, infrastructure, hygiene, medical care, emergency, education), community involvement; poverty, hunger, thirst, housing</i>)
Land use management plan (<i>acquisition, forced relocation</i>)
Management plan for high-risk areas (<i>child labour, education, forced labour</i>)
Human & Resource management plan (<i>bargaining, unions, grievance, remuneration, contracts, benefits, training, working hours and conditions</i>)
OHS management plan (<i>risk and safety management plan, PPE, hazardous work, training, rehabilitation facilities, hazardous substances / work / conditions</i>)
Emergency response plan (<i>medical preparedness and care, infrastructure plan (lightning, communication)</i>)
Construction and Maintenance management plan (<i>tailing dams, equipment, geological / (rock) mechanical failures</i>)
Safety and Security management plan (<i>infrastructure plan (traffic), e.g. security plan, training for security personnel</i>)
Business Integrity Plan (<i>anti-corruption and bribery, criminal machination (revenues & payments), ownership and management structures), illegal mining activities</i>)
Stakeholder management plan (<i>consultation, engagement, grievance mechanism, disclosure</i>)
Supplier management plan (<i>social impact (abusive practices, financial flows, site security, poverty, health problems, forced relocation, working contracts & conditions, accommodation, environmental impact (biodiversity), high risk areas (financial flows, violent conditions, child labour, forced labour)</i>)
Literature:
<ul style="list-style-type: none"> - CERA 4in1 Performance Standard (2019) - German Supply Chain Act (2021) - OECD 5-step management framework (2011) - OECD Due Diligence Guidance (2016) / Conflict-Minerals Regulation 3TG (2017) - EU Taxonomy (2020) - EU principles for sustainable raw materials (2022)

Table 4 List of ESG indicators included in WP 2.1 as initial check of status of ESG awareness on project level.

4. Deliverables

4.1 Fact sheet

An information collection sheet for projects was developed, and the final version was agreed with the project participants for implementation in September 2022. The process of development of the information collection sheet, the content of the sheet, the interaction during the refinement of the sheet and the ESG indicators included are described in Action 4(a) of this report.

4.2 Flowsheet analysis methodology

A key aspect of this phase of the work and the utility of the information gathered for future analyses, is to determine where in the minerals value chain the specific identified project is located. An understanding of the project's place in the minerals value chain will aid future analysis by identifying potential constraints to development. It will also help to identify regional areas where infrastructure or other constraints may hamper development. Additionally, it will identify where a specific project could benefit from development or investment to unlock the constraints that hamper their engagement and full participation in EU markets.

For this purpose, a generic mineral value chain diagram was compiled (Figure 2) with the intention that it will be used once the project information sheets are returned from project participants. A clear understanding of where in the value chain the project is located, will highlight gaps and constraints to development. At a next level of interpretation, this information can also be used to indicate geographic clustering of the project with similar constraints or opportunities. The overall analysis of the collective information about similar projects and similar areas will serve to highlight constraint of a larger regional or national scale, like infrastructure gaps, which hamper mining development or refining capacity.

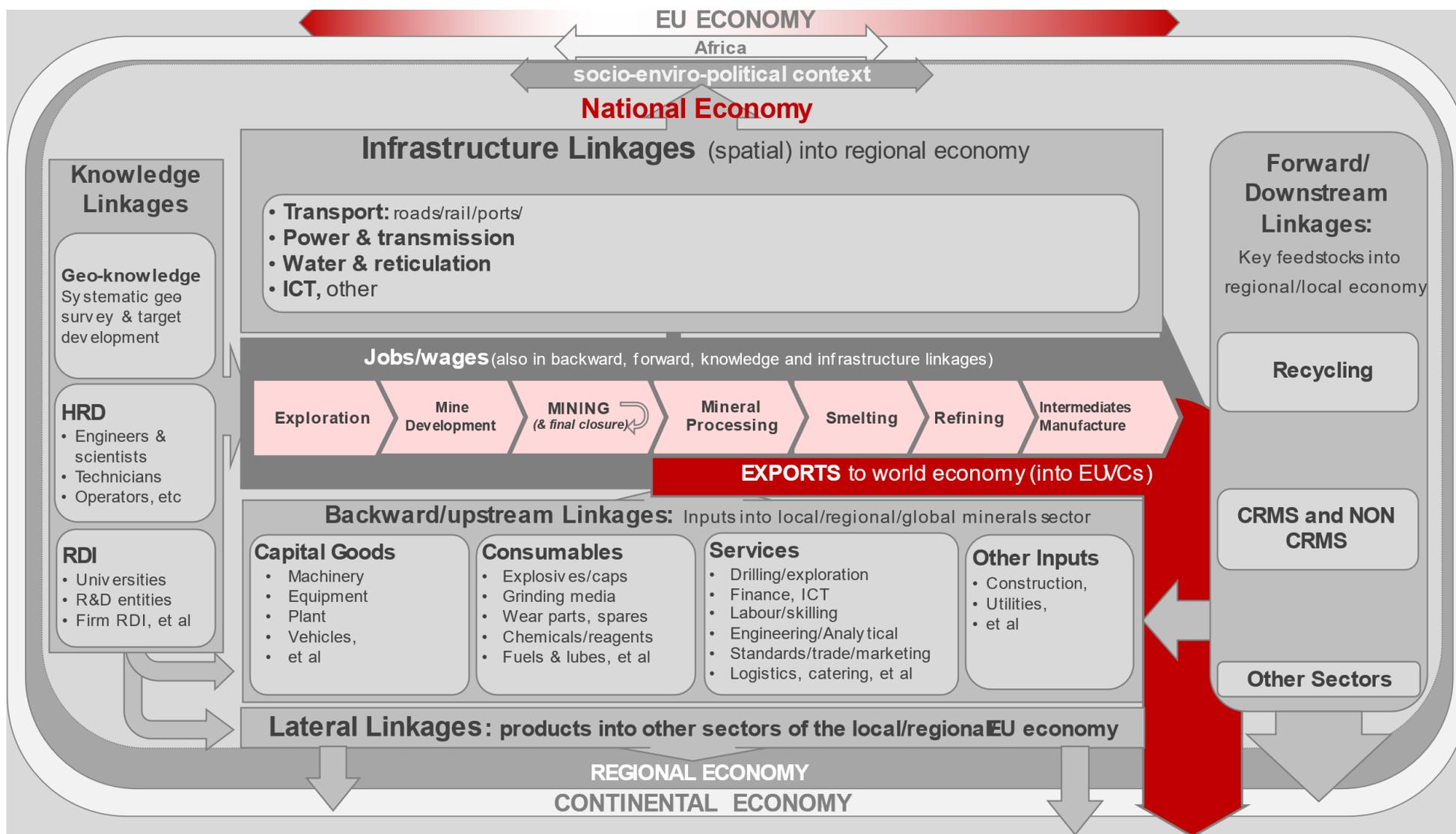


Figure 2 Generic mineral value flow sheet [2].

Figure 2 shows typical mineral value chain stages from exploration to manufacture of intermediates and recycling. Each stage could be a project, for example an exploration one or a development project, or a mining project, or a smelting project, etc. A project could also contain a number of stages, for example, mining-mineral processing-etc. downstream. Each stage of the value chain provides linkages as indicated in the figure. Forward or downstream linkages provide feedstock for downstream manufacturing. Backward linkages provide the necessary inputs for those value chain activities to take place smoothly and successfully. These include capital goods, consumables, services and other inputs. Knowledge linkages are required at each stage of the value chain, and these include, as appropriate, geo-knowledge, human resources development, and RDI. Infrastructure linkages, which are important for mineral value chain activities, link to the regional economy. ESG linkages, which can be used to develop regional socio-economic and ecological improvement measures. These linkages (inputs) may be lacking or inadequate, providing opportunities for support or investment. These become the bases of project proposal for consideration. Lateral linkages provide products originally slated for the mineral value chain activities but find applications in other sectors of the local economy and beyond. When a number or cluster of these mineral value chain projects are within a defined vicinity or proximity to each other, combined or regional infrastructure, for example, may be planned.

The anticipated use of this generic flowsheet in the assessment of ECRM mineral resource opportunities can be described stepwise as follows (Figure 3):

- Step 1: Compile a generic mineral value chain flowsheet
- Step 2: Collect project information using the sheet developed
- Step 3: Determine on a logical placement of each specific project along the mineral value chain to achieve a value chain flowsheet regarding specific CRMs.
- Step 4: Extend the individual CRM flowsheets with project information focusing on infrastructure and ESG.
- Step 5 (optional): Development of a quality rating of projects (A-B-C) based on specific infrastructure/ESG criteria as on top of the BGR criteria in WP 7 (economic / ESG). Will be evaluated and discussed with BGR and their quality rating in the next WP 2 tasks.

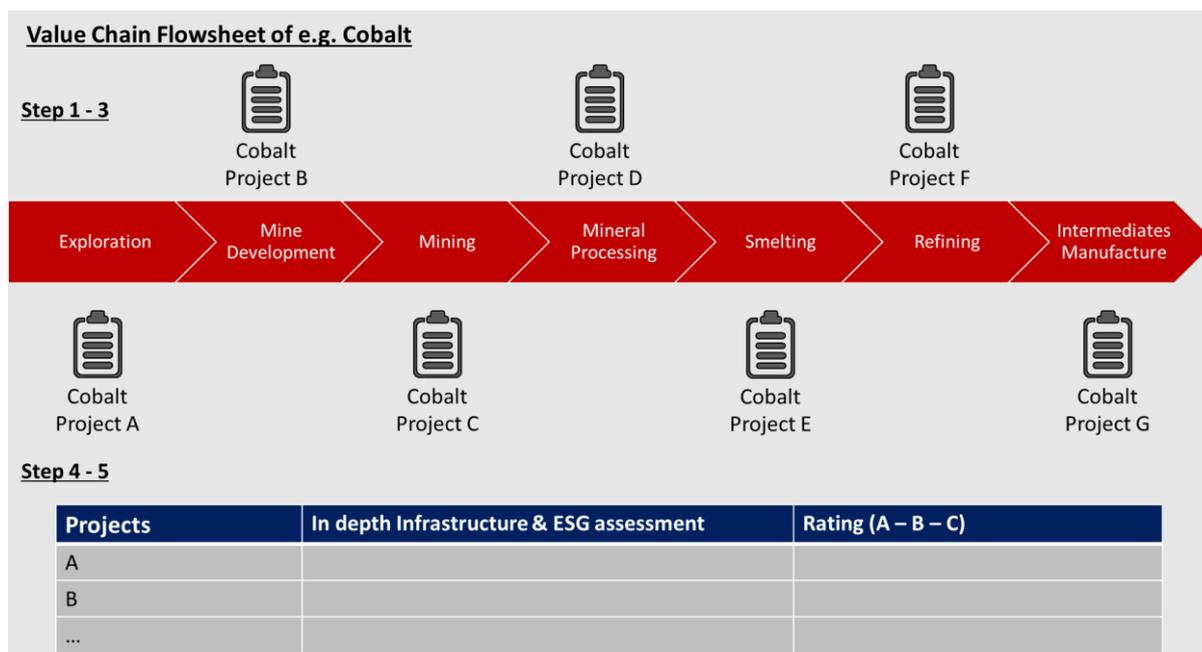


Figure 3 Example of a cobalt value chain flowsheet.

These steps will enable later, more complex analyses, as described above, for example: constraints to the development of each project and the identification of wider geographical regional of regulatory and systemic hurdles to mineral development and sustained exploitation.

5. Key results

A project profile template was developed to send to project participants to collect relevant information on identified ECRM projects. The final version, version 5, was finalized on the 22 of September 2022. This final version includes an information disclosure agreement to be signed by project participants to ensure information was given voluntarily and is not protected in any way nor does it jeopardize company intellectual property. Team members were also instructed to ensure that project participants knew that they were free to withdraw from the interview and information collection process. This document was submitted to the Ethics Board and validated as no personal data will be collected through the surveys.

Country Name	Total number of projects
DRC	6
South Africa	104
Zimbabwe	30
Namibia	18
Mozambique	4
Tanzania	29
Madagascar	26
Senegal	15
Gabon	1
Morocco	29
Total	262

Table 5 Number of projects initially found in the 10 country cases assessed and the total number of projects.

A project list with a total of 262 projects was compiled (Appendix C). Most of the projects included on the list are in South Africa (104 projects) followed by Zimbabwe (30) and then Tanzania and Morocco (29) (Table 5). South African projects make up 40 percent of the projects listed, though it is important to note that this includes recycling projects whereas there were few to no recycling projects earmarked for this list in other countries at present (Figure 4).

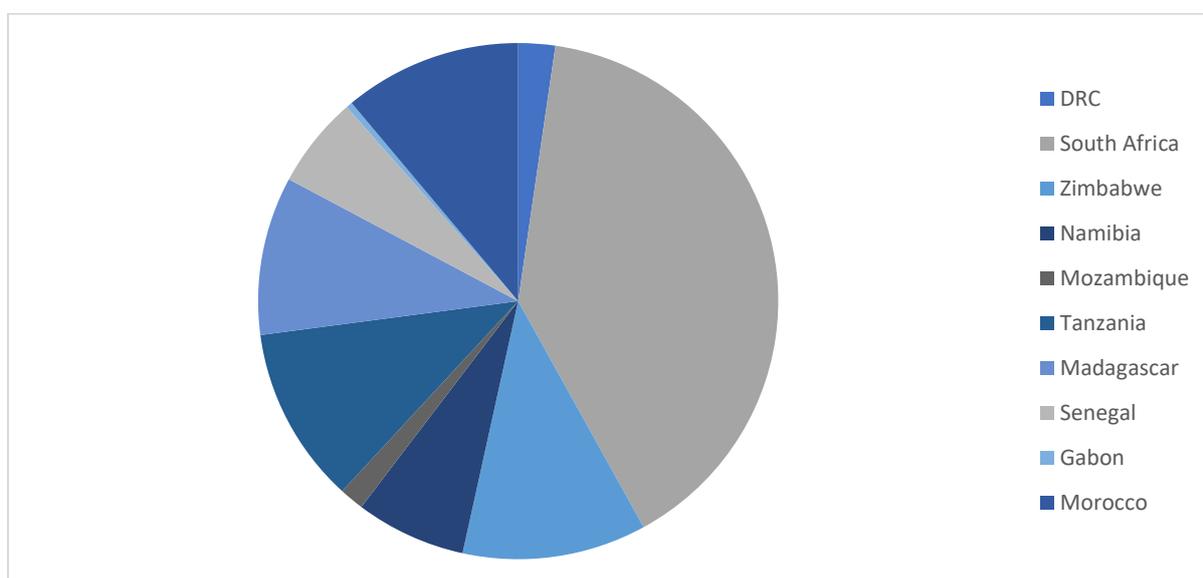


Figure 4 Proportion of projects found in the countries assessed.

Figure 5 shows that PGMs, copper and nickel made up the most numerous projects within the scope of the countries assessed. In total 70 PGM projects have been highlighted, 42 copper projects and 29 nickel projects. Hafnium, strontium, beryllium, bismuth, borate, silicon metal, promethium, phosphorous and antimony did not feature in any of the projects returned by the team. The alkaline-earth metals, LREE, HREE, scandium, bauxite & Fluorspar are also underrepresented in the findings.

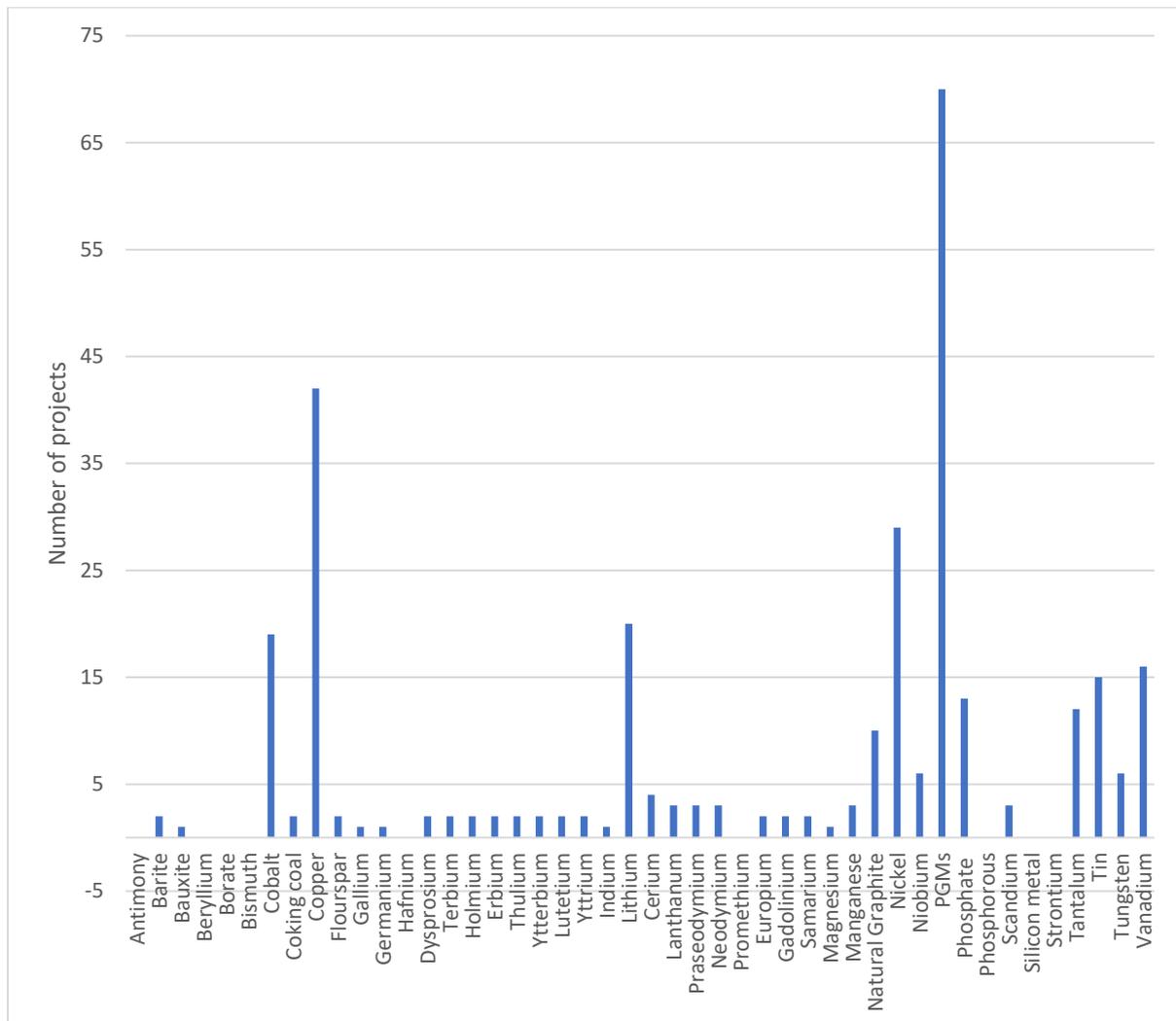


Figure 5 Number of projects found for all the ERCMs.

Responses from the project owners have been scarce (Figure 6). Most projects remain with no established contacts (132 projects) due to inability to find reliable avenues. The contacts that are listed are likely no longer active or there has not yet been an attempt to make contact. Fifty-three project information sheets have been partially completed either with publicly available project or mine technical reports, through interviews or through correspondence with project participants that have filled the sheets to the extent to which information is available. Some projects have been found to be in early stages of development and as a result the information sheets can only be partially filled. Thirty project participants have been contacted and have yet to respond while eight project leaders have responded and are listed as “in communication”. Fourteen projects have missing contact details as it stands. Ownership is still unclear for two projects. In total eight projects have fully completed information sheets at present.

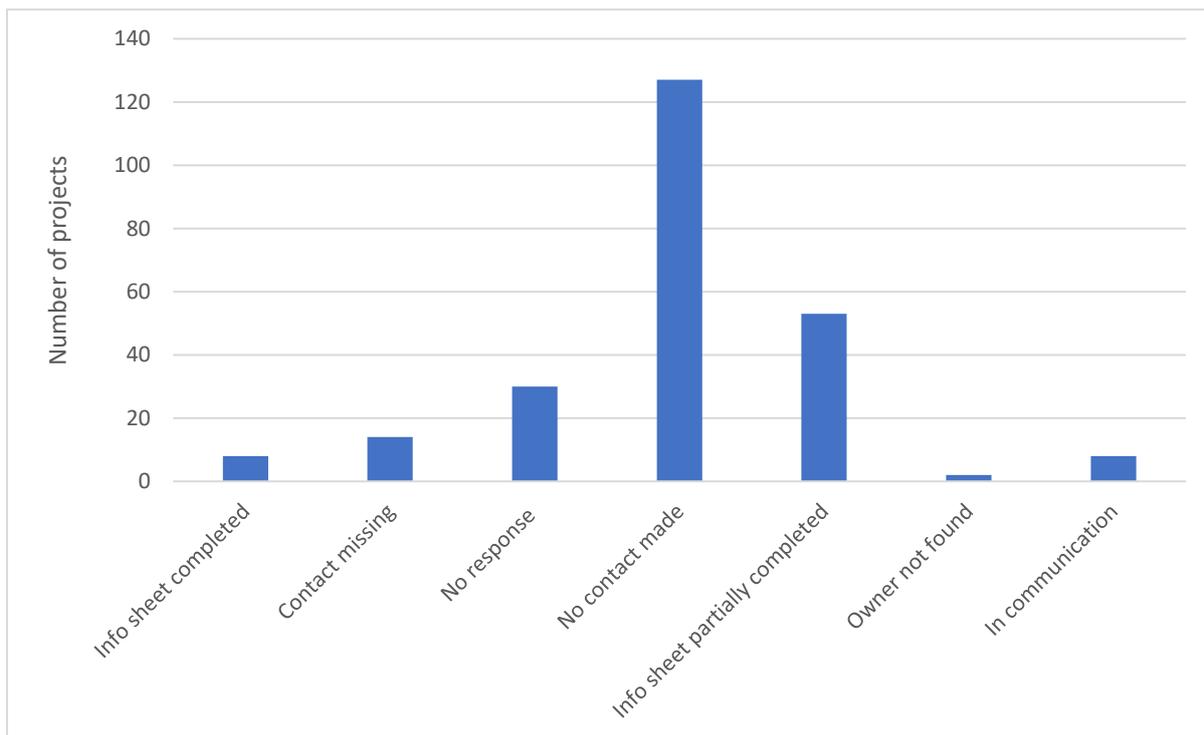


Figure 6 Status of communication for the projects found.

Currently, 88 % of the projects in the list are primary source projects, while 12 % of the projects are recycling and tailings retreatment projects (Figure 7). All these recycling and retreatment projects are in South Africa.

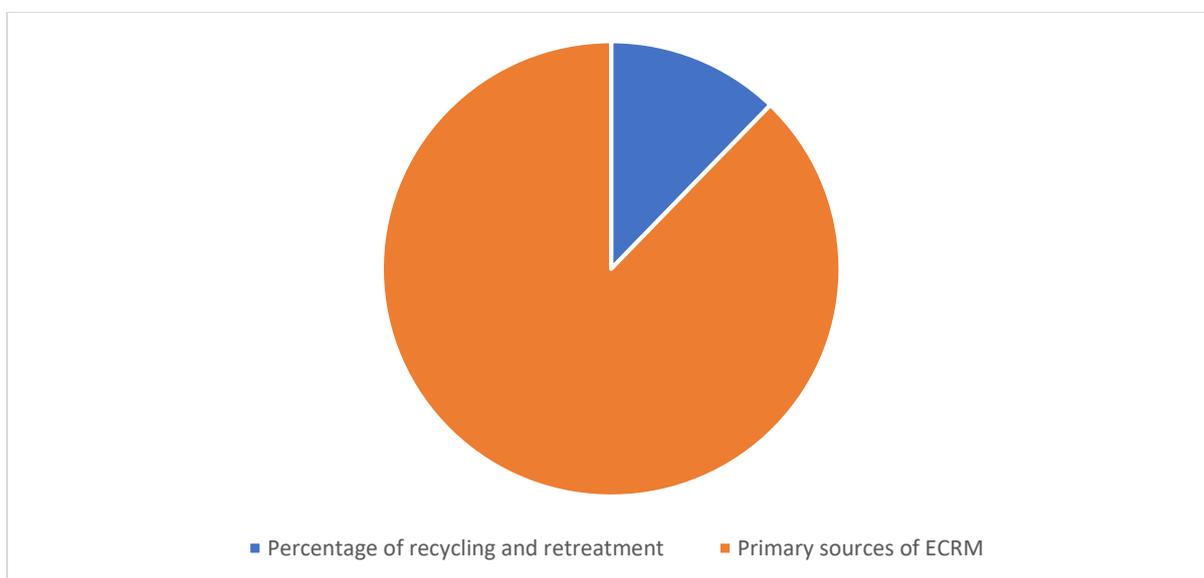


Figure 7 Percentage of recycling and retreatment projects and primary sources of ECRM.

6. Conclusion

The AfricaMaVal project kicked off in June 2022. The first months were spent arranging the internal project team, administrative issues and writing the methodology for the inception report. As the project gained traction and the work of WP 2.1 began in earnest, several challenges emerged that must be recorded here for future reference and for possible responses in future programme work. The following challenges were observed:

a. Lack of knowledge / awareness of external parties about the project

The WP2.1 team had the task of compiling a list of potential projects for investment by AfricaMaVal. A project information sheet was developed in consultation with other project partners. However, the public reception of this request for information was sometimes met with resistance, as people were not aware of the programme. The AfricaMaVal web page only came online about 3 months after the project started, so the team faced the challenge of having to educate people about the programme in addition to requesting information.

b. Marketing as an additional project step

Following on from the above, the project team had to build rapport with the respondents and tell them about the project, get them excited about it, and establish the benefits of participation.

c. Lack of trust

Several project participants also question the EU's motives in the AfricaMaVal programme, and are reluctant to share information, as they do not want to tie down market agreements with unknown benefits and unknown programme objectives and outcomes for them on the project owner level.

d. Vested interests

Some project participants already have adequate investment or have their product tied up in supply agreements already, hampering the development of a full list and participation by all potential project owners.

e. Difficulties establishing contacts

Establishing contact with potential project participants to complete project fact sheets. Some project participants are apprehensive to respond fully.

The way forward for WP2.2 includes continuing with identification of projects and contacting project owners as well as start with in depth assessment of selected ECRM projects. This is followed, in each case, by completion of the project information sheets and ethics declarations. Additionally, administrative and project management tasks related to this activity continue.



Bibliography

Gericke, M., Nyanjowa, W., & Robertson, S. (2021). Recycling of Li-ion batteries in South Africa. South Africa: Mintek. Von https://wasteroadmap.co.za/wp-content/uploads/2021/08/30-Mintek_Final-LIB-presentation_13-Aug-21.pdf abgerufen

Jourdan, P. (2019). Developing the Southern African Mining Supply Chain - Realising the regional market: Scale Economies. MSC Conference. Nasrec. Abgerufen am 24. November 2022 von <https://www.saceec.com/wp-content/uploads/2019/05/P-Jourdan-Developing-Mining-Supply-Chain.pdf>



Appendix A - Data acquisition source grid

Data source type	Origin / Source	Example link or web landing page
Primary sources <i>(Information published by governments or companies in each country. Considered official data. Not consolidated – requires extraction and compilation)</i>	Departments of mines/ mineral resources in each country	https://www.madini.go.tz/
	Country-specific mineral deposit information published by third parties on behalf of the country: government-sanctioned public information hosted by a specialist	https://portals.landfolio.com/uganda/
	Geological survey of each country	https://www.mme.gov.na/gsn/
	Mining company annual reports or resource statements	https://www.glencore.com/publications
	Online Mining Cadastre systems for countries	Tanzania: https://portal.madini.go.tz/map/ Uganda: https://portals.landfolio.com/uganda/ Cameroon: https://portals.landfolio.com/Cameroon/en/ Cote d'Ivor: https://portals.landfolio.com/CoteDivoire/en/ DRC: http://drlicences.cami.cd/EN/ Ethiopia: http://ethiopian.portal.miningcadastre.com/mappage.aspx?pageid=a16a9300-7c58-4f81-9e5c-97e13b22b0c6 Guinea: https://guinee.cadastreminier.org/en/ Kenya: https://portal.miningcadastre.go.ke/site/embeddedmapportal.aspx?pageid=f877b9bc-d68a-415f-b051-5048ff5a68b0 Liberia: http://portals.landfolio.com/liberia/ Malawi: https://portals.landfolio.com/malawi/ Mauritania: https://portals.landfolio.com/Mauritania/en/

Data source type	Origin / Source	Example link or web landing page
		Namibia: https://portals.landfolio.com/namibia/ Senegal: https://cadastreminiersenegal.sn/fr/ South Sudan: http://portals.landfolio.com/southsudan/ Togo: http://cadastreminier.tg/en/ Zambia: https://portals.landfolio.com/zambia/ Mozambique: https://portals.landfolio.com/mozambique/en/
	Import/ export trade statistics by country <i>(Usually need the GHS Tariff codes)</i>	https://tools.sars.gov.za/tradestatsportal/data_download.aspx
Secondary sources <i>(Research by third parties with no commercial interest – considered neutral sources)</i>	United States Geological Survey (USGS) commodity reports	https://pubs.er.usgs.gov/
	CIA World Factbook country reports	https://www.cia.gov/the-world-factbook/countries/
	World Bank country reports	https://data.worldbank.org/country
	Deposit-specific research papers	<ul style="list-style-type: none"> • http://www.scielo.org.za/ • https://www.saimm.co.za/publications/138-about-saimm/about-saimm-sp-373/48-saimm-library • https://www.researchgate.net/
	UN topic-specific reports	https://www.un.org/africarenewal/news/how-can-mining-contribute-sustainable-development-goals
Tertiary sources <i>(Private companies that specialize in mineral market research or country profile reports and provide basic information, but detailed reports at a cost)</i>	Norton Rose Fullbright	https://www.nortonrosefulbright.com/en/knowledge/publications/070cda05/morocco-mining-guide
	McKinsey	https://www.mckinsey.com/industries/metals-and-mining/our-insights/the-raw-materials-challenge-how-the-metals-and-mining-sector-will-be-at-the-core-of-enabling-the-energy-transition
	Mining Weekly Mining Research channel	https://www.miningweekly.com/page/research-home

Data source type	Origin / Source	Example link or web landing page
	Creamer media mining research channel	https://www.researchchannel.co.za/searchadvanced_rc_main.php?ms=mining&ss=profiles

Appendix B - Information collection sheet (Basic)

0. SUBJECT (numbered) <i>Guiding notes to each question are provided in italics</i> a. Numbered sub-items to be completed as part of the full info sheet	Response/ content and notes <i>Expand each section as needed to insert tables/ graphs, images, maps, etc</i>
1. Project Title/ Name	
2. Main Commodity and by-products	
3. Locality a. Country, City/Town, Village b. Describe access route to the site in words c. Coordinates d. Include locality map (+ access route and state of transport infrastructure)	
4. Ownership a. Company name b. Partnerships, JV, investors, etc. c. Contact details (include web page, if available) d. Contact details e. Web page	
5. Stage of development <i>(exploration, development, extraction, processing, recycling, abandoned, PFS, FS, etc),</i> a. Status (Operational, non-operation, Care and maintenance, on hold – state reasons if non-operational), b. Development Plans c. Licensing (e.g. legal compliance, EIA, ISO certification, ESG certification, export permits, emissions permits, etc)	
6. Geology and mineralisation potential (local) <i>(support with maps or other data as available)</i>	
7. Mineral Resources and Reserves <i>How are mineral reserves and resources stated, e.g.: NI43-101, JORC?</i> a. Production b. LoM	
8. Value chain a. Insert a value chain map/ graph / drawing of this mineral in its current use and market	

<p>0. SUBJECT (numbered) <i>Guiding notes to each question are provided in italics</i> a. Numbered sub-items to be completed as part of the full info sheet</p>	<p>Response/ content and notes <i>Expand each section as needed to insert tables/ graphs, images, maps, etc</i></p>
<p>b. Taken from exploration to finished product, where does this project sit? (Refer to the Value Chain diagram above)</p> <p>c. Describe any cross-border interactions (<i>e.g. mineral imported from elsewhere and only processed here, or exported as raw mineral from here to a processing plant elsewhere</i>)</p> <p>d. Who are the current target markets?</p>	
<p>9. Capacity/ Access and Infrastructure:</p> <p>a. Economic</p> <p>b. Policy</p> <p>c. Infrastructure (water, electricity, transport, etc.)</p> <p>d. Technology</p> <p>e. Skills</p> <p>f. Environment</p> <p>g. Social</p> <p>h. ESG components (<i>Complete list under ESG Indicators</i>)</p>	
<p>10. Opportunities for growth/development and support required <i>(Financial, technical, skills, etc.) This is the project owner’s own statement of how they see them selves participating in the market – what do they see as constraints, how do they want to grow market share, etc?</i></p>	
<p>11. References <i>(all sources used in compiling this data – include web links and proper references to print media or other materials)</i></p>	

D2.1 Project fact sheet and flow analyses templates

ESG indicators (From question 9 h) <i>For each item, indicate if the operation has this or not, and record details as appropriate</i>	Response <i>Y/N response only</i>	Details <i>(If Yes, record the details, reference, source doc or other notes)</i>
Air quality management plan (<i>Dust, GHG</i>)		
Waste management plan (<i>slurries, dump sites</i>)		
Surface water / groundwater management plan (<i>contamination, treatment, reuse</i>)		
Mine water / sump management plan (<i>contamination, treatment, reuse</i>)		
Noise & vibration management plan		
Non-destructive exploitation plan		
Management plan for energy and material consumption		
Biodiversity management plan (<i>ecosystem, protected areas, species, vegetation clearance</i>)		
Mine closure plan (<i>land reclamation, decommissioning, remediation</i>)		
Workplace management plan (<i>imbalance, discrimination, inequalities</i>)		
Social management plan (<i>inclusion of vulnerable groups, indigenous people, human right / land defenders, social-cultural understanding / heritages; community development projects (water, infrastructure, hygiene, medical care, emergency, education), community involvement; poverty, hunger, thirst, housing</i>)		
Land use management plan (<i>acquisition, forced relocation</i>)		
Management plan for high-risk areas (<i>child labour, education, forced labour</i>)		
Human & Resource management plan (<i>bargaining, unions, grievance, remuneration, contracts, benefits, training, working hours and conditions</i>)		
OHS management plan (<i>risk and safety management plan, PPE, hazardous work, training, rehabilitation facilities, hazardous substances / work / conditions</i>)		
Emergency response plan (<i>medical preparedness and care, infrastructure plan (lightning, communication)</i>)		
Construction and Maintenance management plan (<i>tailing dams, equipment, geological / (rock) mechanical failures</i>)		
Safety and Security management plan (<i>infrastructure plan (traffic), e.g. security plan, training for security personnel</i>)		
Business Integrity Plan (<i>anti-corruption and bribery, criminal machination (revenues & payments), ownership and management structures), illegal mining activities</i>)		



ESG indicators (From question 9 h) <i>For each item, indicate if the operation has this or not, and record details as appropriate</i>	Response <i>Y/N response only</i>	Details <i>(If Yes, record the details, reference, source doc or other notes)</i>
Stakeholder management plan <i>(consultation, engagement, grievance mechanism, disclosure)</i>		
Supplier management plan <i>(social impact (abusive practices, financial flows, site security, poverty, health problems, forced relocation, working contracts & conditions, accommodation, environmental impact (biodiversity), high risk areas (financial flows, violent conditions, child labour, forced labour))</i>		

Information disclosure declaration

I,(full name), the registered owner/ director/ manager of
(name of business) hereby declare as follows:

- I am offering the information recorded in the Project Information Collection Sheet voluntarily.
- The information provided by me in the Project Information Sheet in support of the AfricaMaVal project is not protected in any way and does not jeopardize company intellectual property or competitive advantage.
- I fully understand the project information sheet that I have completed and I was given an opportunity to ask questions for clarity.
- The aims, methods and implications of the project activity, the nature of the participation and any benefits, risks or discomfort that might ensue have been explained to me.
- I understand that participation is voluntary and I have the right to refuse to participate and to withdraw my/our information, participation, samples or data at any time and without any consequences
- If the further work of the AfricaMaVal programme discovers unexpected or incidental findings, I choose to not be informed about these findings, unless they relate to my operation in particular.
- I am over 18 years of age
- I have not been coerced or pressured into providing any information.

Respondent: _____

Interviewer: _____

Date: _____ Place: _____



Appendix C - List of projects identified

Project Name	Commodity	Country	Location	Status
Rubaco SARL: PR 14658	Sn, Ta, Nb, W, Li, Fe	DRC	Kalongo	Info sheet completed
Rubaco SARL: PR 14666	Sn, Ta, Nb, W, Li	DRC	Dilenge village, Mitwaba Territory,	Info sheet completed
Rubaco SARL: PR 14667	Sn, Ta, Nb, W, Li,	DRC	Kintya village, Mitwaba Territory	Info sheet completed
Rubaco SARL: PR 14660	Sn, Ta, Nb, W, Li	DRC	Kabusondji, Manono Territory,	Info sheet completed
SCOMIS SARL	Co, Cu	DRC	38Km NE from Kolwezi	Technical reports received
Rubaco SARL: PR 14664	Sn, Ta, Nb, W, Li, Au	DRC	Dilenge	Info sheet completed
Steenkampskraal Monazite Mine	Monazite concentrate, Rare Earth salts, Rare Earth Oxides, Thorium hydroxide, Cerium hydroxide, Trisodium phosphate	South Africa	Vanrhynsdorp	Info sheet completed
Karo Platinum Project	Pt, Pd, Ir, Ru	Zimbabwe	West district, Mashonaland	Info sheet sent, Interest shown
Trojan Ni Mine	Ni	Zimbabwe	Bindura	Info sheet sent, No response from owner
Hunters Road Ni Mine	Ni	Zimbabwe	Bindura	Info sheet sent, No response from owner
RHA Tungsten Mine	W	Zimbabwe	Hwange, Matabeleland	Info sheet sent, No response from owner

D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Zulu project	Li, Ta	Zimbabwe	Bulawayo	Info sheet sent, No response from owner
Lubu Project	Coking Coal	Zimbabwe	Hwange, Matabeleland	Info sheet sent, No response from owner
Katete Project	REE's (Ce, La)	Zimbabwe	Matebeleland North	Info sheet sent, No response from owner
Shangani Mine	Ni	Zimbabwe	Insiza district, Matabeleland	Info sheet sent, No response from owner
Hwange Colliery	Coking Coal	Zimbabwe	Hwange, Matabeleland	Info sheet sent, No response from owner
Dorowa Minerals	Phosphate	Zimbabwe	Buhera	Contact missing
Chautsa Vanadium Project	V, Cu, Co, Ti	Zimbabwe		Contact missing
Arcadia Project	Li	Zimbabwe	Masvingo, Bikita Hills	Info sheet sent, No response from owner
Bokai Project	PGMs	Zimbabwe	Shurugwi	Info sheet sent, No response from owner
Darwendale Platinum Project	PGMs	Zimbabwe	Norton	Contact missing
Kamativi Tailings Project	Li	Zimbabwe	Matebeleland North	Email sent
Kamativi Lithium Project	Li, Ta, Nb, Sn, W	Zimbabwe	Matebeleland North	Info sheet sent, No response from owner
Tinde Project	Fluorspar	Zimbabwe	Hwange, Matabeleland	Info sheet sent, No response from owner
Pope Mine	Ta	Zimbabwe	Rambavu	Contact missing



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Bougai Project	PGMs	Zimbabwe	Bougai	Contact missing
Snakes Head PGE Project	Pt	Zimbabwe	Mashonaland Central	No owner found
Good days mine	Li, Cs, Ta	Zimbabwe	Mutoka	To be contacted
Empress Ni Refinery	Ni	Zimbabwe	Kodoma	To be contacted
Mhangura Copper Mine	Cu	Zimbabwe	Chinhoyi district	Contact missing
Shackleton Copper Mine	Cu	Zimbabwe	Chinhoyi district	Contact missing
Todal Mining/ Bogai Project	Pt	Zimbabwe	Shurugwi	Contact missing
ShinZim Platinum	Pt	Zimbabwe	Kadoma	Contact missing
Lutope Special Grant	Sn, Li, Ta, Nb	Zimbabwe	Dete	Info sheet sent, No response from owner
Sandwana Mine	Ta, Cu, Li	Zimbabwe	Sandawana	Info sheet sent, No response from owner
Sanyati Copper Mine	Cu	Zimbabwe	Chinhoyi	Info sheet sent; No response from owner
Hartley Platinum Mine	Pt, Ni	Zimbabwe	Chegutu	Ownership not yet found
Combat Mine Copper deposits	Cu	Namibia	Grootfontein	Info sheet sent, No response from owner
Haib Copper Project	Cu	Namibia	Grunau	Info sheet sent, No response from owner
Hope Copper Gold Project	Cu, Au	Namibia	Windhoek	Info sheet sent, No response from owner
Karibib Project	Li, Rb, Cs, Rb	Namibia	Windhoek	Info sheet sent, No



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
				response from owner
Lofdal Project	La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y	Namibia	Khorixas	Info sheet sent, No response from owner
Epembe Ta-Nb project	Ta, Nb	Namibia	Opuwo	Info sheet sent, No response from owner
Otjiwarongo Rare Earths Project	REE and Flourspar	Namibia	Otjiwarongo	Info sheet sent, No response from owner
Eureka REE project	REE (Nd and Pr)	Namibia	Swakopmund	Info sheet sent, No response from owner
Eisenberg Carbonatite Project on Rare Earth Elements	REE; Ce, La, Nd, Pr, Y (Eu, Gd, Sm, Dy, Er, Ho, Lu, Tb, Tm, Yb; By product: Th)	Namibia	Otjiwarongo	Info sheet returned
Tschudi Copper Project	Cu	Namibia	Tsumeb	Email contact provided on their web page bounced
LoCoSu Project		Namibia		Info sheet sent, No response from owner
REE-Bearing mineral sands	REE		Erongo	
REE-rich Copper Mine	REE, Cu		Swartmodder	
Brandberg West Mine	Sn, W, Cu		Erongo	
In-Ga-Ge mineralization of slag	Ga, Ge		Tsumeb	
Namib Lead Zinc Mine	Pb, Zn, Ag (Cu, Sn, In,F)	Namibia	Swakopmund	Info sheet sent, No response from owner
Sandpiper Marine Phosphate Project	Phosphate	Namibia	Walvis Bay	Info sheet sent, No response from owner



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
AfriTin Projects		Namibia	Uis	Info sheet sent, No response from owner
Uis	(Sn; by-products: Ta, Li)			
B1C1	Sn, Ta			
Brandberg West	Sn, W, Cu			
Nais-Nais	Li-Sn-Ta			
Vanadium and Copper-Lead-Zinc Projects	Vn, Zn, Pb, Cu, Ag, V	Namibia	Tsumeb	Info sheet sent, No response from owner
Opuwo Cobalt Project	Co, Cu, Zn	Namibia	Opuwo	Info sheet sent, No response from owner
Gecko Namibia Projects:		Namibia		Info sheet sent, No response from owner
Okajande Graphite	Graphite		Otjiwarongo	
Gecko Marine Phosphates	Phosphate		Walvis Bay	
Okorusu Fluorspar Mine	Flourspar (CaF ₂)		Otjiwarongo	
Eisenberg Project	Rare Earth Oxides, Thorium, Iron Ore and Related Minerals	Namibia	Kalkfeld	Info sheet completed
Nachinanga Manganese	Mn	Mozambique	Changara	In progress
Changara Manganese	Mn	Mozambique	Changara	In progress
Monte Muambe	Rare Earth Oxides	Mozambique	Tete	In progress
Midwest Africa Limited	Coal	Mozambique	Tete	In progress
Zanzui	Ni	Tanzania	Bariadi District	Info sheet partly completed
Morogoro graphite	Graphite	Tanzania	Mahenge District	Info sheet partly completed
Chambogo Mg	Mg	Tanzania	Chambogo District	Info sheet partly completed



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Dutwa deposits	Ni	Tanzania	Bariadi District	Info sheet partly completed
Galapo REE	Nb	Tanzania	Mbulu District	Info sheet partly completed
Ngwena graphite	Graphite	Tanzania	Nachingwea District	Info sheet partly completed
Hombolo Li	Li	Tanzania	Chamwino District	Info sheet partly completed
Haneti Ni	Ni	Tanzania	Kondoa District	Info sheet partly completed
Kyerwa Sn	Sn	Tanzania	Kyerwa District	Info sheet partly completed
Lake Rukwa	He	Tanzania	Ilemba District	Info sheet partly completed
Pula graphite	Graphite	Tanzania	Ruangwa	Info sheet completed
Mohinga	Li	Tanzania	Chamwino District	Info sheet partly completed
Luwumbu PGE	PGM, Ni	Tanzania	Makete District	Info sheet partly completed
Maganga Matitu Iron ore	Ti, V	Tanzania	Ludewa district	Info sheet partly completed
Morogoro graphite	Graphite	Tanzania	Mahenge District	Info sheet partly completed
Nazareth	Graphite	Tanzania	Rwangwa District	Info sheet partly completed
Nditi and Ntaka deposits	Ni, Cu	Tanzania	Nachingwea District	Info sheet partly completed
Nachendezwaya	REE, Niobium	Tanzania	Mbozi District	Info sheet partly completed



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Pacco Gems	Graphite	Tanzania	Ruangwa	Info sheet partly completed
Sengeri REE	REE	Tanzania	Mbeya rural	Info sheet partly completed
Tanzoz graphite	Graphite	Tanzania	Ruangwa	Info sheet partly completed
Nakonde REE	REE	Tanzania	Chunya District	Info sheet partly completed
Wigu Hill	REE	Tanzania	Chunya District	Info sheet partly completed
Fungoni	Ti, Zirconium	Tanzania	Dar es Salaam	Info sheet partly completed
Kabanga Ni	Co, Ni, Cu	Tanzania	Ngara District	Info sheet partly completed
Lindi Graphite	Graphite	Tanzania	Masasi District	Info sheet partly completed
Lindi Jumbo	Graphite	Tanzania	Ruangwa	Info sheet partly completed
Mahenge Graphite	Graphite	Tanzania	Mahenge District	Info sheet partly completed
Ngwalla REE	Fluorspar, Niobium, REE	Tanzania	Songwe District	Info sheet partly completed
Panda Hill	Niobium, fluorspar	Tanzania	Mbozi District	Info sheet partly completed
Ambato-Arana Madagascar graphite project (Malagasy)	Natural Graphite	Madagascar		Awaiting contact details from associate in Madagascar
Ambatovy Ni / Cobalt mine	Ni	Madagascar	Moramanga	No direct contact yet
Ambodilafa Project	Ni	Madagascar	Nosy Varika	No direct contact yet
Ampanihy Project	Cu	Madagascar		No direct contact yet



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Analalava Project	Cu	Madagascar	Toamasina	No direct contact yet
Andapa Project	Natural Graphite	Madagascar	Andapa	Info sheet sent, no response yet
Belobaka Mafic Project	Cu	Madagascar	Belobaka	No direct contact yet
Fotadrevo Project	V	Madagascar	Fotadrevo	No direct contact yet
Graphmada Large Flake Graphite mine	Natural Graphite	Madagascar	Eastern Madagascar	Info sheet sent, no response yet
Green Giant Vanadium project	V	Madagascar	Toliara	Info sheet sent, no response yet
Imaloto coal project and extension	Coal	Madagascar	South West Madagascar	No direct contact yet - Possibly a thermal coal project
Lanjanina / Pachoud project	Cu	Madagascar		No direct contact yet
Londokomanana project	Cu	Madagascar		No direct contact yet
Maevatanana project	PGMs	Madagascar		No direct contact yet
Mahela graphite prospect	Natural Graphite	Madagascar		Info sheet sent, no response yet
Maniry project	Natural Graphite	Madagascar	Southern Madagascar	In communication - responded with potential interest.
Marofody Graphite project	Natural Graphite	Madagascar		In communication - responded with potential interest.
Millie Reward lithium project	Li	Madagascar	Centra Madagascar	Info sheet sent, no response yet
Molo Graphite project	Natural Graphite	Madagascar	Fotadrevo/Toliara Province	Info sheet sent, no response yet



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Ni Valley Project	Ni	Madagascar		No direct contact yet
Sahamamy graphite mine	Natural Graphite	Madagascar	Gisimay	Info sheet sent, no response yet
Sakoa & Sakamena Coal project	Coal	Madagascar	South West Madagascar	No direct contact yet - Possibly a thermal coal project
Sakoa coal project	Coal	Madagascar	South West Madagascar	No direct contact yet - Possibly a thermal coal project
Valozoro Ni project	Ni	Madagascar		Info sheet sent, no response yet
Vatomina graphite mine	Natural Graphite	Madagascar		Info sheet sent, no response yet
Vohitsara Graphite project	Natural Graphite	Madagascar	Toamasina	In communication - responded with potential interest.
Miferso (Socite des mines de la Faleme) - d2007-851 Faleme	Fe	Senegal	Faleme	No contact established
Jiwana Resources (Request No. 10541)	Li, Sn	Senegal		No contact established
New Energy Investment SARL - ILYMALO (Research Permit application granted subject to reservation)	Li	Senegal		No contact established
GH Mining (Tomoradji)	Mn	Senegal		No contact established
Grande Cote	Zircon & Ilmenite	Senegal	Thies	No contact was found
Emergence Mines & Investissements - Prospect Thieppe-Kap gaye & a research permit	Ilmenite, rutile and zircon	Senegal	Thies	No contact was found



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Kounda Group - Research permit	Heavy Minerals	Senegal	Thies	No contact was found
SEN-HMC MINING SUARL	Heavy Minerals	Senegal	Thies	No contact was found
SARSARA Industries SA- research permit	Phosphate	Senegal	Louga	No contact
Industries Chimiques Du Senegal (Mining D1999-1020 Tobene Nord_ICS)	Phosphate	Senegal	Thies	No contact
Cayor Phosphate Mining SA - Research Permit KEBEMER	Phosphate	Senegal	Ndande	No contact
Rassoul Mining Oil, Gas and Energy - Gossas (Research Permit)	Phosphate	Senegal	Ouadiour	No contact
Haranga Resources Limited - Baitilaye	Li,Sn, REE's	Senegal	Saraya	No contact made
International Company of Trade and Services SA	Li	Senegal	Missirah Sirimana	No contact
Saraya Energy	Li	Senegal	Missirah Sirimana	No contact made
Nyanga Project	Cu, Ni	Gabon	Tchibanga	No contact possible yet.
Bou Azzer Mine	Co, Ni, Cu	Morocco	35 km south of Marrakech (Anti-Atlas Mountain Range)	Info sheet complete
Quansimi Mine	Cu	Morocco		Info sheet incomplete
Akka Mine	Cu	Morocco		Info sheet incomplete
Bleida Mine	Cu	Morocco		Info sheet incomplete
Oumerjane Mine	Cu	Morocco		Info sheet incomplete
Bouskour Project	Cu	Morocco	80 km SE of Ourzazate	Info sheet incomplete
Tizert Project	Cu	Morocco	80 km east of Agadir	Info sheet incomplete



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Imiter Mine	Ag	Morocco		Info sheet incomplete
Zgounder Millennium Mine	Ag	Morocco	150 km south of Marrakech	Info sheet incomplete
Amizmiz Property	Polymetallic	Morocco		Info sheet incomplete
Azegour Mine	Polymetallic	Morocco		Info sheet incomplete
233263 Permit	Polymetallic	Morocco		Info sheet incomplete
Boumadine Mine	Polymetallic (Ag, Au, Pb, Zn)	Morocco		Info sheet incomplete
Tigzha Mine	Pb, Ag, Zn	Morocco	Middle Atlas, Meknes Province	Info sheet incomplete
Achmmach Tin Project	Sn	Morocco	El Hajeb region, central Hercynian Massif, 150 km east of Rabat	Info sheet incomplete
Nkob Mine	Barite	Morocco		Info sheet incomplete
Touroug Mine	Barite	Morocco		Info sheet incomplete
OCP	Phosphate	Morocco	Benguerir	Info sheet complete
OCP	Phosphate	Morocco	Boucraa	Info sheet complete
OCP	Phosphate	Morocco	Khouribga	Info sheet complete
OCP	Phosphate	Morocco	Youssofia	Info sheet complete
Beni Amir Mine	Phosphate	Morocco		Info sheet incomplete
Sidi Chennane Mine	Phosphate	Morocco		Info sheet incomplete
Douar Hajar	Pb, Zn	Morocco		Info sheet incomplete
Draa Sfar	Pb, Zn	Morocco		Info sheet incomplete
Tighardine	Pb, Zn	Morocco		Info sheet incomplete
Taurit Mine	Fluorspar	Morocco	95 km south of Nador Port	Info sheet incomplete



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
El Hammam Mine	Fluorspar	Morocco		Info sheet incomplete
Khemisset Project	Potash	Morocco	SE of Rabat	Info sheet incomplete
SA Metal Group	Non-ferrous and ferrous metals	South Africa	Cape Town, Johannesburg, Pretoria	No contact made
Universal Recycling Company	Non-ferrous metals, electronic waste, Rare metals,	South Africa	Johannesburg	No contact made
Star Recycling Company	Non-ferrous and ferrous metals	South Africa	Alberton	No contact made
Amalgamated Metal Recycling (a subsidiary of Insimbi Group)	Fe, steel, Al, Cu, zinc, stainless steel, lead, Ni, brass, Sn, bronze, etc.	South Africa	Cape Town, Johannesburg, Durban	No contact made
Cast Products South Africa Pty (Ltd)		South Africa	Johannesburg	No contact made
Primo Recycling	Ferrous and Non-Ferrous metals	South Africa	Germiston	No contact made
Maningi Metals	Scrap metal recycling	South Africa	Johannesburg	No contact made
Splitrock recycling	Ferrous and Non-Ferrous metals (paper and plastic)	South Africa	Randburg	No contact made
AST Recycling	E-waste and scrap catalytic converters	South Africa	Johannesburg, Pretoria, Cape Town, Durban	No contact made
Vulcan Metal & Logistics	Ferrous and Non-ferrous scrap metals	South Africa	Gauteng	No contact made
Wykco Metals	Ferrous and non-ferrous metals`	South Africa	Cape Town	No contact made
Paladium Recycling (Pty) Ltd	Scrap metal recycling	South Africa	Gauteng	No contact made
Lynpat Trading Enterprise Pty (Ltd)	Scrap metal recycling, e.g. Cu, copper wires, brass,	South Africa	Gauteng	No contact made



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
	stainless steel, steel			
Sky Metals	Ferrous and non-ferrous metals, e-waste	South Africa	KZN	No contact made
Systemtech Metals (Pty) Ltd	Ferrous and non-ferrous metals	South Africa	Gauteng	No contact made
Isa Cape Investments (Pty) Ltd	Copper wire scrap	South Africa	Cape Town	No contact made
Nigel Metal Industry	Cu	South Africa	Johannesburg	No contact made
Cam Scrap Holdings	Ferrous and Non-ferrous material	South Africa	Mpumalanga	No contact made
SMI Scrap Metal Industries		South Africa	Benoni	No contact made
Dirisanang Metal recycling		South Africa	Boksburg	No contact made
Honeydew Metal Recycling		South Africa	Muldersdrift	No contact made
Asibambane Recycling		South Africa	Midrand	No contact made
DK Scrap Metal's		South Africa	Kepton Park	No contact made
Nzombane recycling		South Africa	Johannesburg	No contact made
Monster Recycling		South Africa	Pretoria	No contact made
Power Metal Recyclers		South Africa	Germiston	No contact made
Bakubung Platinum Mining Project	PGMs	South Africa	North West Province	No contact made
Bauba Platinum Project	PGMs	South Africa		No contact made
Berg PGM Project	PGMs	South Africa		No contact made
Booyse dal	PGMs	South Africa	Mashishing	No contact made
Brits Vanadium Project	V	South Africa	Brits, North West Province	Info sheet sent, no response yet



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Crocette Section Development Project	PGMs	South Africa	North West Province	No contact made
Crocodile River Mine	PGMs	South Africa	North West Province	No contact made
Doornbosch PGM Plant	PGMs	South Africa		No contact made
Dullstroom Plats (Pty) Ltd	PGMs	South Africa		No contact made
Frannor Trading 108 (Pty) Ltd	PGMs's, Au, Cr & acc base me	South Africa		No contact made
Ghost Mountain Prospect	PGMs	South Africa		No contact made
Golden Valley Project	PGMs	South Africa		No contact made
Grootboom Project	PGMs	South Africa	Limpopo Province	No contact made
Hacra Project	PGMs	South Africa		No contact made
Harriet's Wish Project	PGMs	South Africa		No contact made
Highveld Steel & Vanadium	Vanadium	South Africa	Roosenekal, Limpopo	No contact made
Ivanplats (Pty) Ltd	PGMs	South Africa	Mokopane District, Limpopo Province	No contact made
Kalplats Extended Project	PGMs	South Africa	North West Province	No contact made
Kalplats PGM Exploration Project	PGMs	South Africa	North West Province	No contact made
Kliprivier Project	PGMs	South Africa	Gauteng Province	No contact made
Lesego Platinum Project	PGMs	South Africa	Limpopo Province	No contact made
Liger PGM Project	PGMs	South Africa	Limpopo Province	No contact made
Little Swift Investments (Pty)	PGMs, Ni, Cr, Au, Ag, Cu, Co	South Africa		No contact made
Mamma Metal Group (Pty) Ltd	Coal, Iron Ore, PGMs, Ag Ni, V, U, Zn, Au, Diamond, Cu	South Africa		No contact made
Mapochsgronde Realisasie (Pty)	PGMs, precious & base metals	South Africa		No contact made



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Mareesburg Platinum Mine	PGMs	South Africa	Limpopo Province	No contact made
Maseve Mine	PGMs	South Africa	Rustenburg	No contact made
Messina Platinum Mines Ltd	PGMs, Au, Co, Cu, Ni, Sulphur	South Africa		No contact made
Misty Sea Trading 262 (Pty) Ltd	PGMs, Iron ore, Cu, Au	South Africa		No contact made
Modikwa Platinum Mine	PGMs, Gold, Co Metal, Cu, Ni, Sulphur	South Africa	Limpopo Province	No contact made
Mokopane Vanadium Project	V	South Africa	Mokopane District, Limpopo Province	No contact made
Mooi-nooi Tailings Plant	PGMs	South Africa	North West Province	No contact made
Mphahlele Project	PGMs	South Africa	Limpopo Province	No contact made
Nhlalala Mining (Pty) Ltd	PGMs, Au, Cr, Cu, Co	South Africa		No contact made
Nkomati Mine Expansion 1	PGMs	South Africa	Mpumalanga Province	No contact made
Nkomati Mine Expansion 2	PGMs	South Africa	Mpumalanga Province	No contact made
Nkotwane Minerals and Energy	Iron, V, Cr & PGMs	South Africa		No contact made
Nkwe-Garatau Project	PGMs	South Africa		No contact made
Onderstepoort Project	PGMs	South Africa		No contact made
Pilanesberg Platinum Mine	PGMs	South Africa	Pilanesberg	No contact made
Platreef Project	PGMs	South Africa	Limpopo Province	No contact made
Rietfontein 338JQ Project	PGMs	South Africa		No contact made
Roan / Doornpoort Project	PGMs	South Africa		No contact made
Rooderand Project	PGMs	South Africa	North West Province	No contact made
Rooipoort Platinum Project	PGMs	South Africa	Limpopo Province	No contact made
Rustenburg Union Section Project	PGMs	South Africa	Rustenburg	No contact made



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Sable JV Project	PGMs	South Africa		No contact made
Siyanda Bakgatla Platinum Mine (Union)	PGMs	South Africa	Limpopo Province	No contact made
Smokey Hills Platinum Mine	PGMs, Gold, Co Metal Ic, Cu, Ni, Sulphur	South Africa		No contact made
South Block Project	PGMs	South Africa		No contact made
Southern Era Mining	PGMs & associated minerals	South Africa		No contact made
Spitzkop Project	PGMs	South Africa		No contact made
Steelpoortdrift (SPD) Vanadium Project	V	South Africa	Greater Tubatse Local Municipality	No contact made
Styldrift JV Project	PGMs	South Africa		No contact made
Tamboti Platinum (Pty) Ltd	PGMs, Au, Co, Cu, Ni, S	South Africa		No contact made
Tharisa Platinum Mine	PGMs (Pt, Pd, Rh), Chrome	South Africa	35 km east of Rustenburg and 120 km northwest of Johannesburg in the North West Province of South Africa.	No contact made
Tinderbox Prospect	PGMs	South Africa		No contact made
Tivani Iron Ore Project	Iron Ore, Ti & V	South Africa		No contact made
Tivumbeni Mining & Exploration	Iron, Ti & V	South Africa		No contact made
Tjate Platinum Project	PGMs	South Africa	Greater Tubatse Local Municipality	No contact made
Tubatse Project	PGMs	South Africa		No contact made
Tweespalk Project	PGMs (Pt, Pd)	South Africa	Capricon District Municipality	No contact made
Umbono Mining Holdings (Pty) Ltd	PGMs, Cr, Cu, Ni	South Africa		No contact made



D2.1 Project fact sheet and flow analyses templates

Project Name	Commodity	Country	Location	Status
Union Section Declines And Spud Shaft Project	PGMs	South Africa	Sekhukhuneland	No contact made
Vametco Mine	V	South Africa	North West Province	No contact made
Vanchem Processing Plant	V	South Africa	Mpumalanga Province	No contact made
Vanmag Mine	V & Magnetite	South Africa	Mogalakwena Local Municipality	No contact made
Volspruit Platinum Project	PGMs	South Africa	Limpopo Province	No contact made
Walhalla	PGMs	South Africa		No contact made
War Springs Project	PGMs (Pt, Pd)	South Africa	Limpopo Province	No contact made
Waterberg Platinum Project / Group Metals Waterberg Operations	PGMs (Pt, Pd)	South Africa	Mogalakwena Local District	No contact made
Zandfontein Tailings Dam	PGMs	South Africa	North West Province	No contact made
Thadaku Battery Plant	Ni sulphate, Co Hydroxide	South Africa		No contact made
Sylvania Dump Operations	PGMs, Cr	South Africa	North West Province	No contact made
Booyesdal South tailings storage facility	PGMs, Cr	South Africa	Limpopo Province	No contact made
Louis Moore Tailings facility		South Africa	Giyani	No contact made
Marikana Tailings (Eastern Tailings dam)	PGMs	South Africa	Rustenburg	No contact made





WP2 Workshop on Secondary Raw Materials and Inclusive Recycling

WP2 workshop organized by World Resource Forum Association (WRFA)

14 November 2022



Funded by
the European Union

Objective of this workshop

- ▶ WP2: The ECRM value chain analysis activities
 - ▶ Task 2.1: Compilation of reliable data on primary and **secondary ECRM value chains** for the subsequent identification of related opportunities
 - ▶ Action 4: Organize an **internal workshop** with all the project partners to:
 - ▶ define the **scope of secondary raw materials** ECRM value chains
 - ▶ discuss the requirements and approaches for **integration of the informal sector** in secondary ECRM value chains (i.e. **inclusive recycling**).

Agenda

#	Timing	Topic	Speaker
1	09H00-09H10	Welcome and introduction	Shahrazad Manoochehri (WRFA)
2	09H10-09H35	Presentation: <i>Re-processing Mining Waste - Rethinking the “status quo” of mining waste management</i> Discussion and Q&A	Robin S. Gilli (WRFA)
3	09H35-10H20	Presentation: <i>Recovering valuable material from waste - The case of electronics, cars and batteries</i> Discussion and Q&A	Adrien Specker (WRFA)
4	10H20-10H55	Presentation: <i>Informal sector in secondary raw materials value chains – Importance of inclusive recycling</i> Discussion and Q&A	Sonia Valdivia (WRFA)
5	10H55-11H00	Wrap up and closing	Shahrazad Manoochehri



Dr. Robin S. Gilli
Project Manager, WRFA





Re-processing Mining Waste

Re-Thinking the “status quo” of Waste Management

14. Nov 2022, Robin S. Gilli



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Outline

▶ Introduction

- ▶ Circular Economy
- ▶ Secondary Critical Raw Materials
- ▶ Recycling Mining Waste
- ▶ Re-Thinking Mining Waste – Zero Waste Future

▶ Waste Valorization

- ▶ Defining the “R” words – Reuse, Recycling, Reprocessing
- ▶ Types of Mining Waste
- ▶ Grades of Ore in Mining Waste
- ▶ Global Volumes

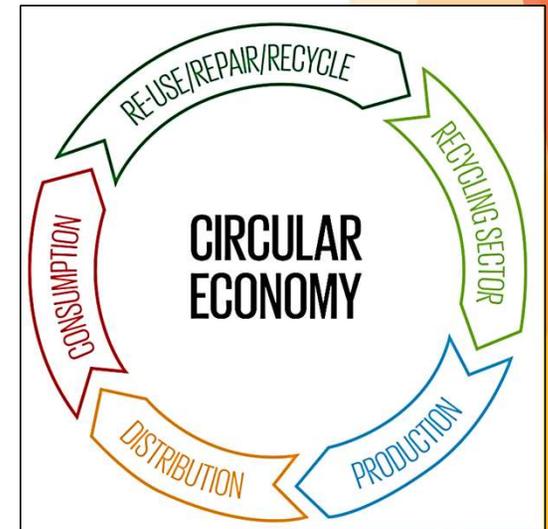
▶ Examples of Active Mining Waste Recycling in Africa

▶ Open Discussions, Q&A

Introduction

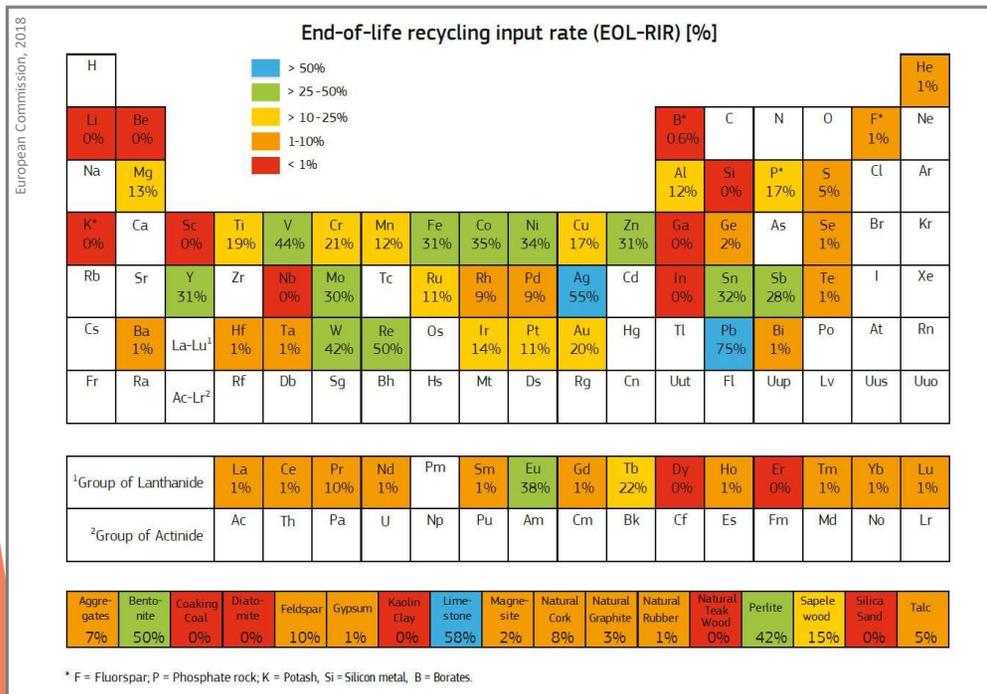
Circular Economy

- ▶ Aims to draw the maximum value from materials
- ▶ Its implementation should be a significant shift from the “status quo”
- ▶ Aims to “**design out**” waste



Introduction

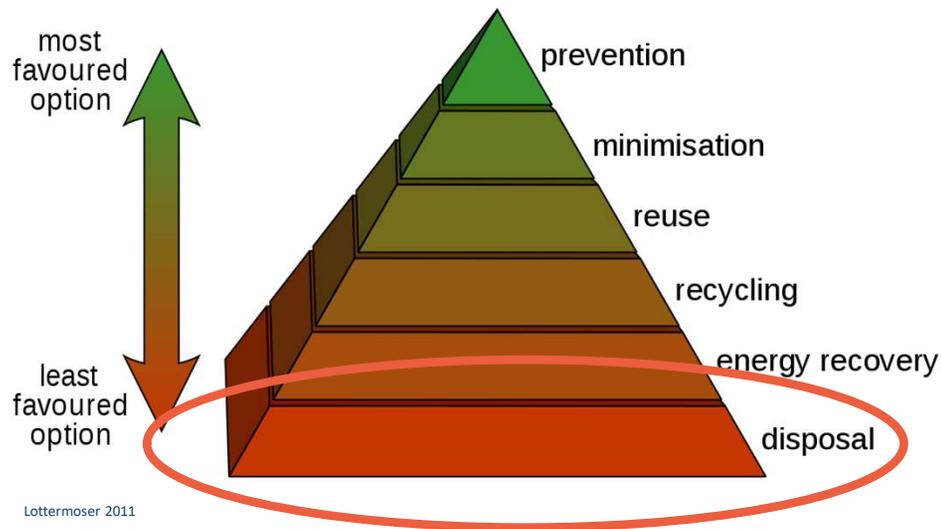
Secondary Critical Raw Materials (CRMs) - Definition



- ▶ CRMs - reach or exceed thresholds for both economic importance and supply risk
- ▶ “Secondary” CRMs – from recycling of waste
- ▶ Recycling Input Rate (RIR) of CRMs is low and dependent on the sectors where CRMs are used
- ▶ Continued access to primary and secondary sources is crucial for European industries

Introduction

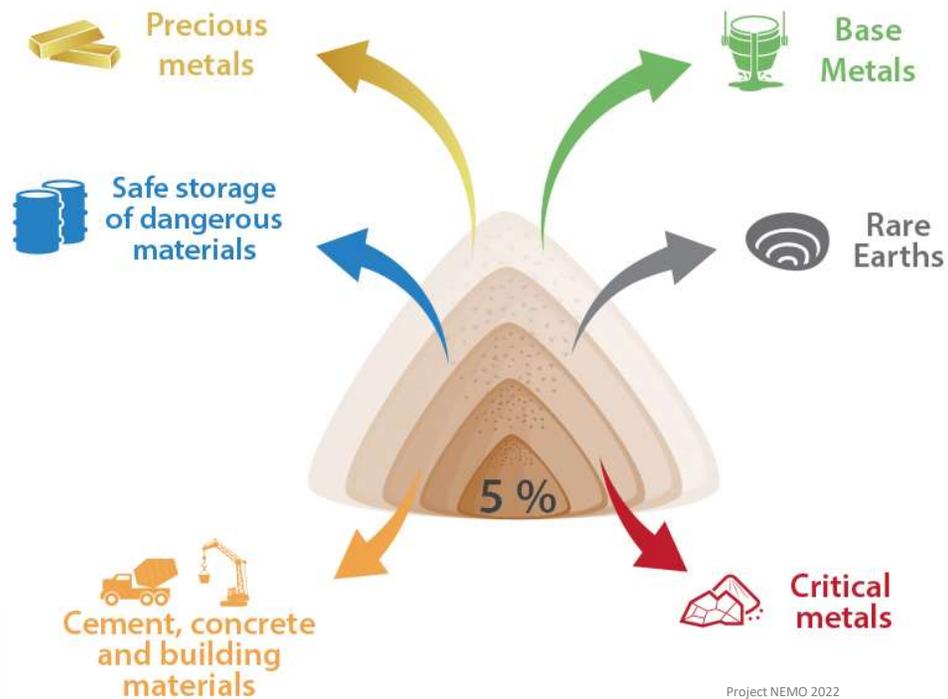
Recycling Mining Waste



- ▶ Recycling and reuse of mine waste are largely driven by their practical applications and financial returns
- ▶ The Mine Waste Hierarchy
 - ▶ Prioritizes waste management practices
 - ▶ Waste Prevention being the preferred option
 - ▶ Disposal and treatment being the least desirable

Introduction

Re-Thinking Mining Waste – Zero Waste Future



Project NEMO 2022

- ▶ Europe – investments, research funding into technologies to utilize all aspects of waste
- ▶ For example: Project NEMO – Near zero Waste
- ▶ Highlight African projects that are rethinking mining waste

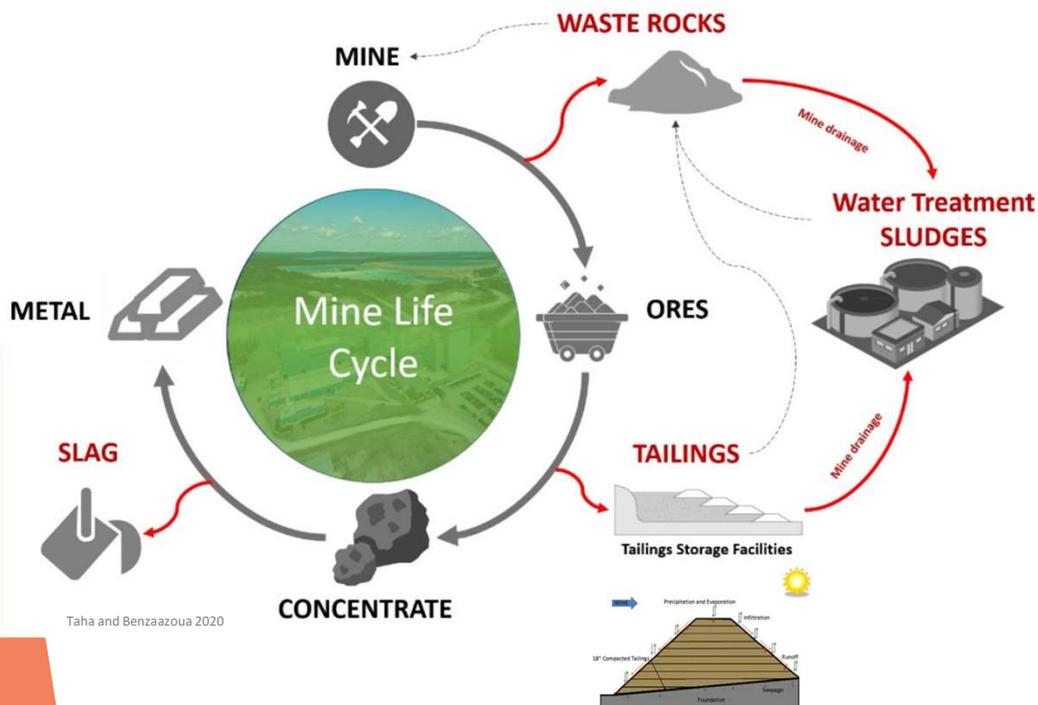
Mining Waste Valorization

Defining the “R” Words for Mining Waste

- ▶ As defined by Lottermoser 2011 - *Elements*
- ▶ Reuse – The process involving the new use or application of mine waste in its original form **without any reprocessing**
- ▶ Recycling – the practice that extracts new valuable resource ingredients and converts the entire mine waste into a new valuable product **with some reprocessing**
- ▶ Reprocessing – designed to use the waste material as **feedstock** (source) for producing a valuable product, such as metal and mineral **recovery**.

Mining Waste Valorization

Types of Mine Wastes



- ▶ Solid and liquid by-products of mining, mineral processing and metallurgical extraction processes
 - ▶ Mining Wastes – Waste Rocks
 - ▶ Mineral Processing Wastes – Tailings
 - ▶ Metallurgical Processing Wastes – Slags
- ▶ Historically unfavorable economics, inefficient processing landed many **minerals & CRMs in various wastes**



Mining Waste Valorization

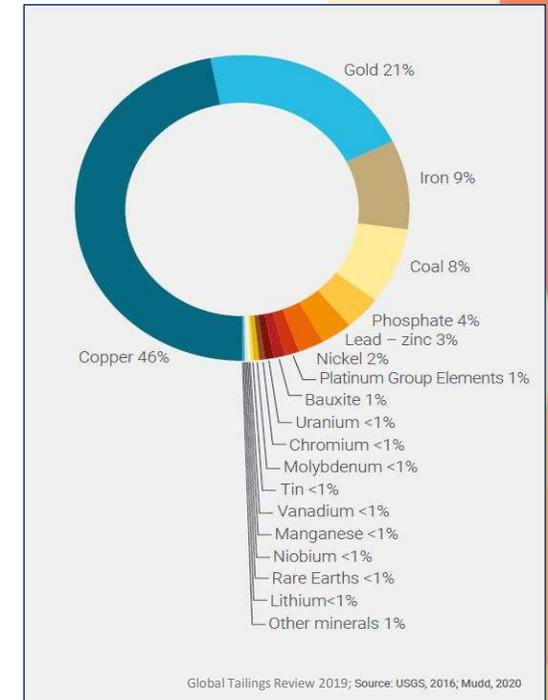
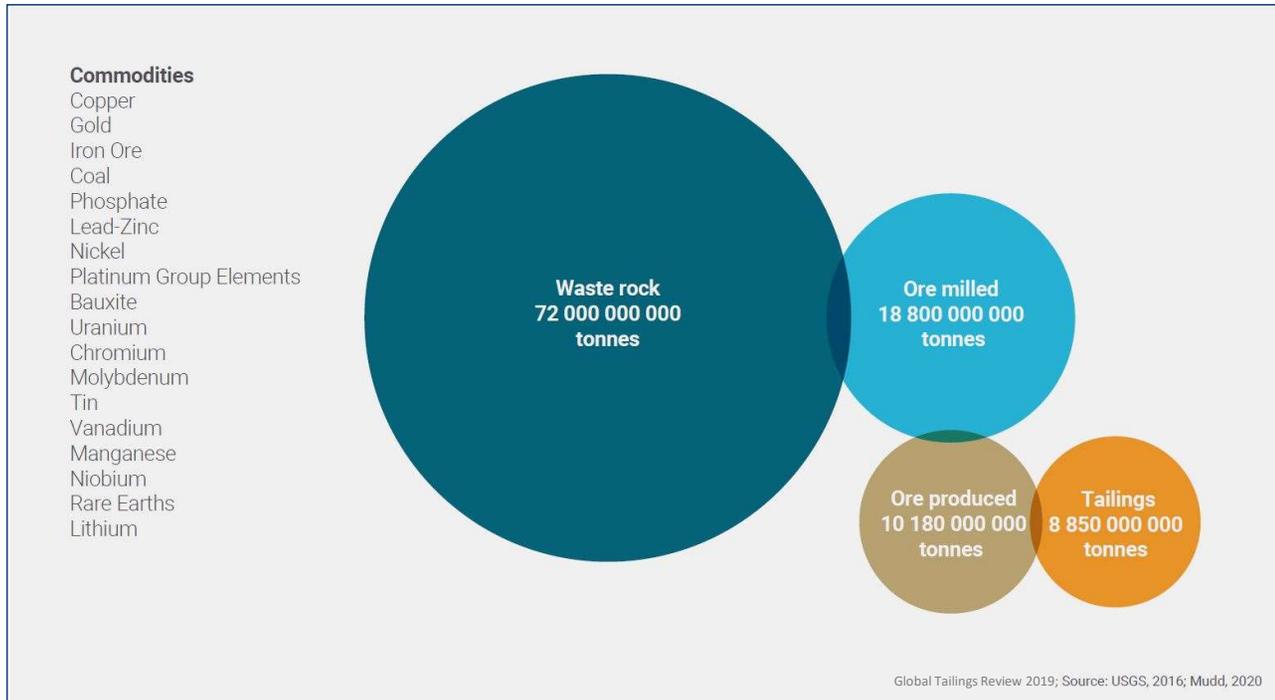
Grades of Ore in Mining Waste

Mucid 2007

Location (DRC) <small>Lutandula and Maloba, 2013</small>	Cu (mg/kg)	Co (mg/kg)
Kolwezi	14'900	3'200
Kakanda	12'000	1'400
Kambove	8'900	1'900
Shituru and Panda	15'000	2'300
Kakanda dump	13'000	1'500

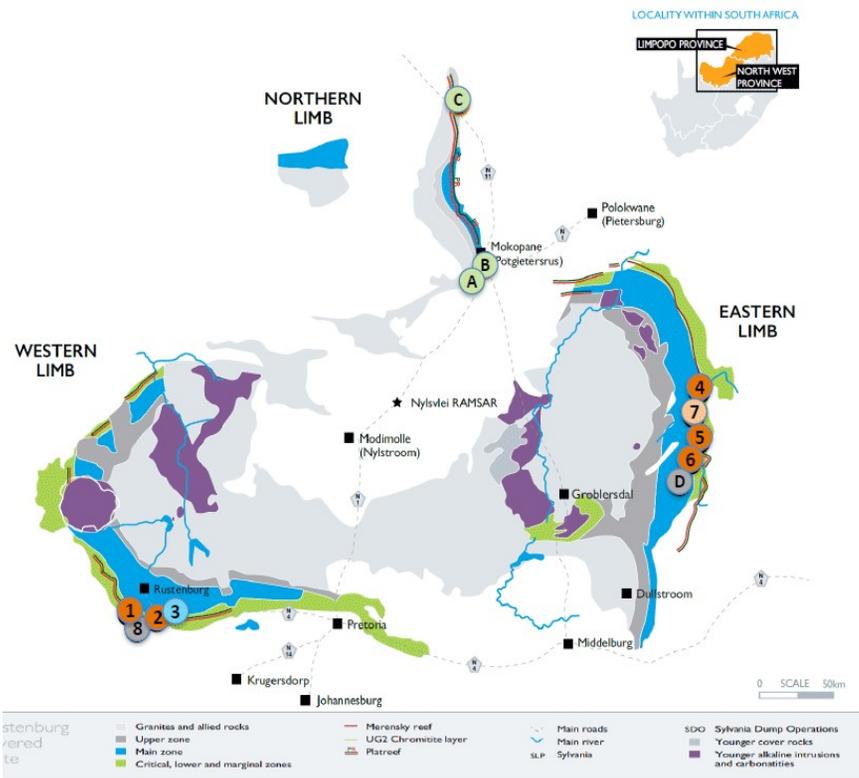
- ▶ Decreasing ore grades means increasing volumes of waste
- ▶ Ore grades in mining waste often exceed the current primary ore grade
- ▶ Estimates show high concentrations of reserves in waste storage facilities
- ▶ Example various copper wastes in DRC

Global Volumes of Mine Waste



- ▶ In 2016 it was estimated that more than 8 billion tons of tailings were produced from the extraction of metals and minerals
- ▶ The majority from copper mining followed by gold, and iron

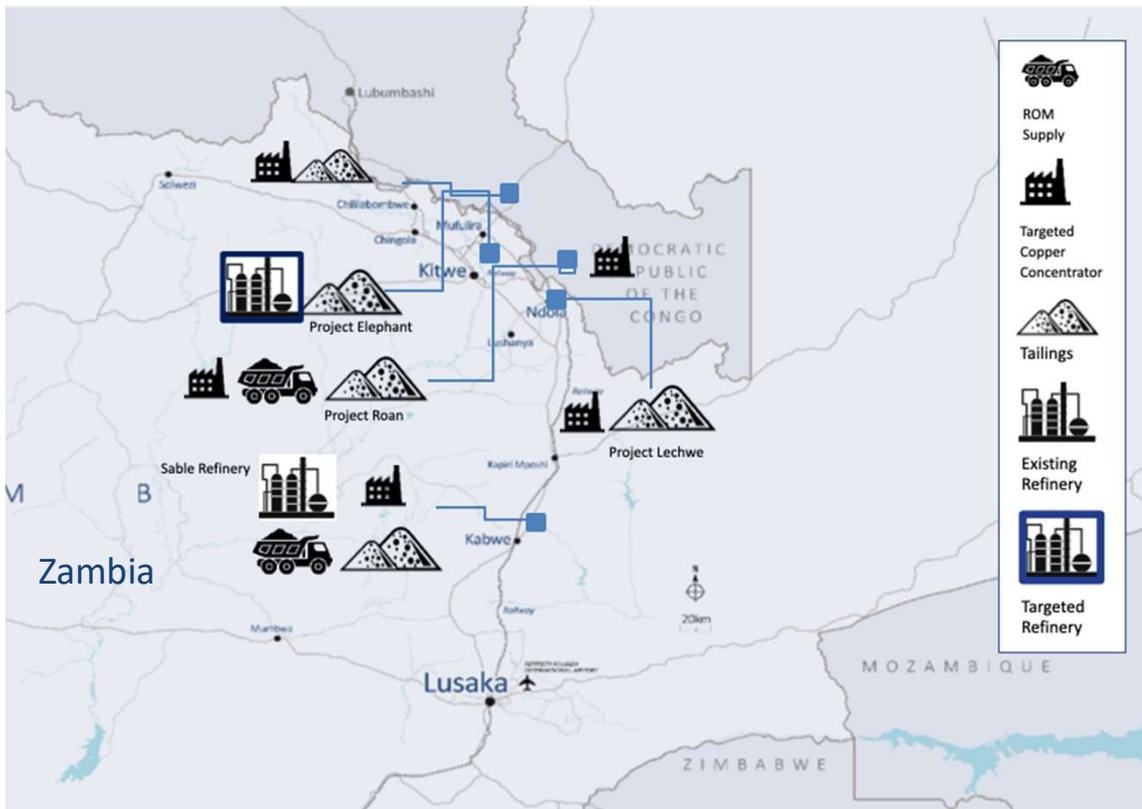
Examples of Mine Waste Recycling- Spotlight Africa



Sylvania Platinum Limited Sylvania Dump Operations, South Africa

- ▶ In operation since 2008
- ▶ Operates seven mining waste reprocessing facilities
- ▶ Utilizes chrome tailings for the recovery of platinum group metals (PGMs) and chrome concentrate
- ▶ Also a primary producer

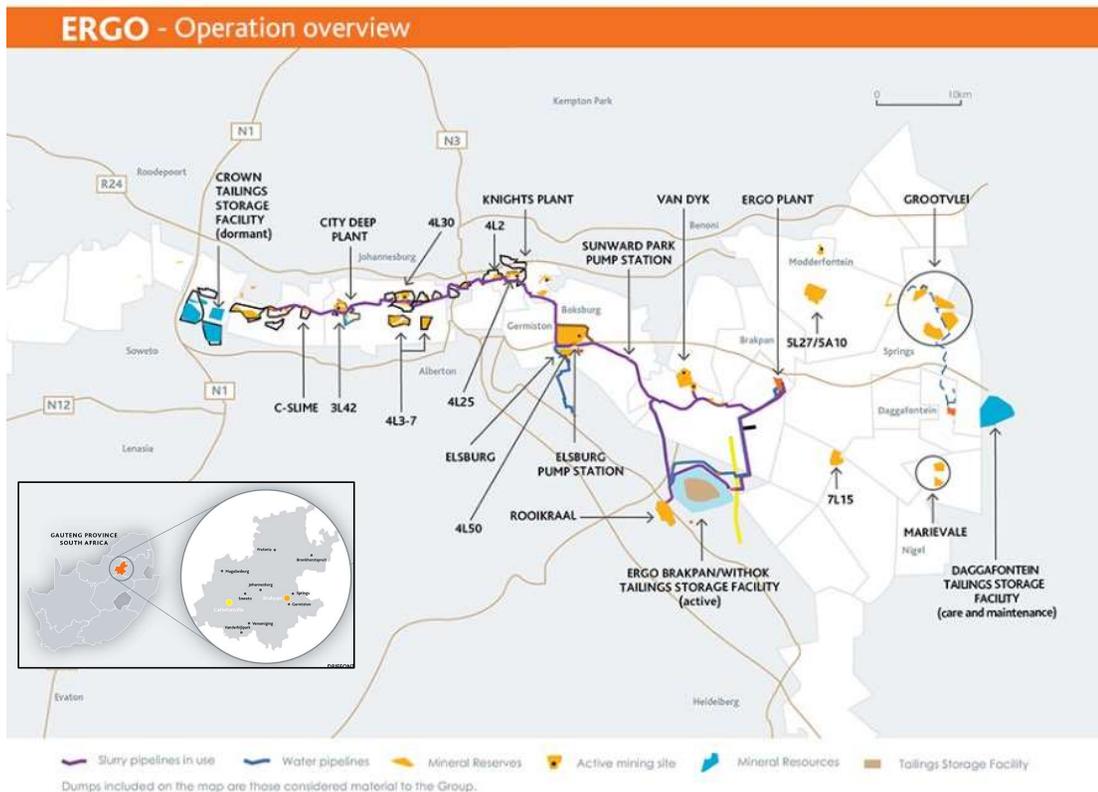
Examples of Mine Waste Recycling- Spotlight Africa



Jubilee Metals Group Kabwe, Zambia

- ▶ Sable reprocessing facility acquired 2019
- ▶ Secures access to large regional supply of historic on-surface wastes tailings for the recovery of copper (Cu) and cobalt (Co)
- ▶ Also works together with primary producers
- ▶ Also have operations in SA recovering PGMs from waste

Examples of Mine Waste Recycling- Spotlight Africa



DRD Gold Limited Brakpan and Carletonville, South Africa

- ▶ Originally established in 1895
- ▶ Operates two mining waste reprocessing facilities
- ▶ Transitioned completely from deep level underground mining to the large-scale retreatment of mine dumps and tailings dams (date of transition unclear)
- ▶ *Au recovery (not an ECRM)



Open Discussion and Q&A



Thank you!



Robin S. Gilli



robin.gilli@wrforum.org



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Recovering valuable materials from waste

- The case of electronics, cars and batteries -

14 Nov, 2022. Adrien Specker



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Outline

- ▶ Introduction
 - ▶ Characteristics of WEEE
 - ▶ Characteristics of ELV
 - ▶ Characteristics of batteries
- ▶ Recycling value chain
 - ▶ Collection
 - ▶ Dismantling/pre-processing
 - ▶ End-processing
 - ▶ Good practices
 - ▶ Current technologies
- ▶ Examples
 - ▶ Plastic waste value chain
 - ▶ Scrap metal value chain

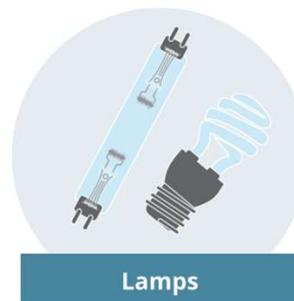
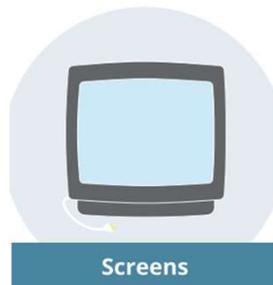
\$ 62 billion

**Three times more than the
annual output of the world's
silver mines**



WEEE are EEE

- ▶ WEEE (waste electrical and electronic equipment) are EEE (electrical and electronic equipment) which become waste, according to the waste definition of the EU
- ▶ Definition of EEE
 - ▶ Equipment depending on electric current or electromagnetic fields in order to function.
- ▶ 6 main categories (set by the WEEE Directive of the EC)



WEEE are valuable

		Occurrence in WEEE		Concentration range (mg/g)																	
		<ul style="list-style-type: none"> Printed circuit boards Displays Hard disc drives 		<ul style="list-style-type: none"> 0.01-1 1-100 >100 																	
hydrogen 1 H 1.0079	beryllium 4 Be																	helium 2 He 4.0026			
lithium 3 Li 6.941	magnesium 12 Mg 24.305																	neon 10 Ne 20.180			
sodium 11 Na 22.990	calcium 20 Ca 40.078																	argon 18 Ar 39.948			
potassium 19 K 39.098	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80					
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	silver 46 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29					
cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57-70 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	wolfram 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]				
francium 87 Fr [223]	radium 88 Ra [226]	actinium 89-102 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	escherium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]						

* Lanthanide series

lanthanum 57 La	cerium 58 Ce	praseodymium 59 Pr	neodymium 60 Nd	promethium 61 Pm	samarium 62 Sm	europium 63 Eu	gadolinium 64 Gd	terbium 65 Tb	dysprosium 66 Dy	holmium 67 Ho	erbium 68 Er	thulium 69 Tm	ytterbium 70 Yb
actinium 89 Ac	thorium 90 Th	protactinium 91 Pa	uranium 92 U	neptunium 93 Np	plutonium 94 Pu	americium 95 Am	curium 96 Cm	berkelium 97 Bk	californium 98 Cf	escherium 99 Es	fermium 100 Fm	mendelevium 101 Md	nobelium 102 No

** Actinide series

Did you know?

There is **100x** more gold in 1 ton of WEEE than in 1 ton of gold ore

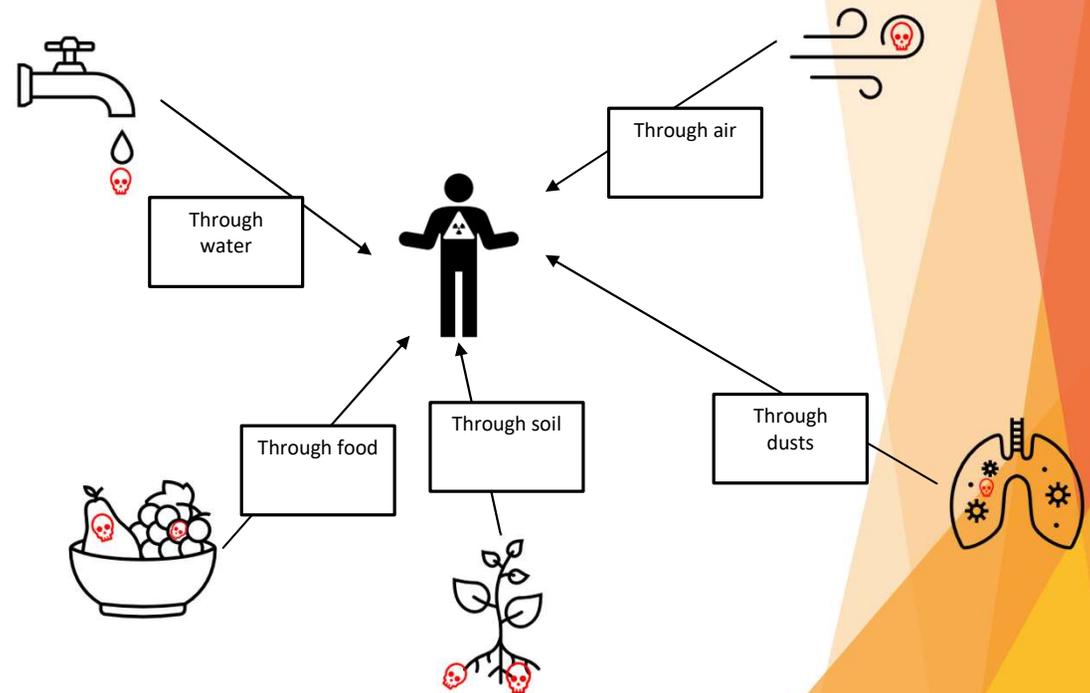
In USA, the equivalent of **\$60 million** in gold and other precious metals from WEEE is dumped each year.

Recycling just 1 million smartphones gives access to **16 tonnes** of recoverable copper

- ▶ WEEE contain a big quantity of “extended” critical raw materials such as Manganese, Nickel, Copper, Indium, Tin or Antimony.
- ▶ Technically, they can all be recovered.

WEEE are hazardous

- ▶ Many substances found in WEEE are toxic and hazardous.
- ▶ Because of this toxic nature of WEEE, they need a special treatment
- ▶ Heavy metals like Lead, Mercury, Cadmium, Chromium, Tin, Antimony



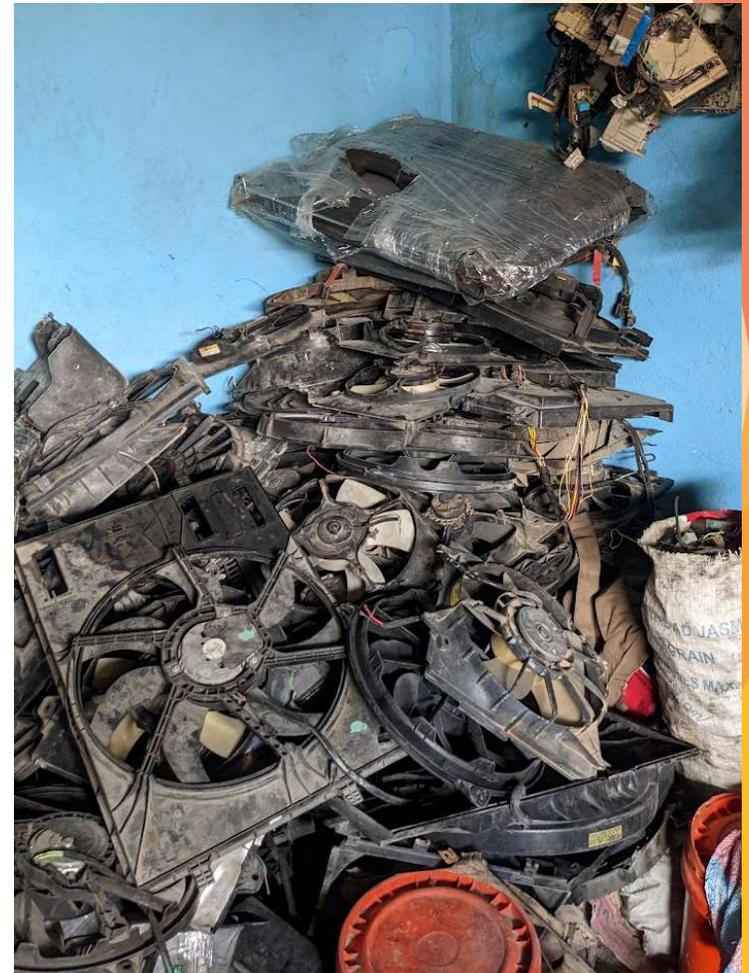
What are ELV?

- ▶ End-of-life vehicles still lack a proper circular economy model in African countries and are mostly stockpiled
- ▶ Some countries are equipped with the sorting infrastructure and furnaces required for properly treating of all the parts and materials in ELVs.
- ▶ This sector is largely dominated by the informal sector.
- ▶ Informal workers scavenge parts from abandoned vehicles and re-sell parts to recyclers.



ELV represent an opportunity

- ▶ Valuable secondary raw materials
 - ▶ Iron, Aluminium, **Copper**, Zinc, catalytic converter.
 - ▶ Electrification of mobility – rare earth metals – cobalt – lithium
 - ▶ Batteries, are also a source of value.



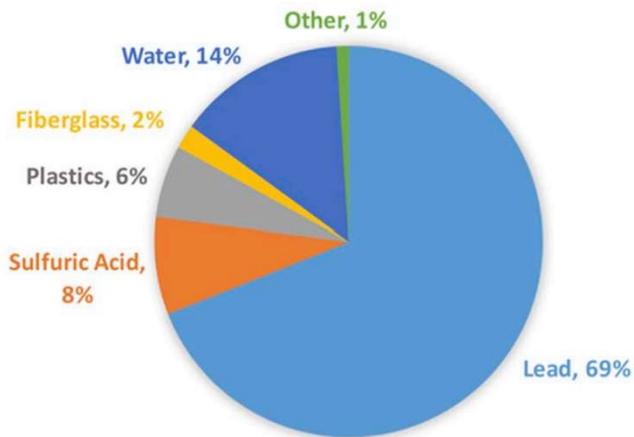
Batteries

- ▶ Most common batteries in Africa are lead-acid batteries LAB, and lithium-ion batteries LIB.
- ▶ Generally more public awareness on LAB than on LIB
- ▶ LAB treatment is quite well established in Africa with plants in South-Africa, Cameroon, Ghana, Kenya, Mozambique, Nigeria, Tanzania and Tunisia.
- ▶ LIB are more problematic in Africa.
- ▶ No decoupling between WEEE and batteries
- ▶ Not one single LIB recycling plant on the African continent.
- ▶ Currently, LIB are mostly stockpiled at WEEE recyclers, and shipped to Europe for pre- and end-processing .
- ▶ >10 000 tonnes/year in South Africa

Batteries are valuable

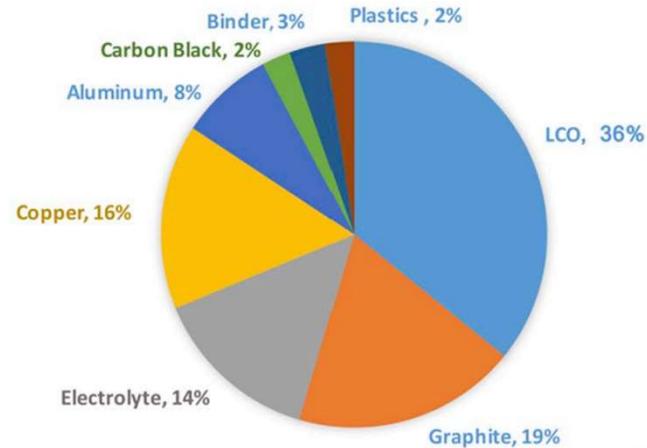
LAB – Lead Acid Batteries

- ▶ Contain mostly lead (~70%), acid (~8%) and plastics (~6-10%).
- ▶ Lead contained in the batteries has a significant value.

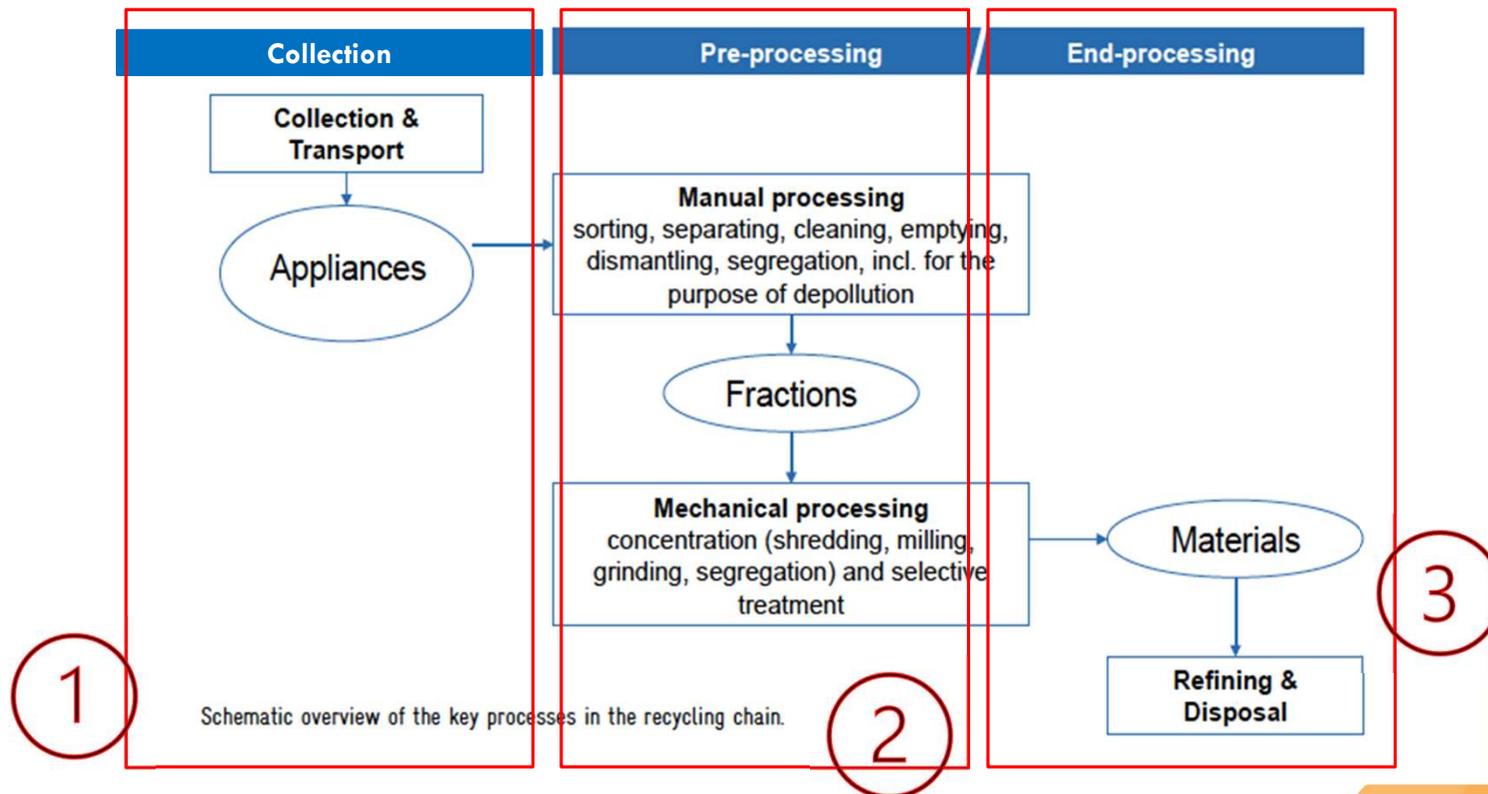


LIB – Lithium-Ion Batteries

- ▶ Contain mostly Lithium, Cobalt (LCO ~40%), Graphite (~19%), Copper (~16%).



The 3 steps of the recycling value chain



Collection

- ▶ First stage of the value chain
- ▶ Sourcing and transporting stage

In the **formal** recycling chain

- ▶ Companies, responsible for the collection and transport of e-waste.

In the **informal** recycling chain

- ▶ Informal workers collect waste in the streets, usually using trolleys and sell it to scrap dealers or recyclers.



Dismantling / pre-processing

Opening of the
appliance

-
Housing separated
from rest

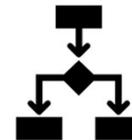


Localization,
identification and
removal of hazardous
components



Dismantling and
separation of the
remaining components

-
Marketable fractions



In the African context, this is
mainly done manually





There is a wide range of technologies

► Crushing and shredding

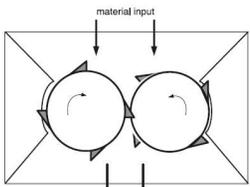


Figure 1. Rotary shears

Rotary shears

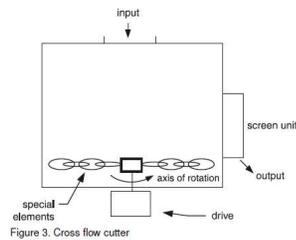


Figure 3. Cross flow cutter

Cross-flow cutter

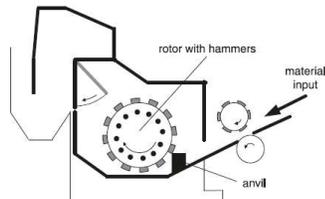


Figure 2. Shredder

Shredder

► Sorting

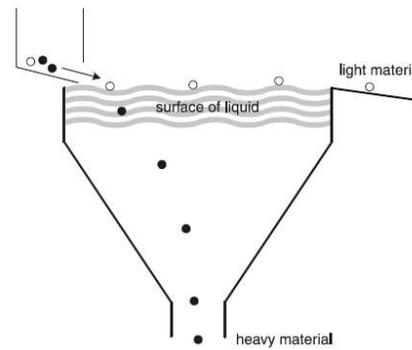
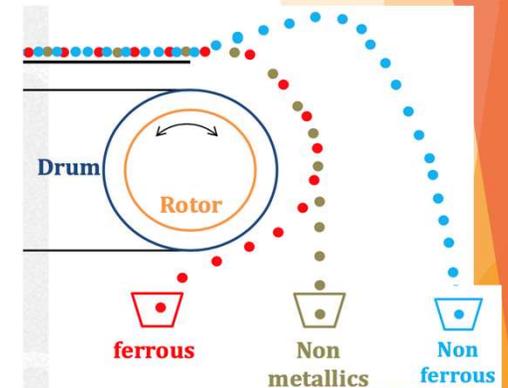


Figure 16. Operating principle of sink-float sorting
Sink-float sorting



End processing

- ▶ The aim is to enable economic and environmentally sound secondary recovery of raw materials.
- ▶ Smelting, melting.



Two examples of recycling value chain in the African context

▶ Scrap metal recycling – steel recycling



▶ Plastic recycling



Example 1

Scrap metal recycling in Abidjan – Ivory Coast Collection





Example 1

Scrap metal recycling in Abidjan – Ivory Coast

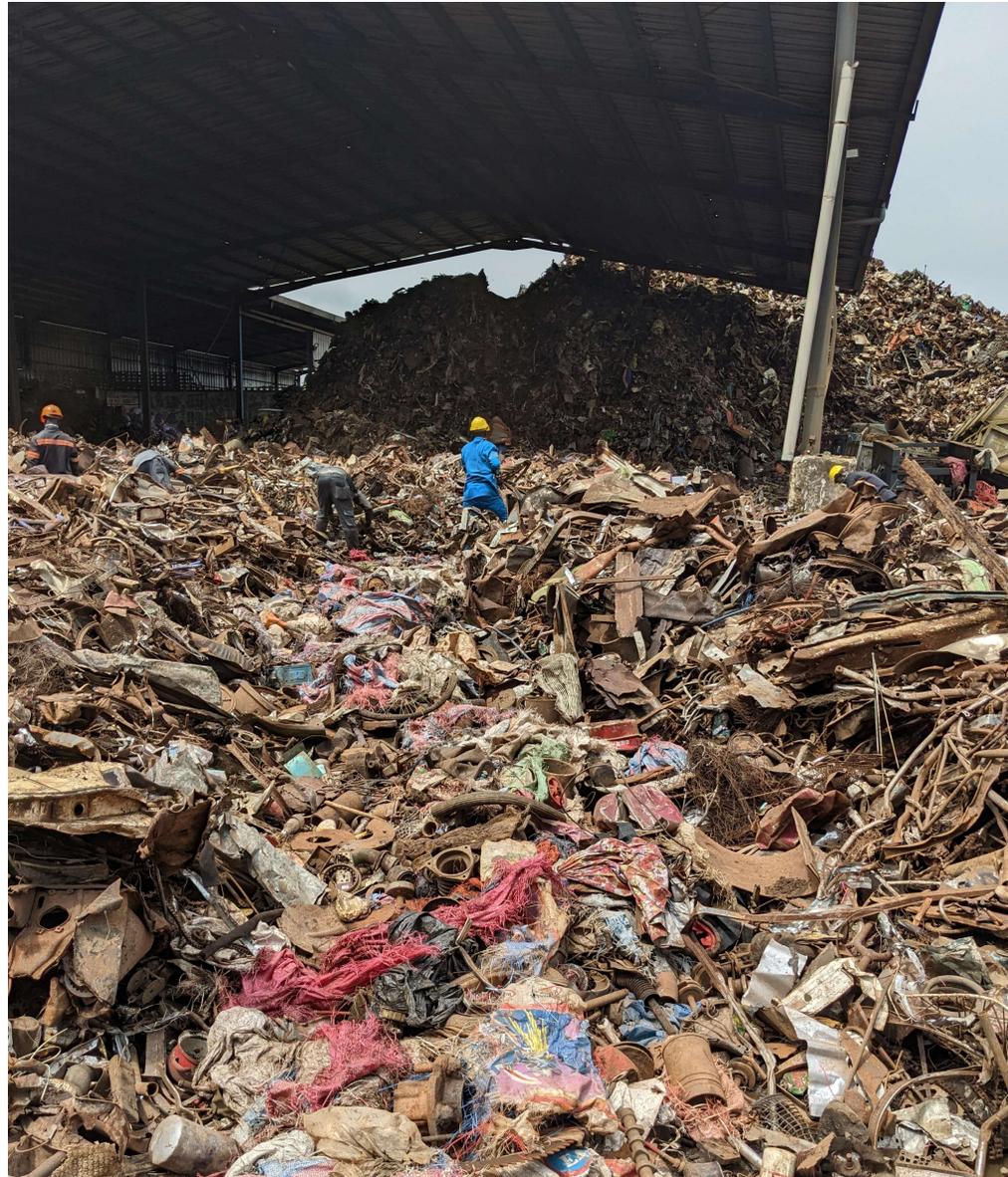
Pre-processing





Example 1

Scrap metal recycling in Abidjan – Ivory Coast Pre-processing





Example 1

Scrap metal recycling in Abidjan – Ivory Coast End-processing





Example 1

Scrap metal recycling in Abidjan – Ivory Coast End-processing





Example 1

Scrap metal recycling in Abidjan – Ivory Coast

Recovery of steel



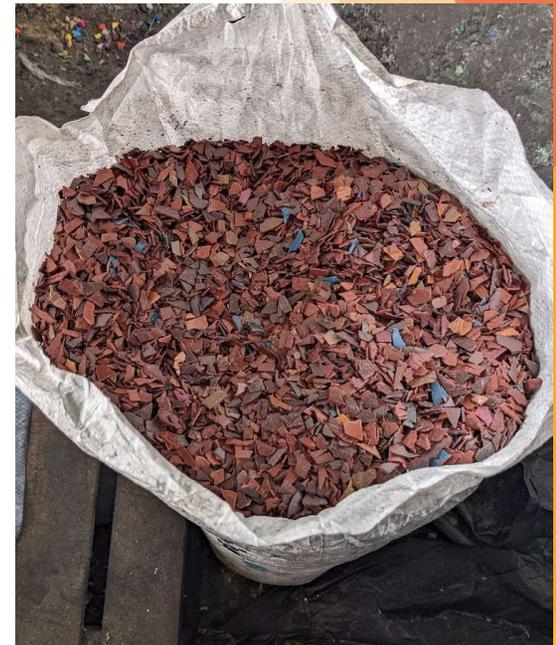


Example 2
**Plastic
recycling in
Abidjan–
Ivory Coast
Collection**





Example 2
Plastic recycling in Abidjan— Ivory Coast Pre-processing





Example 2

Plastic recycling in Abidjan– Ivory Coast End-processing

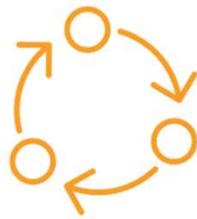




Example 2
Plastic recycling in Abidjan– Ivory Coast
Recovery of plastics



**Mining waste is not a one-time profit but a
regenerative profit!**





Open Discussion and Q&A



Thank you!



Adrien Specker



adrien.specker@wrforum.org



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Recycling and recovering secondary materials

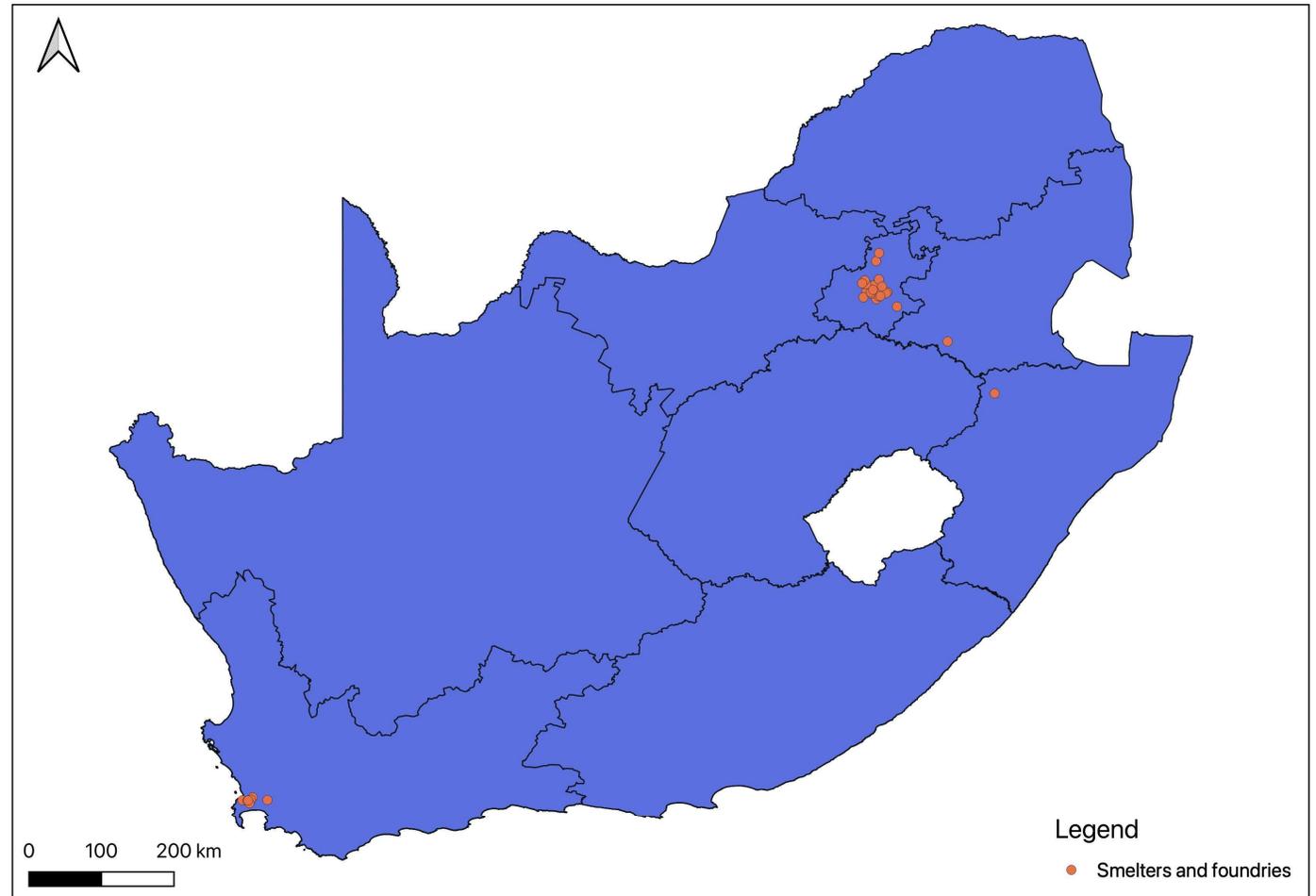
Herman Cornelissen



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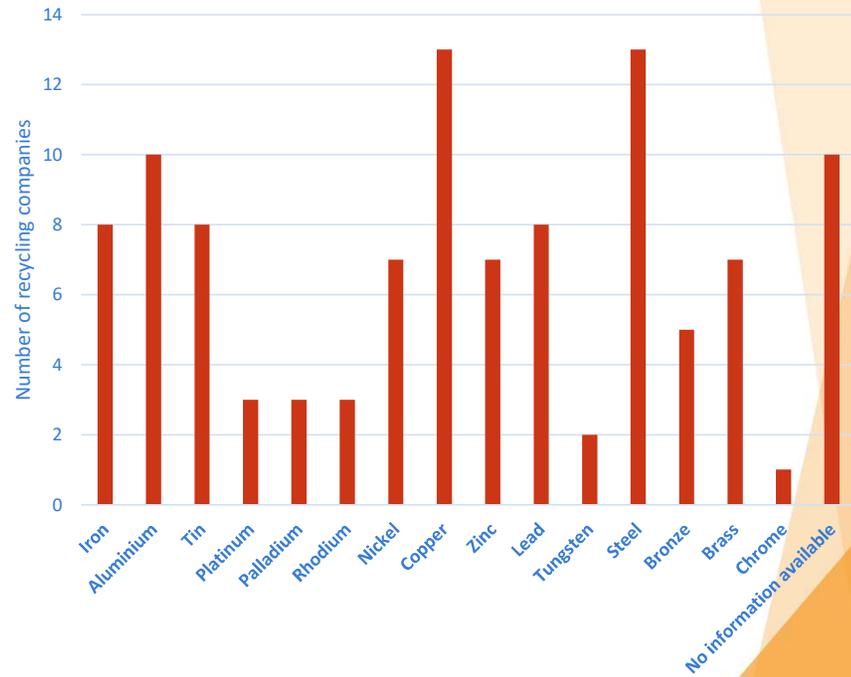
- ▶ Total of 28 recycling companies found
- ▶ Most are clustered around metropolitan centers i.e. Cape Town, Johannesburg and Pretoria, Germiston.
- ▶ One plant found in Mpumalanga and one in KZN.
- ▶ Most are small-scale and localized, SA Metal Group represents the biggest network of metal recycling with multiple divisions (SA Steelworks, SA Copperworks) in Cape Town and Johannesburg.

Map of known recycling plants

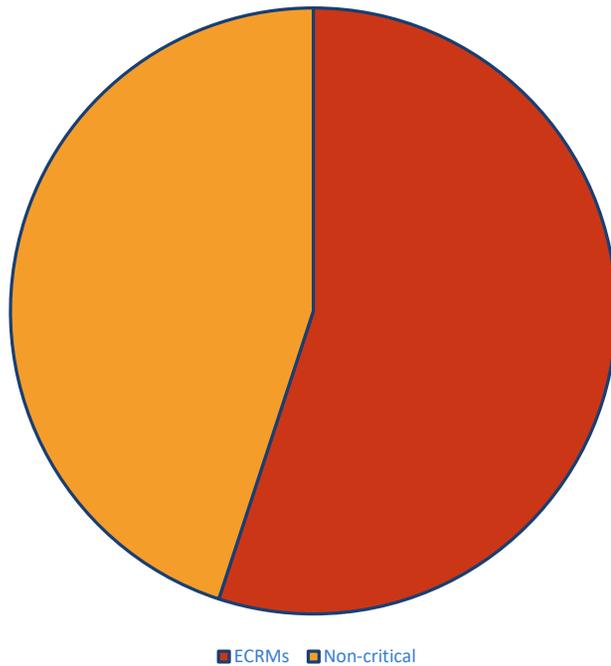


Highlights

- ▶ Copper and steel represent the most widely processed metals in South Africa
- ▶ Aluminum follows closely behind
- ▶ Recycled PGMs (specifically platinum, rhodium and palladium) come from catalytic converters
- ▶ Most companies list steel as a metal they process however there is a lack of information in distinguishing the type of steel received and sold
- ▶ Information is sparse and many companies do not have publicly available information



Proportion of ERCMS recycled



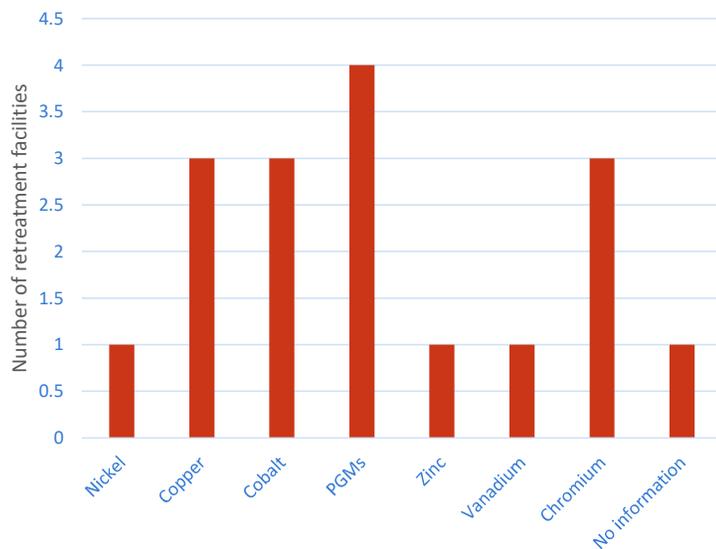
Highlights

- ▶ Of the ERCMs copper is the most widely recycled in South Africa
- ▶ Tungsten, aluminum, tin, nickel, platinum, palladium, rhodium represent the ECRMs that are recycled in South Africa

The state of battery recycling in SA

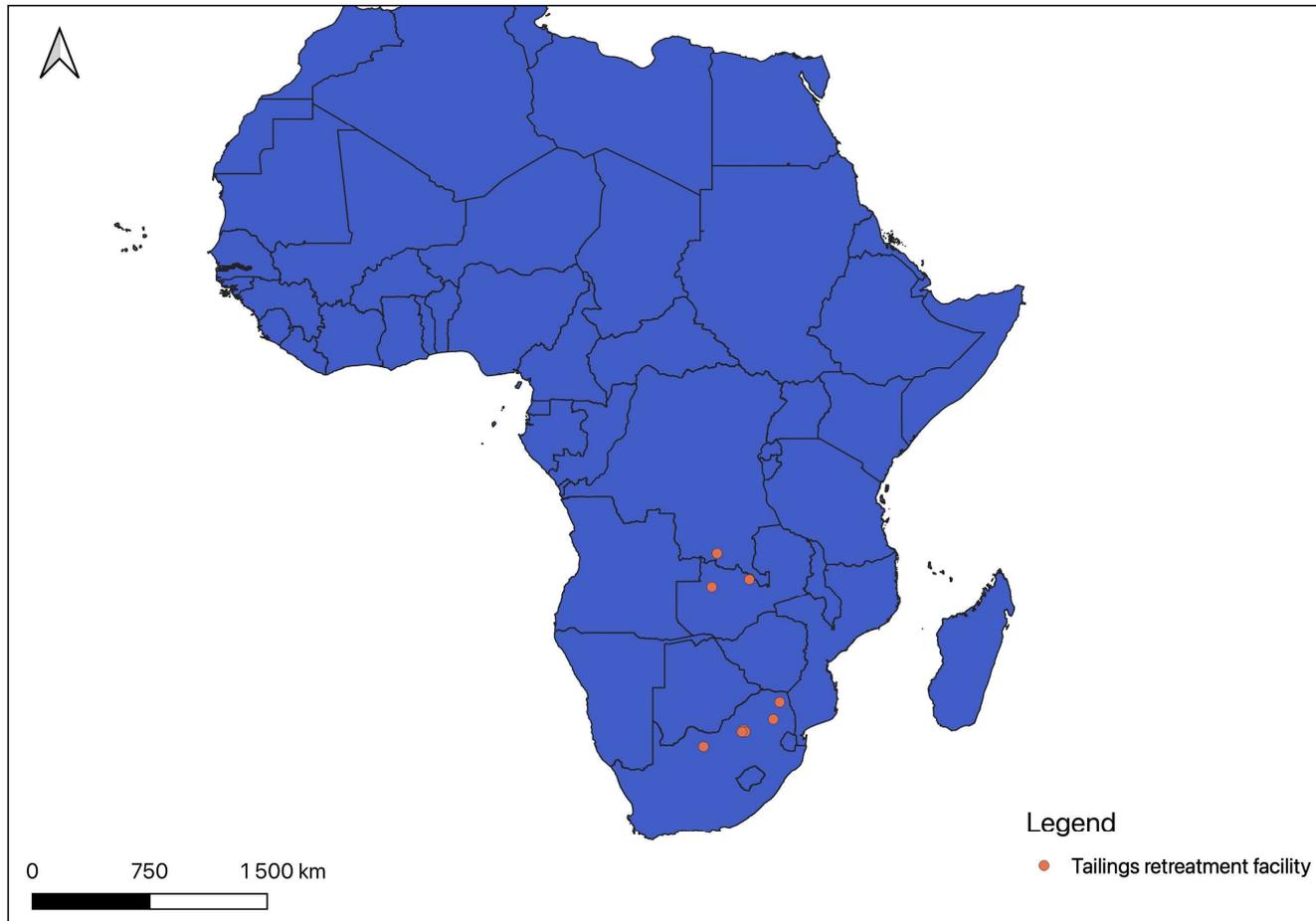
- ▶ Majority of battery recycling in South Africa is still centered around lead acid batteries, where the lead is main recovered material
- ▶ As of 2021 there were no facility for the recycling of lithium-ion batteries in South Africa and Africa (Mintek, 2021).
- ▶ This is true despite an estimated 6 tons - 10 tons of LIB waste having been collected in 2019 but the 2021 DEFF ban on landfilling lithium-ion batteries may be the catalyst for investment in such facilities (Mintek, 2021)

Tailings retreatment



- ▶ PGMs make up the majority of tailings processed
- ▶ Total of 10 tailings retreatment facilities found across, South Africa (7), DRC (1) and Zambia (2)

Tailings retreatment facilities in Africa



Way forward

- ▶ DMT Kai Batla have only just begun looking at recycling and retreatment plants in Africa.
- ▶ Major focus in the first months has been primary sources of ECRM's
- ▶ The list of recycling facilities presented here, is heavily skewed towards South Africa, where most information is available.
- ▶ The work will continue into WP2.2 – until late 2023.



Thank you!



Herman Cornelissen



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group.com**



DMT Kai Batla (Pty) Ltd



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Dr. Sonia Valdivia
Scientific Director, WRFA





Informal Sector

- Inclusive Recycling-

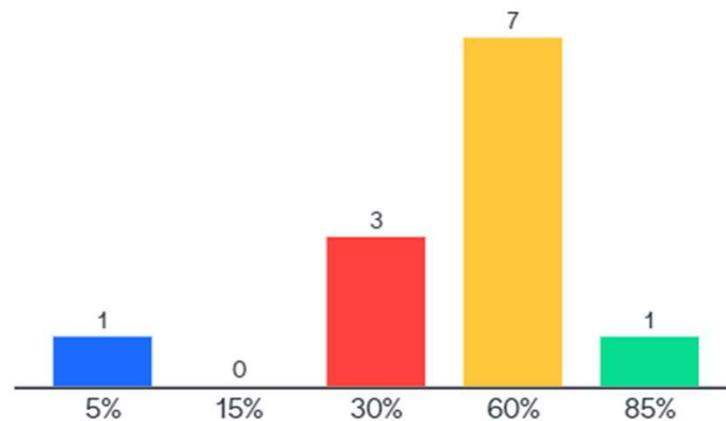
14 Nov, 2022. Sonia Valdivia



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Go to www.menti.com and use the code 2706 5514

What is the share of informal workers in the world economy?



Mentimeter

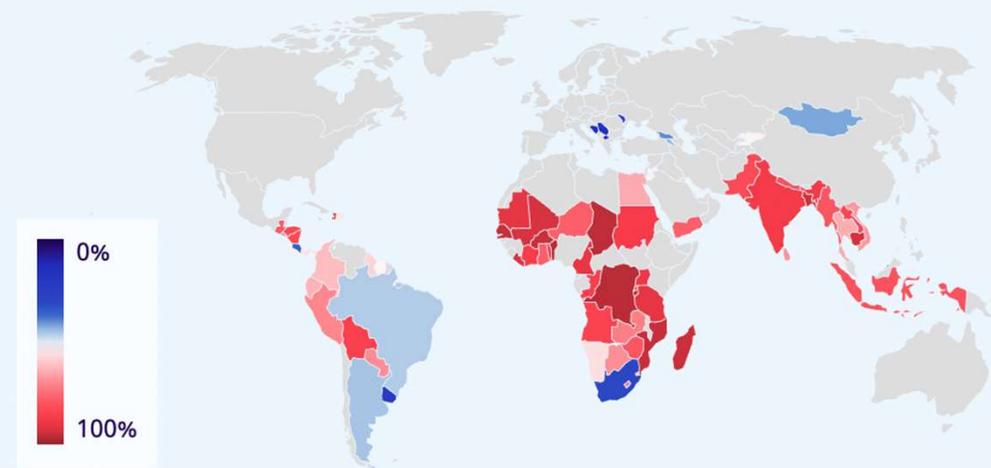
More than 60% of the world's employed population are in the informal economy

Informal employees in Europe amounts to about 15%

- ▶ Own-account workers are most at risk of informality, but employees are most represented in informal employment in developed countries

▶ High shares of informality in developing countries

Share of informal employment by country (in percent), latest year



The boundaries shown on this map do not imply endorsement or acceptance by the ILO.
Last updated on 19 July 2021.

Source: [ILOSTAT](#) • [Get the data](#) • [Embed](#) • [Download image](#)

Definition of informal sector

- ▶ No globally recognised definition
 - ▶ Varies per country
 - ▶ Definitions range from well regulated activities to consider them forbidden ones
- ▶ ILO definition:
any economic activity or source of income that is not subject to government regulation, taxation, or observation. This includes all economically active persons who do not receive social protection through their work.

Subsistence activities

Living wage

- ▶ „living wage“ also sometimes designated “non-poverty wage”

<https://tradingeconomics.com/germany/living-wage-individual>

- ▶ activity conducted by an organization involving an individual or groups of individuals (e.g. families) while earning **below the living wage**

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Japan	Bahamas	Belarus	Botswana	Bahrain	New C
Germany	Barbados	Belgium	Burkina Faso	Bangladesh	New Z
United Kingdom	Belize	Bosnia and Herzegovina	Burundi	Bhutan	Papu
France	Bermuda	Bulgaria	Cameroon	Brunei	Samc
India	Bolivia	Croatia	Cape Verde	Cambodia	Solon
Italy	Brazil	Cyprus	Central African Republic	China	Tonge
Brazil	Canada	Czech Republic	Chad	East Timor	Vanua
Canada	Cayman Islands	Denmark	Comoros	Georgia	
South Korea	Chile	Estonia	Congo	Hong Kong	
Russia	Colombia	Euro area	Djibouti	India	
Spain	Costa Rica			Indonesia	

ISO/WD3 59014: Environmental Management and Circular Economy: Sustainability and Traceability of Secondary Materials Recovery – Principles and Requirements.

Worst form of labour practice: Child labour ISO/WD3 59014

- ▶ work that deprives children of their childhood, their possibility to attend the school, their potential and their dignity, and that is mentally, physically, socially or morally dangerous and harmful to children



Recycling by subsistence activities

- ▶ Recycling rates achieved by the informal sector range from 20 to 50% in China, Pakistan, India, and the Philippines; informal recyclers collect 90% of what is recycled in Brazil and 80 to 90 % of postconsumer packaging and paper recovered in South Africa (GAIA, 2020)
- ▶ In plastics recycling, the informal economy is responsible for 90% of all recycling (GIZ, 2016)
- ▶ In **India**, the informal and unorganised sector is responsible for 80-90% of recycling activities (Packaging Europe, 2022)
- ▶ The job creation potential for inclusive recycling systems is estimated to be on average 321 jobs per 10,000 tonnes per year of recyclables (GAIA, 2020)

Inclusive Recycling

- ▶ Inclusive recycling is about being more transparent and efficient by recognizing the individuals in subsistence activities contributing to recycling as an essential link in the chain of value creation. Only then will the recyclers' labour and human rights be respected, and steps taken to provide fair pay for their services.
- ▶ [MIT Practical Impact Alliance, 2017](#)





International Waste Pickers Alliance, 2022

- ▶ To build and strengthen the **capacity and leadership** of WP by working on strategies that ensure all levels of government listen, receive and respond to the demand of waste pickers by promoting the co-participation of the integrated management of waste
- ▶ To represent and advocate for the **recognition of WP with a fair wage** that compensates for their environmental contribution. This will be done by establishing material pricing, the right to growth in the value chain.
- ▶ To generate **awareness** at local, national and international levels **about WP's contribution to recycling, solid waste management, environmental conservation, and climate change.**
- ▶ To formulate and advocate for programs that ensure all waste pickers have **healthy, safe, and secure working environments free from toxic waste and other hazardous substances**, and that waste pickers have access to **national health insurance funds.**

<https://globalrec.org/>

Technical Guidelines on Environmentally Sound E-Waste Management for Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal in Ghana (EPA, 2018)

	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Who applies?	Anyone -incl. registered informal workers- who collects, sorts or consolidates e-waste	Collection centers	Any entity that transports e-waste	Treatment facilities	Disposal at landfills, incineration and other technologies
Forbideen activities:	<ul style="list-style-type: none"> -Any disposal activities outside the collection centers; -Any treatment activities of e-waste (such as dismantling); -Burning whole or components of e-waste 	<ul style="list-style-type: none"> -Any disposal activities outside the collection centers; -Any treatment activities of e-waste (such as dismantling); -Burning whole or components of e-waste 	<ul style="list-style-type: none"> -Disposal of any e-waste whole or components; -Any treatment activities of e-waste; -Burning e-waste; 	<ul style="list-style-type: none"> -Accept any e-waste it cannot treat. - Dispose any e-waste inappropriately 	<ul style="list-style-type: none"> -Landfilling e-waste with other waste; -Burying and open burning

ISO IWA 19:2017: Gradual implementation on sustainable and inclusive recycling in subsistence activities

Time Frame	Summary of Steps
Year 1	<p>Prioritise training on waste collection of waste and physical segregation while and avoiding worst practices with the most damaging impacts on the environment (e.g., metallurgical processing, disposal of chemicals into rivers or groundwater) and/or health and safety in consultation with affected workers and communities);</p> <p>Identify requirements for the formalisation requirements for process to becoming an association cooperative, association or enterprise or join an existing one;</p> <p>Focus on baseline development and improving working conditions to reduce negative impacts on health.</p> <p>Target by the end of year 1: Partially comply (~10%)¹ with specific requirements. Activities moved away from worst practices.</p>

Time Frame	Summary of Steps
Years 2-3	<p>Continue improving working conditions to reduce impacts on health.</p> <p>Start (or continue if initiated before) with the formalisation process;</p> <p>Establish internal communication channels;</p> <p>Start with the implementation of a verification mechanism such as Self-Assessment for timely identification of potential severe impacts.</p> <p>Target by the end of year 2: Partially comply (~40%)² with specific requirements. Formalization process started.</p>
Years 4-5	<p>Become a legal entity (, e.g., on an association cooperative)/association/enterprise level, or join an existing one;</p> <p>Implement second-party-based verification mechanisms assessment with the supported by the of formal recycler (main client)s or producers of materials engaging SA.</p> <p>Target by the end of year 4-5: Reach full compliance (100%) with the requirements. A legal form was achieved.</p>



Business models - DESCO

Support formalization efforts

- ▶ With training, e.g., on health and safety standards
- ▶ With administrative assistance, e.g., for registering them as formalized enterprises and making them compliant with corporation and tax laws
- ▶ By providing free Personal Protective Equipment (PPE), and the use of dismantling tools and DESCO's premises.



Support formalized subcontractors

- ▶ By providing start-up support in the form of pre-processed stock and starting capital.
- ▶ By providing free of charge use of vehicles for transporting heavy WEEE.

Business models - DESCO

Business model of subcontractors.

These have two income sources:

1. Subcontractors buy e-waste products, components or materials from DESCO for dismantling off-site to recover valuable components or materials. Recovered items are then sold back to DESCO or to any other potential clients such as traders or other recyclers. This applies to all WEEE, components and materials streams except for printed circuit boards, which must be sold back to DESCO.
2. Subcontractors are hired to support the dismantling and processing of e-waste products, components and materials. This work can be done on-site or at the premises of other clients.



Opportunities

- ▶ Increased collection rates
- ▶ Increased productivity in non-destructive processes such as dismantling, emptying, cleaning, etc.
- ▶ Job creation opportunities
- ▶ Women empowerment

Challenges

- ▶ Formalization
- ▶ Lack of minimum PPE
- ▶ Social and cultural barriers



Thank you!



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