# Partnership for Responsible Battery and Metal Recycling (ProBaMet) – Project Summary Report

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**Authors**

Andreas Manhart (Oeko-Institut)
Fred Adjei (Oeko-Institut)
Franziska Weber (Platform Lead of WVMetalle)
Dr. Leslie Adogame (SRADev Nigeria)
Dr. Gilbert Addie (SRADev Nigeria)
Sarah Onuoha (SRADev Nigeria)
Victor Fabunmi (SRADev Nigeria)
Jens Jaeger (Alliance for Rural Electrification)
Julia von Franz (Alliance for Rural Electrification)
Okan Ozkan (Alliance for Rural Electrification)
Otto Neidhardt (Alliance for Rural Electrification)

**Contact**

**Oeko-Institut**
Merzhauser Str. 173
79100 Freiburg, Germany

**Sustainable Research Action for Environmental Development (SRADev)**
18 Olorunlogbon Street, Anthony Village
Lagos State, Nigeria

**Platform Lead (Plattform Blei)**
Initiative of Wirtschaftsvereinigung Metalle
Wallstr. 58/59
10179 Berlin, Germany

**Alliance for Rural Electrification (ARE)**
Rue d'Arlon 63-67
1040 Brussels, Belgium

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# List of Abbreviations

| | |
|---|---|
| ARBR | Alliance for Responsible Battery Recycling |
| ARE | Alliance for Rural Electrification |
| BCI | Battery Council International |
| BMZ | German Federal Ministry for Economic Cooperation and Development |
| BRS COP | Meetings of the Conferences of the Parties of the Basel, Rotterdam, and Stockholm Conventions |
| $CO_2$ | Carbon dioxide |
| CSR | Corporate Social Responsibility |
| DNA | Designated National Authority |
| DNR | Designated National Authority |
| DRE | Distributed Renewable Energy |
| EHS | Environmental, health, and safety |
| EIA | Environmental Impact Assessment |
| EPR | Extended Producer Responsibility |
| ETP | Effluent treatment plant |
| EUROBAT | Association of European Automotive and Industrial Battery Manufacturers |
| FEPA | Federal Environmental Protection Agency |
| FMEnv | Nigerian Federal Ministry of Environment |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| HSE | Health, safety, environment |
| ILA | International Lead Association |
| IPEN | International Pollutants Elimination Network |

| | |
|---|---|
| LAB | Lead-acid battery |
| LASEPA | Lagos State Environmental Protection Agency |
| LMICs | Low- and middle-income countries |
| MEAs | Multilateral Environmental Agreements |
| NCCM | National Committee on Chemicals Management |
| NESP | Nigerian Energy Support Programme |
| µg/dl | Microgram of lead per decilitre of blood |
| mt | Metric tonnes |
| mt/a | Metric tonnes per annum |
| NESREA | National Environmental Standards and Regulations Enforcement Agency |
| OECD | Organisation for Economic Co-operation and Development |
| OGEPA | Ogun State Environmental Protection Agency |
| PAN-Ethiopia | Pesticide Action Nexus Association Ethiopia |
| PIC | Prior Informed Consent |
| PPE | Personal Protective Equipment |
| ProBaMet | Partnership for Responsible Battery and Metal Recycling |
| SAICM | Strategic Approach to International Chemicals Management |
| SOPs | Standard Operating Procedures |
| SOx | Sulphur oxides |
| SRADev | Sustainable Research and Action for Environmental Development |
| t/a | Tonnes per annum |
| ULAB | Used lead-acid battery |

# 1 Background & introduction

The African continent has become a key player in the era of globalization, having experienced moderate economic growth in recent years. Driven by the growing demand for road transport from a developing middle class and industry, the use of automotive lead-acid batteries is steadily increasing across the continent. This trend is further enhanced by strategies to provide to rural communities with electricity through decentralised battery storage systems (e.g. mini-grids), as well as by unstable power grids that drive the demand for battery-based backup solutions in many regions. Although Li-ion batteries are becoming increasingly affordable and are already commonplace feature in many parts of Africa's battery market, lead-acid batteries remain dominant in many segments and are projected to maintain their central position in the foreseeable future (Anglivie et al. 2021).

Lead-acid batteries account for 86% of the world's lead demand (ILZSG 2023). Lead is a heavy metal that has an adverse effect on human health and the environment and is gaining increasing international attention as a pollutant that causes a particularly high global disease burden, ranking amongst the top 25 global health risk factors (Brauer et al. 2024b). While undamaged batteries pose no immediate danger to human health, unsound end-of-life management often results in the release of lead with adverse effects on exposed population groups. For this reason, the unsound management of end-of-life lead-acid batteries has been identified as one of the world's worst pollution problems (Pure Earth & Green Cross Switzerland 2016). There is a wealth of evidence that the recycling of lead-acid batteries in sub-Saharan Africa is often substandard, with severe consequences for human health and the environment. Documented pollution cases have been reported in Senegal, Kenya, Ghana, Nigeria and the Republic of Congo (Haefliger et al. 2009; Kenyan Ministry of Health 2015; Atiemo et al. 2016; Anyaogu 14 Dec 2018; Will Fitzgibbon 4 Dec 2023). Furthermore, evidence suggests that these cases are part of broader patterns of substandard recycling (Manhart et al. 2016; Gottesfeld et al. 2018).

Nigeria is the most populous country in Africa and has one of the largest economies on the continent. It also has a disproportionally high demand for batteries and generates a lot of battery waste compared to most other countries in the region (Tür et al. 2016). Consequently, it has a large lead-acid battery recycling sector involving multiple industrial players, as well as developed lead-acid battery collection and trading networks (see section 2.2 for more details). However, Nigeria also faces significant challenges in terms of lead exposure, with an estimated 23 to 68 million Nigerian children having blood lead levels exceeding 5 µg/dl (UNICEF & PureEarth 2020). While various potential sources of lead exposure are known, such as lead in paints, cookware and spices, unsound ULAB recycling is a common hotspot for severe contamination in and around recycling clusters. In many countries, including Nigeria, such clusters are located in urban or semi-urban environments, affecting large population groups. Although no exhaustive study has been conducted on the health impacts of the sector on workers, local residents and individuals affected by collection and supply activities in Nigeria, indications from similar patterns in other countries suggest that exposure is severe, with blood lead levels commonly significantly higher than those of other population groups (Atiemo et al. 2016; Kenyan Ministry of Health 2015; Anyaogu 14 Dec 2018).

This project, 'Partnership for Responsible Battery and Metal Recycling', was launched in Nigeria in early 2024 in response to the situation described here. Although no systematic sector assessment has been conducted prior to this project, evidence of a high number of industrial ULAB recycling plants operating under substandard conditions was already available (Anyaogu 14 Dec 2018; Gottesfeld et al. 2018; Braide et al. 2021). Moreover, it was known that industrial ULAB recycling in Nigeria was – and still is – a high-volume industry that predominantly serves the global supply chains for raw materials. Thus, in terms of the global supply chain for raw materials, Nigeria is important in terms of both supply chain sustainability risks and raw material volume. The ULAB recycling sector is also important for companies selling and using batteries in Nigeria. Sectors such as solar off-grid electrification bring a large number of batteries to the market, which will require sound end-of-life solutions. While the solar sector is not the only battery-using sector, it has a green reputation and is proactively seeking sustainability solutions. Furthermore, the issue of unsound ULAB recycling was recognised in Nigeria, and policymakers, civil society and industry had already taken various steps to stimulate sector upgrades (see section 2.4). This situation, together with high stakeholder awareness of the issues, motivated this project. Conducted between January 2024 and April 2025, the project aimed to stimulate and realise systematic improvements in the recycling sector for used lead-acid batteries in Nigeria. It was implemented by Oeko-Institut, Sustainable Research and Action for Environmental Development (SRADev Nigeria), the Wirtschaftsvereinigung Metalle platform lead, and the Alliance for Rural Electrification (ARE). Funding came from the Federal Ministry for Economic Cooperation and Development (BMZ), with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

This report provides an overview of the most significant project outcomes and lessons learned. Its aim is to inform decision-makers in policy, administration, and the recycling industry, as well as donors and designers of similar cooperation projects. Chapter 2 provides an overview of the lead-acid battery recycling situation in Nigeria. Chapter 3 outlines the ProBaMet project's approach, while Chapter 4 briefly describes the main project activities and interventions. Finally, Chapter 5 presents strategic recommendations for policymakers, ULAB recyclers, major battery users, and stakeholders who are directly or indirectly linked to lead-acid battery recycling operations in Nigeria. Although these recommendations are tailored to the Nigerian context, they can be applied more broadly to other low- and middle-income countries that are facing similar challenges in the used lead-acid battery recycling sector.

# 2 The lead-acid battery recycling situation in Nigeria

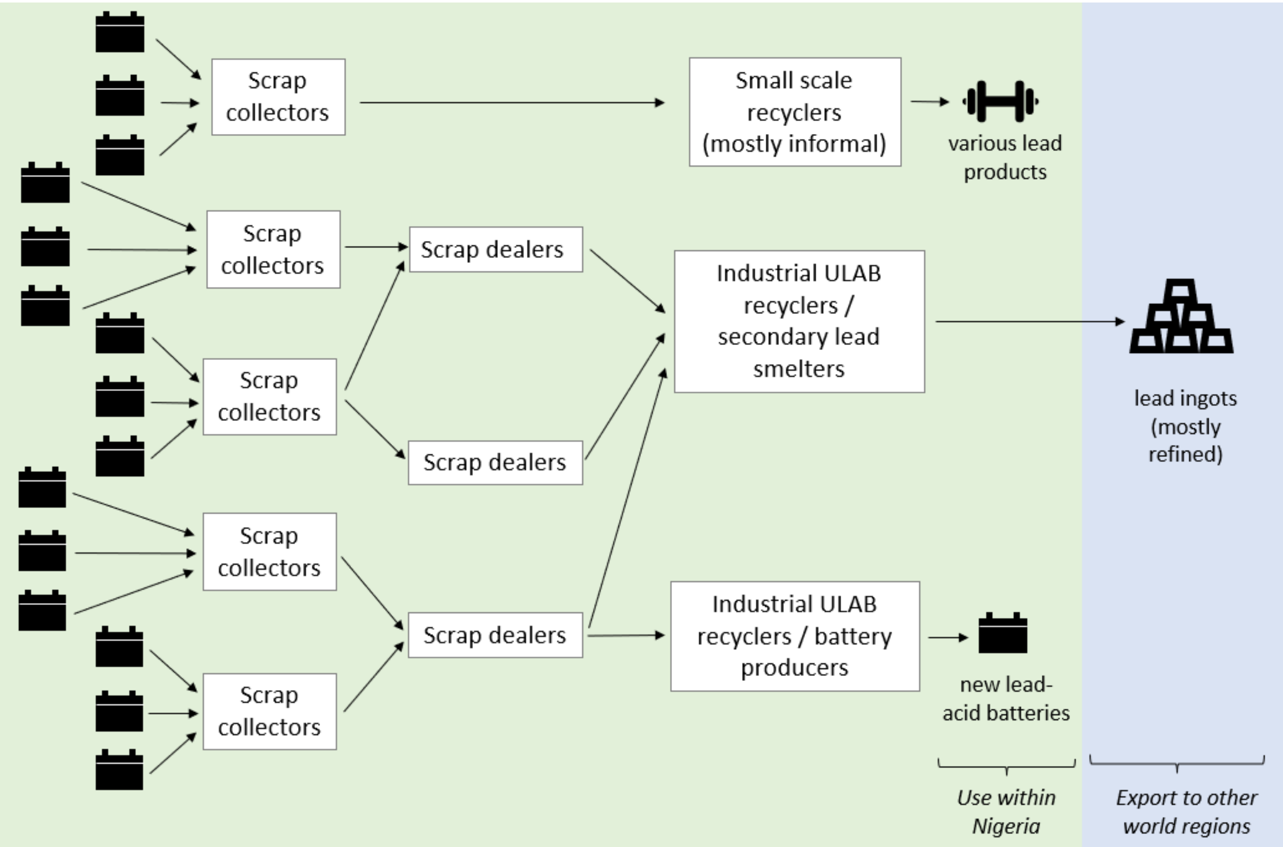
## 2.1 ULAB volumes

As mentioned in Chapter 1, Nigeria generates a high volume of used lead-acid batteries compared to most other African countries. Total annual volumes have been estimated at 69,000 tonnes per annum (t/a) (Tür et al. 2016) and 110,000 t/a in 2016 (Ugbor 2016) and 206,000 t/a in 2018 (Onianwa 2020). While this range indicates uncertainty regarding the total annual quantities, it at least provides an order of magnitude. Due to economic and population growth, it can be assumed that annual volumes have increased accordingly. Assuming an annual growth rate of 2%, total volumes could be estimated to be between 80,000 and 235,000 t/a in 2024 and 2025.

## 2.2 The reverse supply chain & leakage points of lead

The reverse supply chain for ULABs in Nigeria is graphically illustrated in Figure 2-1.

**Figure 2-1: Reverse supply chain of ULABs in Nigeria**




Source: own figure

ULABs are predominantly collected from households and businesses by informal collection networks. These networks usually pay money for each battery collected and organize their logistics in a convenient way for battery owners (e.g. collection of batteries and other metal-containing scrap from homes or vehicle servicing stations). Scrap collectors are often not exclusively focused on ULABs, but also on other types of waste and scrap that they can sell to the local scrap dealers. Scrap dealers take over the collected scrap and often have a specific focus on certain types of scrap– in this case, ULABs. They pay the collectors for the batteries they deliver and act as intermediaries for storage and forward logistics to recyclers. Scrap dealers may operate at various levels, with smaller hubs supplying larger hubs before the scrap is forwarded to recyclers. Scrap dealers often operate under informal or semi-formal conditions (see Figure 2-2).

**Figure 2-2: ULAB-hub of a scrap dealer close to Abuja**

Source: own picture

The majority of the collected ULABs are recycled in specialized ULAB recycling plants. There are currently at least ten such plants operating in Nigeria with a combined capacity of approximately 180,000 mt of ULABs per year (see Table 2-1), as well as likely some additional plants. This combined capacity is in line with the ULAB volumes available on the Nigerian market (see Section 2.1), resulting in competition between the plants and many operating below capacity. Most of the plants have been set up by foreign investors, primarily from India. Seven of the ten listed plants focus on producing refined lead for export. Three of the ten plants use the recycled lead to produce batteries destined for the Nigerian market.

Nine of the plants are located in Ogun State, forming clusters to the northeast of Lagos (see Figure 2-3). These nine plants in Ogun State have been visited and assessed by the ProBaMet team in two assessment campaigns in 2024. The relevant documentation has been made available to the environmental authorities in charge (NESREA, OGEPA and the Federal Ministry of Environment).

**Table 2-1: Overview of industrial ULAB recycling plants and their capacities[1]**

| | Business output | Monthly capacity (lead output) | Annual capacity (lead output)[2] | Annual capacity (ULAB input)[3] |
|---|---|---|---|---|
| Plant 1 | Refined lead for export | 2,000 mt | 22,000 mt | 35,200 mt |
| Plant 2 | Refined lead for export | 1,000 mt | 11,000 mt | 17,600 mt |
| Plant 3 | LABs for Nigerian market | 300 mt | 3,300 mt | 5,280 mt |
| Plant 4[4] | Refined lead for export | 600 mt (2,000 mt) | 6,600 mt (22,000 mt) | 10,560 mt (35,200 mt) |
| Plant 5 | Refined lead for export | 180 mt | 1,980 mt | 3,170 mt |
| Plant 6 | Refined lead for export | 600 mt | 6,600 mt | 10,560 mt |
| Plant 7 | Refined lead for export | 2,000 mt | 22,000 mt | 35,200 mt |
| Plant 8 | Refined lead for export | 1,000 mt | 11,000 mt | 17,600 mt |
| Plant 9 | LABs for Nigerian market | 700 mt | 7,700 mt | 12,320 mt |
| Plant 10 | LABs for Nigerian market | 2,000 mt (est.) | 22,000 mt (est.) | 35,200 mt (est.) |
| **Total** | | **10,380 mt** | **114,180 mt** | **182,690 mt** |

Source: Own calculations based on facility assessments

Informal recycling and smelting of ULABs also exists in Nigeria, but it achieves a low lead recovery rate of 50-60%, compared to around 90% in industrial plants (Wilson and Manhart 2021)[5]. Therefore, most informal networks supply formal industrial recycling plants, as the prices paid for ULABs typically exceed the economic returns from their own informal ULAB recycling and lead smelting activities. Consequently, informal ULAB recycling and lead smelting are commonly limited to niche markets linked to local artisanal industries that require lead (e.g. the artisanal production of dumbbells, weights for fishing nets, solder paste for electrical repairs, etc.).

Lead-acid battery repair activities are common in many low- and middle-income countries, including Nigeria. Repairs are conducted in small workshops and typically involve replacing damaged plates, refilling of electrolyte, reassembling batteries and charging them. This subsector has not been the focus of the ProBaMet project.

1 The ProBaMet team is familiar with all names, locations and contacts, which are thoroughly documented in facility assessment reports. Due to the sensitive nature of the information contained within them, these reports are not made public, but are made available to the relevant environmental authorities in Nigeria (NESREA, OGEPA and Federal Ministry of Environment). However, there is evidence that this list is incomplete and that some additional industrial ULAB recyclers are operating in Nigeria (e.g. close to Abuja).

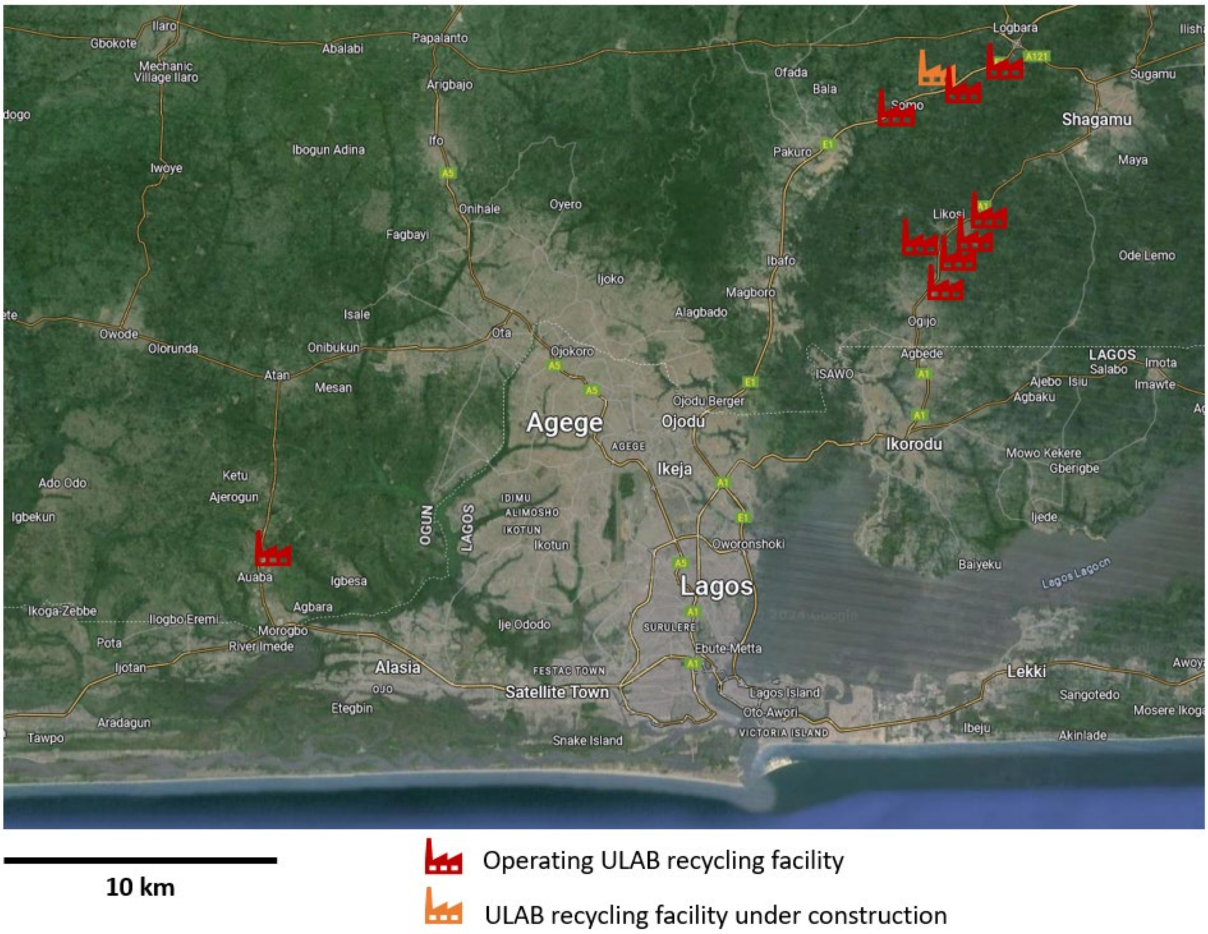
2 Smelters require regular maintenance, which causes periodic downtime. When calculating annual capacities, one month of downtime is assumed for each facility. This does not mean that a facility is entirely under maintenance for one month per year; rather, there are periods during which certain process (e.g. furnaces) are temporarily unavailable, thereby limiting operational capacity.

3 An average lead content of 62.5% is assumed.

4 Plant 4 is planning significant expansion of its facilities and capacities. Planned total capacities are given in brackets.

5 Lead smelting, as practiced in the informal sector in Nigeria, does not make use of smelter designs that generate a reducing environment. Consequently, lead oxide and lead sulfate cannot be recovered in this process.

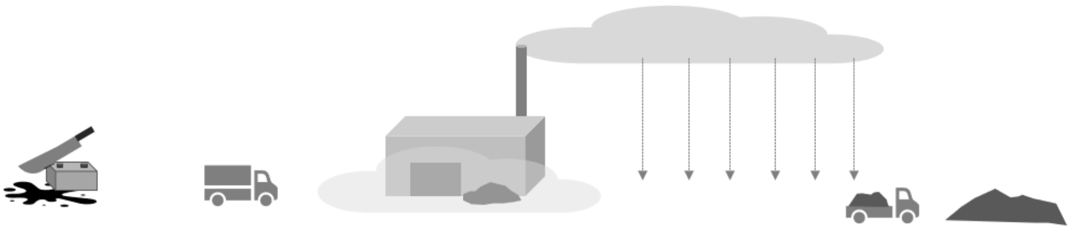
**Figure 2-3: Location of industrial ULAB recycling facilities in Ogun State**




Source: Map: Google, ©2025 TerraMetrics. Icons added by authors.

The current reverse supply chain has several distinct points at which lead is emitted and released into workplaces and the environment (see Figure 2-4)

**Figure 2-4: Main lead emission points in current end-of-life management of ULABs in Nigeria**



1) Uncontrolled drainage of battery electrolyte washing out lead particles

→ anywhere batteries are damaged & drained

2) Generation & emission of lead dust during handling of lead containing materials

→ within the plant & in immediate surroundings

3) Emission of fine lead dust from smelting operations

→ transported with wind and typically settles within a 2.5 km radius

4) Unsound disposal of smelting slags containing residual lead

→ blown out & washed out from unsound slag disposal

Source: Own figure

1) The first major point of lead release is the breaking and drainage of the batteries. In Nigeria ULABs are commonly drained shortly after collection from users. Drainage is conducted either by opening the refill plugs, or by punching holes into the case (commonly done with valves regulated LABs). The electrolyte (dilute sulfuric acid) is commonly drained uncontrolled (e.g. on soil, into gutters). By draining the electrolyte, lead particles that have built-up at the bottom of the battery's inside over the use-phase, are washed out too. There are various reasons why batteries are drained during collection: The most immediate reason is the reduction of weight. Drainage reduces the load weight by around 10-12%. As ULABs are very heavy, the weight (and not the volume) is the limiting factor for the number of units to be transported by one vehicle/carrier. The payment structure of most ULAB recycling plants is probably even more important. Payment is based on the weight of dry (drained) batteries in almost all plants and some of the assessed plants accept only drained batteries from suppliers. Other plants also accept batteries with electrolyte, but at reduced rates. From the side of the ULAB recycling plants, rate reduction aims at accommodating the fact that the battery electrolyte is of no economic use to them. In any case, these purchasing structures cause a situation in which most suppliers conduct battery drainage prior to delivery.
2) The second major point of lead release is the handling and processing of ULABs in the industrial recycling plants. Most assessed plants handle and store ULABs and lead materials in such a way that the release of lead into the workplace and the surrounding environment is an ongoing concern. Practices leading to such release involve (but are not limited to):
    - Multiple lead dust generating process steps that are not housed-in and ventilated to a dust filter system (e.g. manual or semi-automated battery breaking, repeated loading, shoveling and off-loading processes of lead scraps);
    - Storage of lead materials in areas that are exposed to wind and partly even rainfall;
    - Leakages of lead dust from furnaces and emission control systems;
    - Unsound handling of lead-containing residues such as slags and filter dust within the plants' premises;
    - Factory layouts and conditions, where generated dust cannot be captured and contained (e.g. broken factory floor that cannot be (wet) cleaned, unorganized factory and storage areas, unpaved outside areas).

    Related lead particles usually accumulate in the plants' premises but are very likely to be transported to nearby environments through wind and surface runoff. Lead particles can also be transported by other means and to more distant locations, e.g. when workers carry contaminated work clothes to outside areas and their homes on the wheels of outgoing vehicles.
3) Emission of fumes and dust from smelting and refining from the facilities' emission control systems are the third common lead emission pathway. While all assessed facilities have off gas treatment systems with cooling towers and baghouse filters aiming at capturing lead particles, various assessed systems have not been fully functional during the visits. Malfunctions were related to:
    - Situations in which not all fugitive emissions in smelting and refining were captured by the system (e.g. furnaces not housed-in and ventilated);
    - where captured fumes and dust leaked from the system (e.g. through gaps and holes in pipes and joints);
    - and where filter systems where not fully functional causing particle emissions through the stack.

    Such fugitive lead particle emissions (particularly those emitted from stacks) can travel over longer distances with the wind and settle in the wider surroundings[6].
4) The fourth relevant lead emission pathway is the management of slag. The recycling processes as applied by the majority of plants in Nigeria generate between 12 and 20 mt of slag per 100 mt of recycled ULABs (Stevenson 2009; Manhart et al. 2024)[7]. Considering the annually generated ULAB volumes in Nigeria (see section 2.1), this means a generation of slag in a range of 9,600 mt/a to 26,000 mt/a. Furnace slag from secondary lead smelting always contain residual lead and contents my vary from 1% to 16.7% (Topuz et al. 2019). Assuming residual lead concen-

[6] Depending on stack hight and prevailing wind strengths in a radius of various kilometres around the plant.

[7] The only exemption is the recycling process as applied by Green Recycling Ltd. The company separates elementary lead from lead paste during battery breaking and conducts a desulfurisation step prior to smelting. This allows to reduce slag volumes to 3 - 10 mt per 100 mt of treated ULABs.

trations in a range of 5-10%, this means that 480 to 2,600 mt of lead are transferred to disposal every year in Nigeria. There are indications that slag management/disposal is substandard and that at least part of the generated volumes is dumped in an uncontrolled manner (see Figure 2-5).

**Figure 2-5: Uncontrolled dumping site for furnace residues close to industrial lead smelters in Ogun State**

Source: Own picture

A summary of the plant assessment results is given in section 2.3.

## 2.3 Specific environmental, health & safety challenges

The following section is based on two facility assessment campaigns conducted in April and September 2024 in Ogun State within the ProBaMet project (see section 4.2). The assessments covered all active plants indicated on the map in Figure 2-3. The assessments were conducted under the leadership of the *National Environmental Standards and Regulations Enforcement Agency (NESREA)* and with participation of experts from the *Federal Ministry of Environment*, the *Ogun State Environmental Protection Agency (OGEPA)*, the *Alliance for Responsible Battery Recycling (ARBR)* and the ProBaMet team. Some assessments were also joined by representatives from local communities. All assessment results are document in a non-public detailed report that is available to the responsible authorities (Federal Ministry of Environment, NESREA, OGEPA) and the sector body ARBR (Adie et al. 2024).

The following summary is anonymised in a way that individual shortcomings cannot be traced back to individual plants and operators. Nevertheless, the summary should give a detailed overview on the sectors' state as encountered in mid-2024.

### 2.3.1 Generic description of plants found to be clearly sub-standard

Seven out of the nine assessed plants showed severe weaknesses in various technical and operational aspects of ULAB recycling and lead smelting.

While all plants made use of rotary furnaces that were connected to bag-house filter plants, a large number of other aspects were of severe concern during the visits and in a state where emissions of hazardous lead dust to the workplace and the environment were inevitable and obviously considered as something normal by the respective managements. Concerns particularly centred on:

- Battery reception and storage: Common storage practice was piling up of (mostly broken) batteries. There was no visual evidence in any of the seven plants to prevent damage to and leakage from the batteries during reception and storage.
- Manual battery breaking: The conducted manual breaking was associated with severe exposure of workers to lead and sulfuric acid. One of the plants applied semi-automated battery breaking with housed-in battery saws. Nevertheless, the process was conducted in a sub-standard manner with workers being exposed to very high noise levels and acid mist. Six plants had no immediate plans to upgrade to a more controlled form of battery breaking.
- Storage of lead materials: Storage and handling of lead materials was observed widely insufficient in all of the seven plants with various heaps of lead scrap and filter dust distributed throughout the facility and partly being exposed to wind and rainfall. Observed storage patterns and plant set-ups require repeated handling (interim transport, mixing, charge preparation) that inevitably generate dust and exposure of workers.
- Housekeeping and dust control: Most of the seven plants lacked factory floors that allow regular and thorough wet cleaning and dust control (heavily broken and damaged floors). At one facility, some parts of the internal plant did not have a concrete floor (only very dusty soil and debris floor). Moreover, most plants had various materials stored and piled-up in the plant, representing not only tripping and tipping hazards, but also making effective dust control impossible. The indoor areas of two plants showed slightly better floor properties, but housekeeping and dust control were severely neglected in both plants.
- Furnace charging: In two of the seven plants, furnace charging was done manually which exposes workers unnecessarily to lead dust over quite prolonged time periods (0.5 to 1 hour for every charging cycle). In four of the seven plants, charging was done with forklift trucks but without any effective means to protect the operators of the trucks (no enclosed cabin with a filtered air supply). Automated charging systems were installed at one of the seven plants. Nevertheless, the whole surroundings (dusty soil floor, no extraction ventilation over the furnace and charging) gave rise to the assumption that under such conditions charging is also associated with generation and stirring-up of dust.
- Extraction ventilation during furnace charging, smelting and tapping: Installed furnaces at four of the seven plants were not encapsulated or sufficiently covered with effective extraction ventilation / fume hood. This inevitably leads to fume and dust emissions to the workplace during charging and tapping (and possibly also during smelting). At three of the seven plants furnaces were equipped with fume hoods. Effectiveness of these systems (e.g. during tapping) was not verified during the visits, but heavy smoke emissions at one plant were a clear indication of a dysfunctional state in this plant during the time of the visit.
- Desulfurization: One plant did not use a wet-scrubber and therefore relied on only one (incomplete) desulfurization method (adding iron to the charge). Another plant had one wet-scrubber, but it was only linked to one of several installed furnaces. SOx emissions to the nearby environment were therefore unavoidable in these two plants.
- Filter plant dust management: While all plants fed captured filter plant dust back into the recycling process, handling of such hazardous dusts was a severe weakness in all seven plants. In this context, four plants stuck out in a negative sense with filter plant dust falling onto the ground in the filter plant section, requiring workers to shovel the dust into containers to be transported back to the plant. In addition, filter plant dust was piled up high in the

plants and in manner that unintentional transport of dust to the work floor and even outer parts of the plant was unavoidable.

- Effluent capture and treatment systems: While most plants had an effluent treatment plant (ETP), drainage channels and systems were broadly crudely manufactured and/or leaking and congested with debris. Combined with the fact that all of the seven plants mainly received broken and drained batteries (mostly intentionally and with an aim to encourage drainage prior to delivery), it must be assumed that ETPs are only treating a small fraction of the theoretically necessary effluent volume.
- Immediate surroundings of plants: The plants' surroundings were widely chaotic and in a state where contaminants (e.g. lead material) could not be captured and fed back into the plant because of soil, rocks, debris and unused equipment hindering such activities. Out of the seven plants of high concern, only one plant made some attempts to keep parts of the surroundings pollution free with well-designed, smoothly paved ground and a suitable drainage system. Nevertheless, in that plant the rear area was far from being well managed and the presence of numerous workers in an adjacent aluminium recycling section was of concern also. In this regard, one plant was found to be slightly better than the other plants of high concern, as the immediate surroundings of this one plant were widely free from other material. At one plant smelting slags were stored outdoors on open soil and only covered with plastic sheets.
- Amenities: None of the seven plants had satisfactory amenities (change rooms, washrooms, showers, toilets, canteen) that were well separated from the plant, clean and large enough to cater for peak hours (change of shifts). Although the assessment did not focus on this aspect, it is questionable if any of the plants has its own in-house laundry and provides clean work clothes prior to every shift.
- Lead-in-blood testing: Only one of the seven plants could provide evidence of (limited) lead-in-blood testing. This evidence only covered five workers and lead levels were remarkably high compared to accepted limits, widely confirming the assessment that operational standards were correspondingly low in this facility. The fact that lead-in-blood testing is not conducted regularly and with all workers may be explained by a company culture of trying to hide difficulties rather than seeking ways for improvements.

In addition, the following general observations were made in most of the seven facilities:

- In almost all the plants it was corporate practice to prioritise sourcing of dry (drained) batteries, effectively 'outsourcing' the high-risk process of battery drainage to their supply networks operating under informal and uncontrolled conditions (see section 2.2);
- Inadequate provision of Personal Protective Equipment (PPE) and poor enforcement of use of PPE by the facility's management;
- Lack of proper drainage systems, impermeable flooring and appropriate bund wall to prevent accidental discharges of untreated liquids and runoff;
- Poor separation of wastewater from storm water, making its sound management more difficult or even impossible;
- Poor litter prohibition systems with various materials (battery cases, other battery materials…) found littered in various plant areas;
- Poor Corporate Social Responsibility (CSR) programmes as well as poor community relations by most facilities;
- Inappropriate firefighting equipment;
- No systematic health monitoring and health treatment for workers.

**Figure 2-6: Visual impressions from some of the seven sub-standard plants**

Manual battery breaking with new (unused) PPE

Chaotic storage of materials within a ULAB recycling plant

A smelting hall with furnaces and visible emissions

Outdoor areas of a ULAB recycling plant

Source: Own pictures

### 2.3.2 Generic description of plant found to be mid-standard

One of the nine assessed plants falls in a middle category: While installed capacity and throughput were comparably small, the plant featured a good design and there was an obvious emphasis on safe and hygienic operation. These included:

- Sound designs of indoor and outdoor floors and slopes that avoided rainwater/stormwater incursions into plant and storage areas and channels that runoff to well-designed drainage channels and settling ponds.
- Use of encased battery saws.
- Plastic washing system was linked to an effluent treatment plant.
- Complete off-gas treatment system with sound filter dust capture and recycling.
- Good housekeeping and dust control.

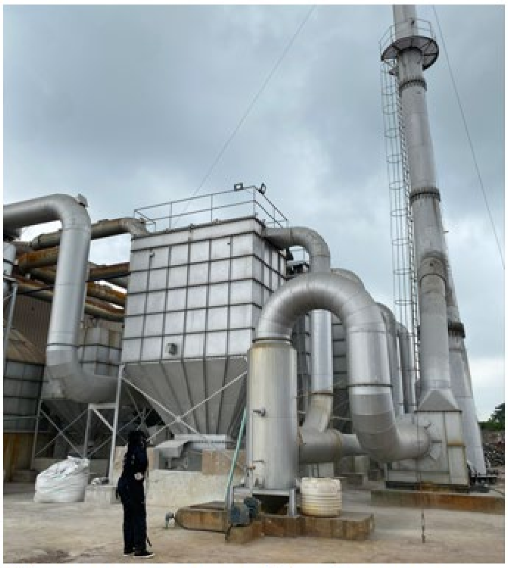
- Suitable storage facility for smelting slags.
- Efforts to minimise safety risks (e.g. by protected transmissions).

Despite these positive points, the plant showed some technical shortcomings:

- One of the two installed rotary furnaces was not housed-in or covered by a fume hood.
- The other rotary furnace was covered by a fume hood, but the system did not develop any suction.
- There were visible emissions from the stack, indicating a problem with the off-gas treatment system during the time of the visit.
- The refining kettles were not covered by a fume hood and therefore lacked extraction ventilation and off-gas treatment.

**Figure 2-7: Visual impression from the mid-standard plant**

Main smelting hall with the two installed rotary furnaces



Off-gas treatment system with cooling towers, baghouse, scrubber and stack

Refining kettles with automated casting machine

Slag storage area

Source: Own pictures

### 2.3.3 Description of plant found to be high-standard

One of the visited plants (*Green Recycling Ltd.*) remarkably stood out and showed a plant set-up and operation that was in many aspects in-line with best practices. These included:

- A battery reception system where batteries were handled with care to avoid damage and leaks.
- Fully automated battery breaking and material separation through a high-class hammer-mill breaker. This system entailed automated treatment of process liquids, including battery electrolyte.
- Separation of elementary lead and lead oxide that were treated separately in the subsequent melting and smelting processes. Such separate treatment significantly reduces energy consumption and $CO_2$ emissions.
- Holistic desulfurization that included a chemical desulfurization of the battery paste prior to smelting. This does not only minimise sulfur emissions, but also effectively reduces the amount of generated slag.
- New smelting and refining equipment with fully automated furnace charging and housed-in and ventilated furnace (to off-gas treatment system).
- Housekeeping was significantly better than in any other plants visited. The factory floor was smooth and widely kept free from alien materials, which facilitates cleaning and dust control.

The plant has meanwhile been publicly named as best-practice option for disposing / recycling ULABs in Nigeria through the ProBaMet project (see section 4.5).

**Figure 2-8: Visual impression from the high-standard plant (Green Recycling Ltd.)**

Battery reception and offloading area

Fully automated hammer mill breaker

Housed-in rotary furnace with automated charger
(meanwhile replaced by a more modern furnace)

Filter press to reduce the moisture content of desufurised
battery paste (desulfurisation prior to smelting)

Source: Own pictures

## 2.4 Legislative framework & policy approaches

The Nigerian Federal Ministry of Environment (FMEnv) was established in June 1999 as a legal entity by the President of the Federal Republic of Nigeria to ensure the effective management of all environmental concerns. It succeeded the Federal Environmental Protection Agency (FEPA), which had been established in 1988. As part of its mandate, the FMEnv serves as the Designated National Authority (DNA) for the implementation of chemical-related Multilateral Environmental Agreements (MEAs), including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes, the Bamako Convention, and the Strategic Approach to International Chemicals Management (SAICM). The Ministry also coordinates national chemicals management activities and co-chairs the National Committee on Chemicals Management (NCCM) alongside the Federal Ministry of Health, promoting cooperation and sound management practices, particularly in areas such as lead contamination.

Nigeria has been a party to the Basel Convention since 1992 and has actively participated in regional capacity-building initiatives and policy development efforts, particularly related to electronic waste and used lead-acid batteries (ULABs). The country ratified the Rotterdam and Stockholm Conventions in 2004 and supports the Prior Informed Consent (PIC) procedure for the international trade of hazardous chemicals and waste. In accordance with Section 12 of the Nigerian Constitution, ratified international treaties must be domesticated through enabling legislation to become fully enforceable within the national regulatory framework. More recently, Nigeria's environmental governance has been informed by the United Nations General Assembly Resolution A/RES/76/300, which recognizes the right to a clean, healthy, and sustainable environment as a universal human right (UN General Assembly 2022).

In response to growing concerns over ULAB management, the FMEnv, in partnership with the European Union and the German Government under the Nigerian Energy Support Programme (NESP), conducted a 2021 baseline survey on mini-grids for electrification and waste battery management. Building on this momentum, the Ministry developed the National Policy on Battery Waste Management in 2022. This policy aims to ensure the environmentally sound management of waste batteries by providing a clear regulatory framework for enterprises involved in the collection, storage, transportation, accumulation, recycling, transboundary movement, and final disposal of waste batteries—while minimizing risks to human health and the environment.

Prior to the enactment of the National Environmental (Battery Control) Regulations in 2024, the ULAB recycling sector was primarily governed under the National Environmental (Electrical and Electronics Sector) Regulations of 2011. These were revised in 2013 to include an Extended Producer Responsibility (EPR) component for e-waste management, which facilitated the establishment of a Producer Responsibility Organization (PRO)—the Alliance for Responsible Battery Recycling (ARBR)—formally launched in 2019. Additionally, aspects of the sector were regulated under the National Environmental (Sanitation and Waste Control) Regulations of 2009. These regulations introduced mechanisms for monitoring and licensing recycling facilities at both state and federal levels and reinforced the polluter-pays principle essential to the effective implementation of EPR measures.

Furthermore, Nigeria has had dedicated legislation on Environmental Impact Assessments (EIAs) since 1992. This legislation, which includes provisions for licensing material recovery and recycling operations, has served as a legal basis for regulating the ULAB sector, even in the absence of a specific battery law. As such, ULAB recycling plants are generally licensed facilities, frequently located in special economic zones or free trade zones. These zones offer incentives such as tax waivers and are intended to promote export-oriented production, with the additional objective of distancing industrial operations from residential areas. However, this latter goal is often undermined by encroachment from surrounding communities. The interventions of the ProBaMet project - particularly its support to regulatory agencies in conducting facility assessments and enforcing compliance – are well-aligned with Nigeria's existing national environmental policies and regulatory framework.

The recently enacted National Environmental (Battery Control) Regulations (2024) represent the culmination of concerted efforts by national environmental authorities, state governments, and the federal government to prioritize the regulation of the battery recycling sector, recognizing its significant potential impact on human health in the event of uncontrolled emissions. Regulatory oversight and enforcement in this sector are principally the responsibility of the National Environmental Standards and Regulations Enforcement Agency (NESREA), in collaboration with the Federal Ministry of Environment.

Key provisions of the 2024 Regulations include the following:

- In accordance with the polluter-pays principle, the responsibility for the collection, treatment, transportation, and final disposal of waste lies with the facility that generates it. Furthermore, such facilities are held liable for the costs associated with damage assessment, containment, clean-up, remediation, and reclamation and/or restoration, as applicable.
- The regulations clearly delineate the responsibilities of producers, manufacturers, component dealers, collection centres, and recyclers. For example, producers, importers, and distributors of portable batteries are required to take back used batteries from end users at no additional cost. Additionally, key stakeholders must register with a Producer Responsibility Organisation (PRO) for the implementation of Extended Producer Responsibility (EPR) schemes.
- The importation of used batteries and their components is prohibited. Similarly, the export of used batteries and components is not permitted, except where a relevant permit has been issued by the Federal Ministry of Environment.
- The regulations provide comprehensive guidelines governing the recycling, collection, transportation, and storage of used batteries. Specific schedules (13 & 14) are on ULABs and contain requirements for battery transport and breaking, smelting, effluence treatment and other pollution control systems as well as blood lead level testing for workers.

As a federal republic, Nigeria's governance structure allows each state to operate its own environmental protection agency or ministry, with mandates that mirror those of the Federal Ministry of Environment (FMEnv). This decentralized approach supports localized implementation of environmental policies. The legal and regulatory framework governing the end-of-life management of used lead-acid batteries (ULABs) in Nigeria is relatively robust and comprehensive, offering a solid foundation for effective sector regulation. However, persistent challenges continue to undermine enforcement and compliance. Key constraints include a shortage of technical expertise for conducting Environmental Impact Assessments (EIAs), political and systemic interference in regulatory processes, and a lack of reliable, current data on licensed and operational recycling facilities. These gaps hinder effective oversight and risk assessment across the ULAB value chain. To guide environmental governance, Nigeria has enacted a range of national regulations, several of which are relevant to the management of ULABs. The following list, curated by the National Environmental Standards and Regulations Enforcement Agency (NESREA), outlines key legislation currently in force:

1. National Environmental (Chemicals, Pharmaceuticals, Soap and Detergent Manufacturing Industries) Regulations, S. I. No. 36, 2009.
2. National Environmental (Sanitation and Wastes Control) Regulations, S. I. No. 28, 2009.
3. National Environmental (Noise Standards and Control) Regulations, S. I. No. 35, 2009.
4. National Environmental (Standards for Telecommunications/Broadcasting Facilities) Regulations, S. I. No. 11, 2011.
5. National Environmental (Base Metals, Iron and Steel Manufacturing/Recycling Industries) Regulations, S. I. No. 14, 2011.
6. National Environmental (Domestic and Industrial Plastic, Rubber and Foam Sector) Regulations, S. I. No. 17, 2011.
7. National Environmental (Surface and Groundwater Quality Control) Regulations, S. I. No. 22, 2011.
8. National Environmental (Ozone Layer Protection) Regulations, S. I. No. 65, 2022.
9. National Environmental (Air Quality Control) Regulations, S. I. No 88, 2021 (Amended).
10. National Environmental (Battery Control) Regulations, 2024

# 3 The ProBaMet approach

The ProBaMet approach was developed to stimulate and realise systematic changes in geographical areas where recycling of used lead-acid batteries (ULABs) often follows sub-standard and highly polluting patterns. While the approach is based on a broad stakeholder participation combining government actors, civil society, academia and the private sector to join forces for the intended sector improvements, the main characteristic is the combination of push-factors (regulation & enforcement) with pull-factors (market demand for sound recycling solutions and their generated raw materials). Due to the competitive nature of the ULAB recycling sector, the approach requires a national approach. This means that it must be applied to all industrial ULAB recycling companies of a country. An exclusive focus on one or few plants, while others remain unaffected (particularly with regards to enforcement of standards), is not only endangering the approach's effectiveness, but may also lead to unintended effects such as increasing market shares for sub-standard recyclers.

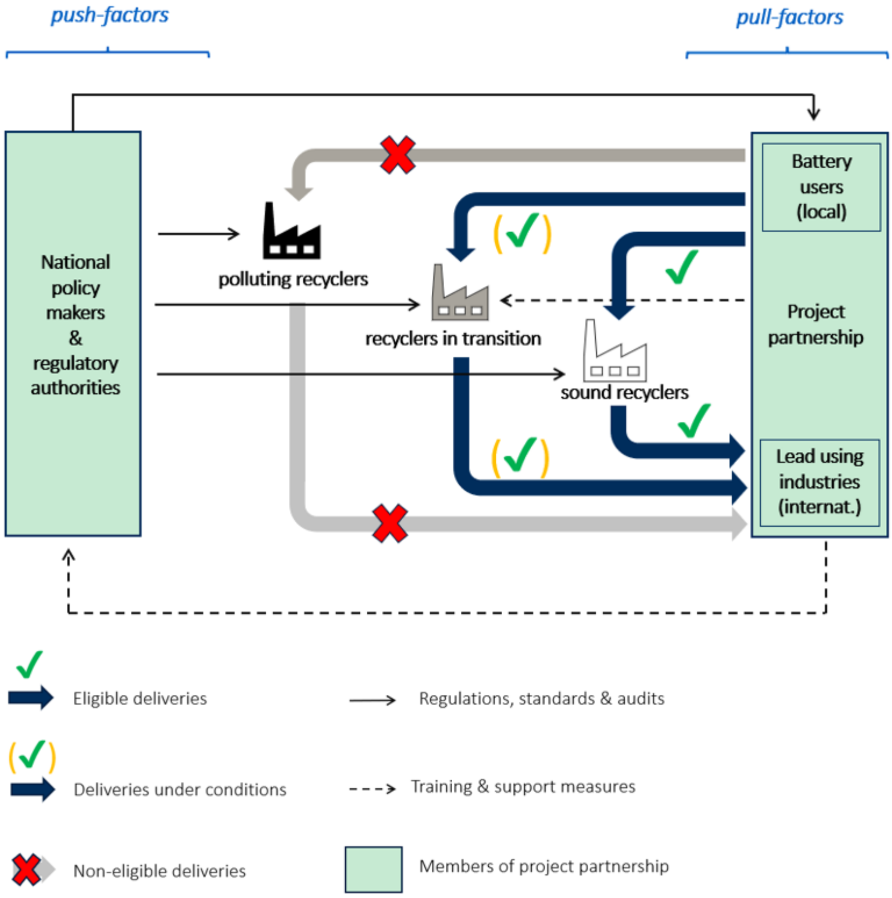
In addition, the ProBaMet approach strongly builds on the following success factors:

- Existing national awareness: Key stakeholders in government, civil society and industry must be aware of negative impacts from sub-standard recycling activities and have the willingness for systematic sector improvements in their respective country;
- Use of a common reference benchmark: A documented reference benchmark should clearly define sound practices and be acknowledged by regulators, recyclers, as well as players interested in sound battery disposal solutions or purchasing of secondary raw materials. In the case of lead-acid battery recycling, these are the Standard Operating Procedures for Environmentally Sound Management of Used Lead-acid Batteries (Wilson and Manhart 2021);
- Strong position of the formal sector: The recycling sector in focus should be characterised by formal sector players that have a competitive edge over informal operations. While informal sector activities (e.g. in collection) are common in most secondary raw material streams in LMICs, it is important that key processes such as smelting and refining are conducted by entities that require permitting from national authorities and that cannot escape regulatory pressure through frequent relocation of operations.
- Interest in upstream and/or downstream industries for substantial improvements: There must be an interest of upstream players (players generating and disposing the relevant waste types) and/or downstream players (players that have interests in sourcing the generated secondary raw materials) to support positive developments in the sector. This interest is needed to develop the intended pull-factors.

Figure 3-1 provides a graphical illustration of the ProBaMet concept, which includes a coalition of national policymakers and regulators, battery using sectors[8], as well as lead using industries. By applying a joint standard and transformation process, they have the possibility to strongly influence the national recycling landscape with a view to push worst polluters out of the market and to promote best performers. Recyclers in transition are given the chance to improve their operations, presupposing they are willing and capable to do so.

[8] In that context, it must be noted that the focus on battery using sectors does solely focuses on management solutions within a country and does by no means aim at stimulating or encouraging transboundary movements of hazardous battery waste for the purpose of recycling in Nigeria or any other low- or middle-income country.

**Figure 3-1: Overview of the ProBaMet approach**




Source: Oeko-Institut

By doing so, companies and players either requiring sound disposal solutions for old batteries, or requiring secondary raw materials (mostly lead, tin and antimony) for their business operations can integrate and use this approach for strengthening responsible business conduct with downstream partners (battery disposal) and/or upstream partners (supplier of secondary raw materials)[9].

[9] In that context it must be noted that the focus on downstream solutions (sound recycling of old batteries) does solely focus on management solutions within a country and does by no means aim to stimulate or encourage transboundary movements of hazardous battery waste for the purpose of recycling in Nigeria or any other low- or middle-income country.

# 4 Main ProBaMet activities & interventions

## 4.1 Stakeholder outreach & dialogue

The ProBaMet project developed and maintained close ties to key stakeholders in Nigeria and beyond. This includes the following links:

- All project activities in Nigeria have been planned and conducted with the Nigerian Federal Ministry of Environment, the Nigerian National Environmental Standards and Regulatory Enforcement Agency (NESREA) and the Alliance for Responsible Battery Recycling (ARBR). All activities affecting operations in Ogun State have additionally been coordinated and conducted with Ogun State Environmental Protection Agency (OGEPA). Further government agencies (LASEPA, Lagos and Anambra Sate Ministry of Environment) have been invited to project consultation meetings and events. Further Nigerian stakeholders (e.g. academia) were also invited to key events and involved through the project partner SRADev.

- From the side of industries, the project developed exchanges with various ULAB recycling companies. These exchanges were first initiated in a first stakeholder workshop in April 2024 in Ogun State and continued during facility assessments (see section 4.2), trainings (section 4.3) and the final conference (section 4.9). While there were some additional (remote) contacts with various recyclers, project communication with recyclers was mainly done through NESREA and ARBR.

- Local communities affected by ULAB recycling were involved from an early stage on. Amongst others, the traditional leader of the Ogijo community HRH Oba Alayeluwa Kazeem Olaonipekun Gbadamosi (Okuselu I)[10], where several ULAB recycling facilities are located, actively participated in all ProBaMet events and took active positions in supporting and shaping sector improvement measures.

- Players from battery using industries were primarily involved through members of the project partner, Alliance for Rural Electrification, which actively informed its 22 companies with an active presence in Nigeria on relevant project activities and achieved significant support from these companies (see section 4.6 and 4.8). Amongst others, the project and its activities were presented at the ARE Energy Access Investment Forum in May 2024 in Lagos.

- International lead buying and lead using industries were involved through the project partner Platform Lead. This involved outreach and regular exchange with lead using industries in Germany and Europe, major commodity traders and the International Lead Association (ILA). Amongst others, this exchange led to project support through ILA, EUROBAT and BCI in developing a facility assessment methodology used in the project (see section 4.2). Outreach to international lead and battery industries was also generated with an article in one of the most read sector magazines (Adjei et al. 2024).

Furthermore, the project was guided by a Project Steering Group, which received regular project updates and met in joint calls with the ProBaMet team to exchange on critical aspects and decision points of the project[11].

[10] The Ologijo of Ogijo is the installed king of the Ogijo community in Ogun State, which hosts many ULAB recycling plants. He is a well-respected traditional leader and shapes and directs manifold activities within this community.

[11] The following persons and organizations were members of the Project Steering Group: Isa Abdul Salam (NESREA), Ola Oresanya (OGEPA), Miranda Amachree (ARBR), Dr. Tadesse Amera (IPEN), Dr. Steve Binks (ILA), Andrew McCartor & Gabriel Sanchez Ibarra (PureEarth), Stefan Trittler & Nicolas Rohrer (Asantys Systems GmbH), Jana Mandel & Paul Steimer (GIZ).

## 4.2 Sector & plant assessments

Assessments of industrial ULAB recycling plants operating in Nigeria were a key element of the project and laid the foundation for an understanding of the market, the state of the sector in terms of EHS standards and to develop sector improvement strategies in-line with national needs and based on the ProBaMet approach (see chapter 3). Plant assessments were conducted in two campaigns (April and September 2024) and covered the active plants indicated in Figure 2-3. Results of plant assessments, as well as the mode of conduct are summarised in section 2.3. The assessments used the *Standard Operating Procedures for Environmentally Sound Management of Used Lead-acid Batteries* as reference document (Wilson and Manhart 2021). This reference document was operationalised for plant assessments with an “SOP assessment form”. The form was specifically developed for this project with know-how and resources provided by the International Lead Association (ILA), EUROBAT and the Battery Council International (BCI).

The assessment results do not only inform on individual plants, but also allow a holistic view on the current state of the ULAB recycling sector as summarised in section 2.2. The assessments were also part of the wider cooperation and training approach and are now a documented baseline against which further sector developments and improvement strategies can be gauged.

**Figure 4-1: Impression from a ULAB recycling facility assessment**

Source: Own picture

## 4.3 Training of auditors & plant managers

Monitoring and enforcement of EHS standards is a key element of ensuring sound plant operations and a core element of the ProBaMet approach (see chapter 3). While the ProBaMet project conducted joint facility assessments with environmental authorities in charge (see section 4.2), compliance verification is a permanent / periodical task to ensure sound operations to grant / extend operating licenses of facilities.

In that context, ProBaMet conducted a training exercise composed of classroom training and practical application:

- The classroom training session covered the general technical background of ULAB recycling, the use of SOPs, methods of plant assessment and documentation of results. It was attended by regulators (staff from the Federal Ministry of Environment, NESREA, OGEPA, LASEPA and Anambra State Ministry of Environment) as well as representatives from the ULAB recycling industry (ARBR and managers of ULAB recycling plants operating in Nigeria).
- The practical training was conducted in four ULAB recycling facilities in Ogun State where the participants were able to apply the gained knowledge from the classroom training in practical cases. In that part of the training, industry representatives were – apart from ARBR – excluded as facility assessments allow insights in sensitive business aspects not destined for potential competitors.

**Figure 4-2: Group picture from the practical training at a ULAB recycling plants**

Source: Own picture

## 4.4 Development of improvement plans

Based on the facility assessments (see section 4.2), improvements plans have been developed for assessed plants and provided to the Federal Ministry of Environment, NESREA, OGEPA and ARBR. NESREA used the assessment reports and improvement plans in their interaction with the respective companies. While plant-specific improvement plans cannot be published, the project developed a generic improvement plan addressing the most urgent shortcomings identified in sub-standard plants (see section 2.3.1). This plan can be found in Annex I.

## 4.5 Positive listing of responsible recycler

As described in section 2.3.3 one plant was found to operate on a significantly higher standard than any other plant assessed in this project. In-line with the ProBaMet concept that combines push- and pull-factors, the plant was publicly listed as the "most advanced sector player […] with regards to emission controls, occupational health & safety and industrial hygiene in their respective country" (ProBaMet 2024). This positive listing is based on the following criteria:

- The plant meets all applicable regulations in the respective country/region;
- It operates significantly above the commonly encountered industry practices in their respective country;
- It complies with a minimum set of requirements listed;
- The management is committed to continuous improvements with a view to full compliance with all established good practices as laid out in the Standard Operating Procedures within 3 years.

Positive listing is meant to support up- and downstream industries (particularly battery using industries in Nigeria and players interested in buying lead from Nigeria) in identifying responsibly operating business partners. When partnering with the listed company, the document can be used as supporting evidence of a sound operation and to avoid situations in which battery disposal and/or lead sourcing is associated with supply-chain misconduct (particularly related to lead emissions and exposure, as well as related effects on human health and lives). Indirectly, this positive listing also informs that ULAB recycling plants in Nigeria that are not listed in that document operate at lower standards, likely with adverse effects on human health and the environment.

The positive listing document, which also specifies the approach and criteria in more detail, can be downloaded from: https://www.oeko.de//fileadmin/oekodoc/Resp_ULAB-recyclers_Nigeria.pdf

## 4.6 Renewable energy circularity guidelines

As described in chapter 3, the ProBaMet approach strongly builds on a combination of push- and pull-factors, whereof pull-factors encompass players controlling relevant volumes of lead-acid batteries. The Alliance for Rural Electrification (ARE) as one project partner was in charge of communicating with and initiating related action in the renewable energy sector in Nigeria and beyond. In Sub-Sahara African countries, renewable energy companies are strongly involved in electrification of rural communities with solar solutions requiring battery storage. Thus, this sector has influence over relevant battery volumes and disposal habits may – if targeted towards high quality end-of-life management – act as a relevant pull-factor, supporting best recyclers such as identified and communicated in the ProBaMet project (see section 4.5).

To develop the "Circularity Guidelines on end-of-life battery management", ARE conducted in-depth desk research and industry consultations, receiving sector feedback to ensure completeness and feasibility. The ARE guidelines set minimum standards in the renewable energy space in low- and middle-income countries and called for renewable energy companies to endorse and embed these guidelines within their daily operations. The guidelines define key roles and responsibilities of market participants by setting out global and progressive principles and standards. The different elements in the guidelines are categorised under four main headings:

- Quality & durability;
- Warranties, maintenance & repair;
- Take-back, and;
- Sound end-of-life management.

ARE subsequently launched a campaign to call distributed renewable energy (DRE) companies to endorse the guidelines and embed them in their daily operations within two years of signing the endorsement.

During the conference on Upgrading the Lead-acid Battery Recycling Sector in the African Region (see section 4.7), a number of DRE companies signed the endorsement letters for the circularity guidelines. So far, over 80 companies have endorsed the Circularity Guidelines. These operate across 46 countries and are distributed across the DRE value chain, including manufacturers, developers, engineering, procurement, and construction companies, investors/financiers, research institutes and battery recyclers.

The outreach on the guidelines also lead to a number of DRE companies signing agreements with Green Recycling in Nigeria to ensure adhering to high-standard recycling practices (see section 2.3.3 and 4.5). The impact even went beyond Nigeria, with DRE companies in the region inquiring about sound recyclers they could sign agreements with, within their countries of operation. This showcases that the DRE sector understands the importance of sound end of life battery management, but at the same time the difficulties they face in actually finding high-standard recycling facilities to cooperate with.

**Figure 4-3: Circularity Guideline signing ceremony on 19th of March 2025 in Abuja**


Source: Own picture

The Circularity Guidelines can be downloaded from:

https://www.ruralelec.org/wp-content/uploads/2024/09/ProBaMet-Circularity-Guidelines.pdf

## 4.7 Conference on Upgrading the Lead-acid Battery Recycling Sector in the African Region

Between March 18 - 19, 2025, the ProBaMet project organised a conference[12] in Abuja, Nigeria, marking the conclusion of its implementation phase. Hosted by the National Environmental Standards and Regulations Enforcement Agency (NESREA), the event—titled "Upgrading the Lead-Acid Battery Recycling Sector in the African Region"—brought together high-level stakeholders from Nigeria and other African countries, where the used lead-acid battery (ULAB) recycling sector faces comparable environmental and regulatory challenges.

For donors, policymakers, and industry actors, the conference offered a critical platform for dialogue, evaluation, and strategic alignment. Day one focused on national progress in ULAB end-of-life management, with NESREA presenting notable advancements in regulatory enforcement and facility assessment capacities. These institutional improvements underscore the growing capacity within Nigeria to address hazardous waste risks more effectively.

Importantly, the conference also gave voice to private sector actors committed to responsible recycling practices. Mr. Ali Fawaz, General Manager of Green Recycling—the only positively listed recycling facility in Nigeria—shared frank insights into the structural challenges still undermining the sector. He cautioned that without stronger enforcement of environmental standards, largely compliant facilities with substantial investments in advanced technologies remain at a competitive disadvantage against recyclers who offer unsustainably high prices for ULABs, while operating with minimal environmental safeguards (see section 4.5 on positive listing of responsible recyclers under the framework of the ProBaMet project). As part of ongoing efforts to build on the progress made in highlighting the critical issues within Nigeria's used lead-acid battery (ULAB) recycling sector, a multi-stakeholder visioning workshop was convened. Guided by invited experts and stakeholders from across Africa, participants collaborated to articulate a shared 10-year vision for a safer, more sustainable ULAB recycling industry. This strategic exercise was followed by a high-level panel discussion that examined the enabling conditions and institutional framework necessary to achieve this vision.

The panel featured prominent voices, including the Director General of the National Environmental Standards and Regulations Enforcement Agency (NESREA), respected community leaders and legislative representatives, and the head of the German Platform Lead. The dialogue was both candid and forward-looking, underscoring the urgency of strengthening regulatory oversight, monitoring, and continuous facility assessments aimed at ensuring progressive improvements in recycling plants. These discussions should further galvanize NESREA and relevant authorities at both federal and state levels to scale up their efforts in monitoring, inspection, and enforcement — actions that are critical to safeguarding public health and environmental integrity in the sector in the medium to long term.

**Figure 4-4: High-level panel discussion on outcomes of a visioning exercise for the Nigerian ULAB sector**


Source: Own picture (From left to right: Dr. Sampson Atiemo, MRI-Ghana; Dr. Innocent Barikor, DG NESREA, Mrs. O.M. Osinaike, OGEPA; Hon. Terseer Ugbor, Vice Chairman Nigerian Senate Committee on Environment; Oba Kazeem Gbadamosi, Oba of Ogijo Community; Ms.Franziska Weber, Platform Lead)

[12] The ProBaMet conference invitation and programme flyer is attached to this report in Annex II.

The second day of the conference adopted an outward-looking perspective, featuring insightful reflections from invited experts representing Ghana, Tanzania, Cameroon, Kenya, and Ethiopia. These country-specific presentations offered a comparative lens on the state of used lead-acid battery (ULAB) management across the continent, emphasizing that the challenges faced in Nigeria are mirrored in other African contexts. This shared reality underscored the potential for cross-border collaboration, knowledge exchange, and the adoption of mutually reinforcing best practices.

A spirit of constructive competition also emerged, fostering a dynamic in which African nations are encouraged to strive for continuous improvements in ULAB recycling standards and regulatory effectiveness. Notably, Dr. Hannah Wamuyu of the School of Law at Jomo Kenyatta University in Kenya highlighted the legal consequences[13] faced by regulatory agencies that issue licenses to environmentally unsound recyclers. Her presentation served as a compelling case study, illustrating the importance of legal accountability in driving systemic change.

In addition to the presentation of the Renewable Energy Circularity Guidelines (see Section 4.6) and a technical briefing by Engitec Technologies - an international market leader in ULAB recycling equipment design and manufacturing - on emerging challenges and future trends in the sector, the afternoon session shifted focus toward the formulation of a continent-wide strategy for ULAB management in Africa. This effort was led by Dr. Tadesse Amera of PAN-Ethiopia, who emphasized the urgent need for standardized regulatory and operational frameworks across the continent.

A high-level podium discussion followed, bringing together African regulators, technical experts, and representatives from international lead buying firms to deliberate on a proposed Call for Action. This strategic proposal marks a pivotal first step toward harmonizing and scaling effective ULAB management practices across Africa in a manner which would encourage local stakeholder ownership, aligning public health objectives, environmental and material stewardship, and sustainable industrial development. The Call for Action was subsequently advanced for broader international engagement and featured on April 28 at the 2025 Basel, Rotterdam, and Stockholm Convention of Parties in Geneva. Further details of the side event are provided in Section 4.9 of this report.

**Figure 4-5: Panel dialogue on advancing a Pan-African framework for ULAB end-of-life Management**


Source: Own picture (From left to right: Mr. Fred Adjei, Oeko-Institut; Dr. Tadesse Amera, PAN-Ethiopia; Dr. Sampson Atiemo, MRI-Ghana; Dr. Luhuvilo Mwamila, NEMC-Tanzania; Dr. Hannah Wamuyu, Jomo Kenyatta School of Law – Kenya; Mr. William Lemnyuy, Ministry of Environment Cameroon; Dr. Leslie Adogame, SRADeV-Nigeria; Mr. Norma Mukwakwami, Global Head of Responsible Sourcing, Trafigura)

[13] In Kenya, the National Environmental Management Authority (NEMA) was held partly responsible by the country´s judiciary for licensing a polluting ULAB recycler. The legal case lead by Ms. Phyllis Omido, garnered international attention with NEMA and the recycler having to pay US$ 12million in fines (BBC 1 Aug 2020).

## 4.8 Cross-sector dialogue & cooperation agreements

The ProBaMet approach builds on a broad stakeholder participation and combines push- and pull-factors (see chapter 3). Thereby the pull-factors rely on strategic decisions of business entities in the up- and downstream part of ULAB-recycling, as well as ULAB recyclers themselves. Namely, the willingness to respond to the changing framework and business conditions. The ProBaMet approach is aimed at stimulating exchange between relevant market players and initiate cooperation agreements between involved business players. In that context it must be noted that a project such as ProBaMet can initiate exchanges and raise awareness for the importance of the issue but cannot control business decisions of any third party. In a similar manner, business decisions and inter-business agreements and contracts are typically not public and the ProBaMet team may not have a full overview over agreements initiated partly or fully through ProBaMet. The following list may therefore be incomplete, but does nevertheless give an impression on developments in that field:

- 80 companies from the renewable energy industry signed Circularity Guidelines and thereby committed to embed sound end-of-life management of batteries into their business routines (see section 4.6).
- Various renewable energy companies with activities in Nigeria have met agreements with the positive listed company Green Recycling (see section 4.5) to cooperate for lead-acid battery disposal and recycling.
- The occasion of the international conference (see section 4.7) was used by one ULAB recycling company in Nigeria to get in contact with an international manufacturer of battery recycling and smelting equipment to discuss plant upgrading possibilities and equipment costs. The outcomes of this exchange are not known to the authors of this report and are likely falling under sensitive business aspects not meant for public disclosure.
- Trafigura, a leading global commodity trading company, has launched a project aimed at mitigating the EHS risks and impacts related to the activities of its Nigerian suppliers of recycled lead. Trafigura has engaged in an exchange with ProBaMet which has informed the development of the project. The following information on the company's key project components was provided by Trafigura:
    - Responsible sourcing due diligence assessments of its suppliers which took place in 2024,
    - Inclusion of contractual clauses that are partly informed by the new Nigerian batteries regulations and which specify required improvements for each supplier in supply contracts,
    - Agreement with suppliers on improvement plans,
    - Regular monitoring visits to lead recycling plants to assess improvements and inform business decisions,
    - Capacity building activities, and
    - Multi-stakeholder dialogue on industry-wide challenges and opportunities.

While ProBaMet can – at the time of writing of this report – not verify the state of implementation and impacts of these project elements, they would (if implemented thoroughly as sketched) align with various aspects of the "Call to Action on Africa's Lead-acid Battery Recycling Industry" that emerged from ProBaMet's Conference that took place in March 2025, particularly the points addresses to "buyers of lead and lead-alloys" (see section 4.9 and Annex III).

Furthermore, the approach also aligns with the OECD's Due Diligence Guidance for Responsible Mineral Supply Chains, emphasizing collaboration to address challenges proactively, rather than abruptly withdrawing from markets when issues emerge.

## 4.9 Pan African dialogue & outreach

At the 2025 Basel, Rotterdam, and Stockholm (BRS) Conventions held in Geneva, the ProBaMet project, in collaboration with the GIZ Go Circular programme, convened a side event on the 28th of April titled "Bridging Gaps in E-Waste and End-of-Life Battery Policies and Standards: Strategies for Effective Implementation." The second half of the event focused on advancing the Call to Action on Africa's Lead-Acid Battery Recycling Industry, first initiated at the ProBaMet Conference in Lagos (see Section 4.7). This segment brought together leading African experts, civil society representtatives, and national delegates to present a unified vision for reforming the sector.

Moderated by Dr. Tadesse Amera (PAN-Ethiopia), the panel included African experts and Mr. Santos Virgilio, delegate for Angola at the BRS COP25, who outlined the rationale and urgency for a coordinated, African-led effort to improve the environmental and health performance of used lead-acid battery (ULAB) recycling across the continent. The event marked the official unveiling of the Call to Action document[14], presented to an international audience, underscoring the need for systemic change and collaborative support for sustainable battery management in Africa.

The Call for Action document, endorsed by invited experts, urges all actors along the ULAB end-of-life value chain to implement practical measures aimed at preventing and mitigating lead emissions. Specifically, the Call for Action outlines responsibilities for key stakeholders, including:

- ULAB recyclers
- National and subnational governments
- Battery owners
- Buyers of lead and lead alloys
- Civil society organizations
- Academic and research institutions

To support the implementation of these commitments, the Call for Action also calls for the establishment of a dedicated multi-stakeholder initiative — drawing on models such as the ProBaMet project in Nigeria and the SRI initiative in Ghana. The proposed platform would perform five core functions:

- Support for Standards Development: Assisting governments, regulatory agencies, and recycling operators in formulating and adopting robust, enforceable industry standards.
- Empowering Civil Society: Enabling civil society groups to mobilize affected communities and advocate for safer practices, acting as a critical link between grassroots concerns and regional or global policy dialogues.
- Benchmarking Best Practices: Designing and maintaining an independent system to identify and promote top-performing recycling facilities through a public "positive listing" approach.
- Facilitating Cross-Border Exchange: Encouraging regional cooperation and peer learning among stakeholders driving ULAB sector reforms across the continent.
- Documentation and Dissemination: Tracking progress and sharing lessons through case studies and periodic updates on regulatory and industry advancements within the African ULAB recycling landscape.

[14] The Call for Action document is attached to Annex III of this report.

**Figure 4-6: Panel presentation and dialogue at the BRS COP 25 Side Event partly focused on the Call to Action for Africa’s lead-acid battery recycling industry.**


Source: Own picture (From right to left: Mr. Santos Virgilio, Delegate from Angola; Dr. Leslie Adogame, SRADeV-Nigeria; Dr. Tadesse Amera, PAN-Ethiopia; Mr. Fred Adjei, Oeko-Institut; Ms. Anuradha Varanasi, Oeko-Institut)

## 4.10 Considerations on other countries & material streams

The ProBaMet concept proved quite effective in stimulating systematic environmental sector performance assessments and an upgrading process in Nigeria. From that perspective, various stakeholders voiced interest in a systematic review if and how the concept may be applied to other countries and secondary raw material streams. A related analytical study was conducted by Oeko-Institut and WVMetalle (Manhart et al. 2025). The study concludes that the approach holds potential to be successfully applied for ULABs and secondary lead, particularly in various other African settings. In addition, it may be applied to secondary aluminium supply chains, as well as zinc from galvanised steel. In both material streams significant improvement potentials in terms of environmental performance as well as resource recovery efficiency are assumed. Further details would require a more specific feasibility phase, including cooperation with and visits to aluminium remelters and secondary steel plants in low- and middle-income countries.

The study can be downloaded from: https://www.oeko.de//fileadmin/oekodoc/Feasibility_ProBaMet_2025.pdf

# 5 Open points & recommendations

As outlined in chapter 4, the ProBaMet project had a significant impact on the ULAB recycling landscape in Nigeria. It paved the way towards structured plant assessments and upgrades, more responsible battery disposal options and supply chain due diligence for buyers of lead from Nigeria. However, comprehensive and sustainable sector reform will require the continuation of these activities and further efforts. The following aspects highlight important strategy elements and measures considered important for successful long-term sector reform.

## 5.1 Recommendations to policymakers in Nigeria

**Prioritisation of the ULAB recycling sector:** Due to the high pollution potential of unsound UALB recycling and its associated public health impacts, the sector requires continuous attention from the government and regulatory agencies. While Nigeria's National Environmental (Battery Control) Regulations of 2024 are a significant step forward, the existing legal requirements must be enforced, with clear consequences for non-compliance, including effective sanctions for polluting companies.

**Establish a nationwide radar for ULAB companies:** There is currently strong investor interest in Nigeria's used lead-acid battery (ULAB) recycling sector. While the ProBaMet assessment covers a large part of the sector (see section 4.2), it remains dynamic, with new industrial-scale investments emerging, particularly in Ogun State and Abuja. Furthermore, there are abandoned plants in Anambra State and Kano, and probably more sites not known to the ProBaMet team. It is of the utmost importance that national regulatory agencies closely monitor these developments and maintain an up-to-date registry of all entities engaged in ULAB and lead-related industrial activities. This registry should include operational and abandoned and inactive plants, as well as pending applications for new facilities.

Crucially, this registry must be incorporated into the regulatory decision-making process for approving new investments and issuing operating licenses. Access to the registry should also be granted to all relevant authorities responsible for environmental protection and public health. Such a registry is essential for regulating and upgrading the sector.

**Strategic focus on a limited number of high-quality / high-standard recycling plants:** The market for ULAB recycling in Nigeria is limited by the volume of available batteries, rather than the number of plants. The more ULAB recycling plants operating in Nigeria, the fewer batteries will be available to each individual recycling plant. Considering that sector upgrades will require significant investment in modernising equipment and plant set-ups – including automated battery-breaking systems, improved off-gas capture and treatment, and improved material handling, dust control, housekeeping, and occupational hygiene – economies of scale are important for achieving economic profitability. Small- and mid-sized plants will likely be unable to undertake such investments, and fierce competition between plants will further limit the (financial) scope for upgrades and maintaining high operational standards. It is therefore recommended that Nigerian regulators implement a strategy for a limited number of large, high-standard ULAB recycling plants[15]. This can be achieved by closely monitoring all current plants and demanding ambitious upgrades[16]. Plants that cannot implement the expected upgrades within the foreseen timeline should be sanctioned, with the worst performers facing permanent closure.

**Repeated plant assessments and plans for ambitious and continuous improvements:** As recommended above, the sector requires ongoing regulatory attention. This should lead to robust monitoring, repeated plant assessments and

[15] Germany ranks seventh in terms of refined lead output with 251,000 t/a (ILZSG 2023). This volume is produced by only five companies that meet the highest standards. In contrast, the ten ULAB recycling plants listed in Table 2-1 have a combined production capacity of 114,000 t/a, but are producing much less than this. Therefore, current plant sizes in Nigeria are substantially smaller than those in countries that have successfully upgraded their lead industries.

[16] The minimum criteria set out in Annex I can be used as a starting point for improvement plans, but these should go beyond that, with the aim of achieving full compliance with all SOPs (see Wilson and Manhart 2021)), as well as implementing continuous improvement processes.

the development and enforcement of ambitious improvement plans. While the minimum criteria set out in Annex I can be used as a starting point for improvement plans, these should go beyond this to achieve full compliance with all SOPs (see Wilson and Manhart 2021), as well as continuous improvement processes. Facilities with the worst environmental and safety performance must face sanctions that make non-compliance significantly more costly than compliance. If environmental standards are weakly enforced and polluting practices are tolerated, the sector will fail to attract responsible investment and will not develop into a sustainable or credible business environment.

**Installation of continuous plant monitoring systems:** Monitoring of plants requires physical assessments by experienced auditors. Due to Nigeria's size and the associated travel logistics and costs, the scope and frequency of audits will not allow misconduct to be revealed within days or weeks. In this situation, additional remote monitoring systems can complement audit-based plant monitoring. Such systems are a common feature in many developed economies and – amongst others – use emission monitoring devices at critical points of the plant (e.g. at the stack, the fence line and the operating hall). Live monitoring data is shared with regulatory oversight bodies. It must be stressed that, while remote monitoring systems are an important element of compliance monitoring, they are not intended to fully replace field assessments. Aspects such as dust control, housekeeping, battery breaking, providing clean work cloths and blood lead testing cannot be done remotely and require trained assessment auditors to be on the ground. Nevertheless, intelligent monitoring (e.g. sensors coupled with webcams) can certainly improve regulatory oversight.

**Systematic blood lead monitoring:** Testing of all workers for blood lead levels is a key approach for monitoring all plants handling lead materials. Currently, no such testing is conducted in Nigeria's ULAB recycling industry. In fact, most plants have never conducted any blood lead testing on workers or other stakeholders. From an international sector standpoint, this is a severe shortcoming and not in line with established best practice. Details of blood lead testing, common methods, schedules and threshold limits are set out in SOP No. A.2.7 (Wilson and Manhart 2021). Tests are typically organised and financed by the ULAB recycling company and should be conducted by independent test laboratories. Original evidence of test results must be filed and made available to inspectors. The results must also be shared with the individuals tested, together with an interpretation of the results. If blood lead levels are elevated, appropriate action must be taken to reduce exposure to lead (e.g. job rotation and identification of exposure sources), without resulting in job losses. Blood lead testing should also extend to neighbouring communities where plants have residential or business neighbours. In such situations, offers of free lead testing should be made alongside the provision of information on the nature and risks of the industrial practices in question. Building on good community relations and acting with the consent and permission of community leaders is crucial for success here.

The importance of systematic and regular blood lead testing at ULAB recycling companies cannot be overestimated, as it provides the most direct indication of whether a plant operates at the required industrial hygiene standard.

**Promotion of best recyclers:** The ProBaMet approach uses push- and pull factors to transform the ULAB recycling market, and this combination has proved very promising. While it is clear that market transformation without push factors (strong regulatory enforcement) is prone to failure, market incentives for the best performers (pull factors) should also be developed further. One meaningful approach would be for the government to dispose of ULABs from government sources (e.g. police cars, the military and backup power systems) solely with the best-performing ULAB recyclers. Furthermore, the Alliance for Responsible Battery Recycling (ARBR) could introduce measures to ensure that batteries are channelled to the best performers. Other sectors that produce batteries, such as telecommunications, organised transport firms, and local vehicle maintenance syndicates, could also be encouraged to dispose of their ULABs likewise with the best-performing recyclers.

**No tolerance policy for polluting recyclers:** As highlighted in the preceding sections, a meaningful transformation towards environmentally sound ULAB recycling in Nigeria will not be achieved without reforming the sector's economic framework conditions. Specifically, it must become less viable and less profitable to operate polluting, low-standard facilities, and more advantageous to invest in high-standard, legally compliant operations. At present, this dynamic is reversed. The only operator that has made substantial investments in environmentally sound, compliant recycling processes continues to face serious market pressure from low-cost, substandard competitors. The business case for responsible recycling will remain weak unless such low-standard operators are effectively regulated and held accountable. Creating a level playing field, where compliance is rewarded and non-compliance is penalized, is essential to drive sustainable change in the sector.

It is therefore important to understand that stringent enforcement of standards supports environmentally sound and responsible industry investments, and is not, as is sometimes falsely portrayed, an anti-industry strategy. Enforcement should not only involve fines and the temporary or permanent withdrawal of operating licenses, but also legal action against polluters to compensate victims of pollution, as well as to finance the healthcare of individuals poisoned by lead and efforts to remediate sites.

## 5.2 Recommendations to ULAB recyclers in Nigeria

**Take environment, health and safety seriously:** ULAB recyclers in Nigeria are strongly encouraged to prioritize environmental, health and safety (EHS) considerations more than has traditionally been the case. Assessments conducted under the ProBaMet project revealed that health and safety officers in many facilities often assume multiple roles and are not meaningfully involved in decision-making or senior management. EHS practices were often treated as secondary to core recycling operations and appeared to be primarily geared towards appeasing regulators, particularly during pre-announced inspections. Preparations for compliance visits often seemed rushed and superficial, focusing on low-cost measures rather than addressing structural weaknesses. There is an urgent need to foster a culture within ULAB recycling facilities that prioritizes environmental stewardship and the health and safety of workers and surrounding communities— not as a compliance tick-box exercise, but as a core value. Focus must shift critically from symbolic protective measures, such as using disposable face masks without taking effective steps to reduce lead dust generation and accumulation in the plant, to more impactful interventions that target the root causes of lead emissions, exposure, and environmental harm. These include strong housekeeping practices, effective pollution control systems (e.g. dust capture via baghouses and effluent capture and treatment), and safer furnace charging and tapping processes (e.g. the use of effective fume hoods), as well as the various other steps laid out in the Standard Operating Procedures for Environmentally Sound Management of Used Lead-Acid Batteries (SOPs)[17], which must be thoroughly implemented. Prioritizing these areas will lead to more meaningful, long-term improvements in EHS performance.

**Invest proactively in improved recycling technology and processes:** Field assessments conducted under the ProBaMet project indicate that most ULAB recycling facilities in Nigeria use mid-level technologies for their smelting and refining operations and even basic approaches for breaking down batteries. Although technological upgrades in this sector are acknowledged to be capital-intensive, adopting improved systems greatly facilitates compliance with environmental regulations and standards. Advanced technologies, particularly fully automated battery breaking systems that efficiently separate various materials including battery electrolyte (acid), elementary lead and lead paste, offer significant operational advantages and are a prerequisite for safe and hygienic operations. These include the ability to process elementary lead at lower temperatures, resulting in substantial energy and $CO_2$ savings. Additionally, integrating effluent capture and treatment processes with downstream applications, such as gypsum production, can generate new revenue streams and offset some of the investment costs. As global and regional scrutiny of ULAB recycling practices increases, the risks and costs associated with non-compliance, harm to workers, and lead pollution in surrounding communities may now outweigh, or soon exceed, the financial burden of investing in cleaner, more efficient technologies. Embracing these innovations is therefore not only a regulatory imperative, but also a strategic choice for achieving long-term sustainability and competitiveness.

**Cooperate with stakeholders:** In the rapidly evolving ULAB recycling sector, cooperation with stakeholders is not just beneficial — it is essential. While collaboration with regulatory and enforcement bodies is often mandated by law, meaningful engagement with local communities and civil society organizations is less formalised, yet equally important. Recyclers must recognize the critical roles these stakeholders play. For instance, communities need regular commu-

[17] See: https://www.sustainable-recycling.org/wp-content/uploads/2022/04/ULAB_recycling_SOPs.pdf

nication regarding facility operations and the potential impacts on their health, environment, and livelihoods. This is particularly important given that many recycling facility workers live in close proximity to their workplace, often within the same communities. Without adequate sanitary facilities and proper protocols for changing work clothing, lead exposure may be inadvertently transferred from the workplace to the home, thereby endangering families. Further pathways, such as fugitive lead emissions and lead dust transport, may also result in lead contamination and exposure in neighbouring communities. Communities have a right to know what measures recyclers are taking to protect them from such scenarios and the impacts of lead pollution. Measures such as voluntary lead-in-blood testing for the community and tests of soil and air can be implemented transparently and ethically. Civil society organisations also play a vital role in advocacy, shaping public discourse and influencing policy. They often advocate for affected communities and workers, calling for improved safety standards and working conditions. By fostering open, proactive relationships with these stakeholders, recyclers can address concerns early on, build trust and avoid conflict. A cooperative approach is far more likely to result in sustainable, mutually beneficial outcomes than one rooted in defensiveness or resistance.

**Strive for continuous improvement:** Field assessments conducted during the implementation of the ProBaMet project revealed that most facilities must urgently take concrete action to meet the minimum improvement criteria outlined in Annex I. Building on this, they should progressively implement the Standard Operating Procedures (SOPs) for the Environmentally Sound Management of Used Lead-Acid Batteries (see sections 4.2 and 4.3). It is important to convey to ULAB recyclers, however, that neither regulators nor international lead buyers expect immediate conformity with the most advanced technologies or the strictest process standards. What is expected, however, is a demonstrated commitment to ambitious and continuous improvement, undertaken in collaboration with national and international stakeholders. This includes progressive enhancements in recycling practices, the adoption of cleaner technologies, improved pollution control systems, and measurable reductions in workers' and, where relevant, nearby communities' blood lead levels. At the same time, it must be clearly understood that the principle of continuous improvement is not a justification for maintaining the status quo. Rather, it is a framework for steady, verifiable progress towards safer, more sustainable recycling operations.

**Be transparent:** During its assessments in Nigeria, the ProBaMet project observed that many ULAB recyclers demon strated a high level of openness and transparency regarding their facilities, operations, and areas for improvement. This willingness to engage honestly provides a positive foundation upon which further progress can be built. Recyclers are strongly encouraged to maintain this transparency, particularly with regard to critical issues such as testing workers' blood lead levels. While most plants have not yet conducted any such testing of workers (see section 5.1), it is vital that this is done systematically across all plants, with the results shared and discussed transparently even if some are above the recommended alert or limit values. Hiding shortcomings not only undermines trust, but also often leads to more severe situations, reducing the range of viable responses available to regulators and eroding constructive dialogue with affected communities. For example, recyclers should establish systematic monitoring protocols with competent, recognized and independent laboratories for blood lead testing of workers and neighbouring communities, provided that community members consent to this. Sustained transparency is a sign of good faith and a practical tool for continuous improvement and long-term compliance.

## 5.3 Recommendations to large users of batteries in Nigeria

**Acknowledge the responsibility for sound end-of-life management**: At the ProBaMet Conference, co-hosted with NESREA in Abuja, several stakeholders from the decentralised renewable energy sector endorsed the circularity guidelines developed by the Alliance for Rural Electrification. These guidelines call on major battery users — including those in the renewable energy, telecommunications, transport, and banking sectors — to recognise their responsibility in ensuring the environmentally sound end-of-life management of used lead-acid batteries (ULABs) generated through their operations (see sections 4.6 and 4.7). While calling for the recognition of the ethical co-responsibility of large users of batteries in Nigeria, they should also realise their role in strengthening the country's Extended Producer Responsibility system by actively engaging in measures such as take-back schemes and finance mechanisms to support the ULAB recycling sector and regulators in implementing environmentally sound recycling. Proactively embracing responsibility and adhering to circularity principles is not only a matter of corporate social responsibility but a prudent risk management strategy in an increasingly regulated and environmentally conscious landscape.

**Partner with best-in-class recyclers**: Building on the recognition of responsibility by users of batteries above, it is equally important to identify and ensure the environmentally sound end-of-life management of the ULABs generated through their operations. To this end, large users of batteries are strongly encouraged to partner with the best-performing recyclers available in Nigeria, where "performance" is defined not merely by the possession of an operating permit, but demonstrated by excellence in environmental, health, and safety (EHS) practices across the entire recycling process. The ProBaMet project has published a list of such recyclers, and further information can be obtained from national and local regulatory authorities. It is essential to understand that "best-in-class" recyclers are those who meet comprehensive EHS criteria — not just the possession of an operating permit, but effective implementation in practice (see section 4.5).

While these high-performing recyclers may offer slightly lower purchase rates for ULABs compared to polluting operators, the potential costs of regulatory sanctions, reputational damage, and environmental harm should far outweigh any short-term financial trade-offs. Moreover, the sale of used batteries is not a core revenue stream for most users of batteries and is unlikely to materially impact overall profitability. In this context, aligning with responsible recyclers is also a sound business decision and an expression of meaningful corporate social responsibility.

## 5.4 Recommendations to buyers and users of lead

**Conduct environmental, health & safety risk assessments of lead suppliers located in, or sourcing from low- and middle-income countries**: Both international and domestic buyers and users of lead, particularly within the Nigerian context, are strongly encouraged to establish and implement robust supply chain due diligence systems. These systems should comprehensively address occupational health and safety, worker welfare, and environmental protection. In line with international good practices, buyers should adopt and apply thorough risk assessments and – in case environmental and human rights risks are identified – take effective action to mitigate them within their supply chain and sphere of influence. Within the framework of the ProBaMet project, buyers and users of lead have demonstrated their importance as pivotal stakeholders that can drive sustainable transformation within the sector. Their market influence constitutes a critical 'pull factor' in these multi-stakeholder initiatives. It is imperative that buyers and users of lead acknowledge the strategic role they play and utilise their market leverage to complement the 'push factors'—namely, enforcement actions by local and national regulatory authorities. Such steps may start with Nigeria, but should reach out to further countries and jurisdictions with evidence of sub-standard recycling practices. Aligning due diligence practices with national regulations and internationally recognized environmental standards is essential. Due diligence efforts should also be aligned with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD 2016). Due diligence elements should include strong company management systems for responsible sourcing, mapping of the supply chain and field assessments, design and implement a strategy to respond to identified risks, carry out third party audits of the supply chain and report transparently on due diligence efforts. Past incidents in the sector have shown that potential financial and reputational consequences of sourcing lead from unregulated and polluting recyclers may outweigh the costs of implementing effective supply chain due diligence.

**Actively engage with lead supplying industries from Nigeria and other low- and middle-income countries**: Through its engagements with lead buyers and users sourcing from Nigeria, the ProBaMet project has observed a growing sentiment that international buyers may withdraw from the market if local recyclers fail to meet environmental, health and safety standards. While such concerns are valid, the project emphasises that immediate withdrawal should not be the default response of the sector. The ongoing reform of the used lead-acid battery (ULAB) recycling industry in Nigeria is a complex process that requires transition time and sustained commitment. Buyers and users of lead, particularly those with significant market influence, are therefore encouraged to remain engaged with the Nigerian supply chain and with those in other low-to-middle income countries. Rather than divesting, they are urged to actively support sector transformation by using their market leverage strategically. A practical approach would involve offering preferential purchasing terms to front-runners and high-performing recyclers that demonstrate compliance with environmental and occupational health standards as laid-out in the SOPs (Wilson and Manhart 2021). Conversely, engagement with polluters and laggards should involve clear and effective improvement expectations (to be integrated in contractual relationships), thorough performance monitoring and ultimately cessation of business relationships in case improvement expectations are not fulfilled. Such business disengagement should ideally be undertaken in collaboration with local and national regulatory authorities. This approach amplifies the impact of international buyers' leverage and reinforces the capacity and authority of regulators to drive sustainable change within the sector.

## Annex I: Recommended minimum criteria as starting point for further improvement plans

The following list describes criteria and measures that are recommended to be fully met by a ULAB recycling facility in order to demonstrate willingness and ability to improve recycling operations in a manner they will be compliant with established minimum requirements as laid out in the Standard Operating Procedures for Environmentally Sound Management of Used Lead-acid Batteries (SOPs)[18].

Note that a full implementation of the points below is a necessary pre-condition for sound operations but will – without further measures as they are described in the SOPs – not be sufficient to guarantee safe and hygienic ULAB recycling. **This list should therefore be regarded as an absolute minimum list justifiable only for a limited transition period where unsound recyclers are given a final chance to demonstrate willingness and ability for substantial changes.** Companies that are able to fully implement the points within a limited timeline of around 6 months, should be given further (mandatory) improvements plans derived from a renewed facility assessment using the full SOP-set as the benchmark. For companies that are not able or willing to implement the points below stringent sanctions are recommended (revoke licenses, permanent closure, including freezing of assets to finance site remediation and workers compensation) as their continued sub-standard operation inevitably has severe negative implications for workers, communities and the environment, while also undermining the business model of better performing ULAB recyclers in the country.

It is noteworthy that compliance verification shall be conducted when a facility is in full operation. Ideally, this is done in unannounced inspection visits.

| Subject | Measure | Further comments |
|---|---|---|
| Lead-in-blood testing | All workers (including contract workers) must undergo regular blood lead testing in-line with SOP A.2.7. Results of testing must be made available to the tested persons (including a medical interpretation of the respective test results) and be filed to be made available for inspections.<br>The lead-in-blood testing shall be made regularly in the rhythm specified in SOP A.2.7.<br>Elevated blood lead levels (alert and limit values are specified in SOP A.2.7) must lead to remedial measures but must not include layoff of affected workers. | • Test campaigns must involve all workers (permanent and contract workers). Limited test campaigns that do not include all workers shall be regarded as non-compliance.<br>• Testing must be periodically repeated. Failure of periodical testing with the recommended regimes shall be regarded as non-compliance.<br>• Tests shall refer to independent medical laboratories. In case such laboratory services are demonstrably not available, a mobile test kit (such as LeadCare II) may be used. |
| Amenities | A sound and clean amenity block must be provided that is large enough to cater needs of all employees, male and female (including contract workers) in peak periods. It must have washing, shower and toilet facilities, as well as change room and lockers for private clothes in sufficient numbers. The amenity block must be separated from the factory area and with segregated male and female sections. The amenity block must be kept clean and functional and be mandatory used by all workers that enter and leave the facility (also for eating breaks). | • More information is given in SOP B.2.3.<br>• Provisions of clean works clothing is a key element of this requirement. Situations in which workers must provide their own works clothes and/or are required to wash clothes themselves are not acceptable. |

[18] See: https://www.sustainable-recycling.org/wp-content/uploads/2022/04/ULAB_recycling_SOPs.pdf

| Subject | Measure | Further comments |
|---|---|---|
| | Clean works clothing and PPEs must be provided to each worker at the beginning of every shift. | |
| Personal protective equipment (PPEs) | All operators must be provided with appropriate PPEs for their respective tasks. For factory workers, this must include protective boots, long sleeve works clothing, suitable respirators (at least FFP2 / N95) and gloves. Depending on the specific positions, this may also involve further PPEs such as googles, helmets and ear defenders.<br>Details are given in SOP A.2.1 and A.2.2. | • Surgical masks do not qualify as a suitable dust respirator and are unacceptable to be provided / used in ULAB recycling plants.<br>• Fresh works clothing and respirators must be provided to workers at the start of every shift.<br>• Personalised neoprene cartridge respirators are recommended (instead of disposable FFP2 or FFP3 masks). |
| Factory layout and floor | All ULAB recycling steps must be conducted in one or more factory halls that shelter the lead-containing materials and processes from wind, rainfall and storm water. The floor of all halls and its immediate surroundings (at least 5 meters from the outer walls of each hall) must consist of a smooth impermeable cover/paving. The floor must not be broken and uneven and shall allow regular wet cleaning (e.g. with ride-on sweepers).<br>A channel system must be in place and kept free from sludge, blockages, and interruptions. The system must capture all effluents and liquids and channel them to an appropriate treatment plant. Appropriate treatment may be an effluent treatment plant (ETP) in areas prone to acid leakages and settling ponds for rainwater to capture lead dust particulates.<br>The factory halls and their immediate surroundings must be kept free from any unnecessary material and equipment. Necessary material and equipment must be stored in clearly assigned areas that are demarked as such. | • Uneven and broken factory floors are not acceptable as this prohibits effective dust control / wet cleaning and will lead to unnecessary exposure of workers to lead dust.<br>• Holes in factory roofs and walls are not acceptable.<br>• All particles captured through the drainage system (sludge) must be recycled through the furnace.<br>• The channel systems must be designed and maintained in a way it does not unnecessarily capture soil from surrounding areas.<br>• The factory halls must be kept in a clean and orderly condition at all times. Chaotic storage of materials, machinery and other things are a clear sign of violations to basic hygiene and safety standards. |
| Housekeeping & dust control | The factory and its immediate surroundings must be kept clean and dust free all of the time. Cleaning shall by no means use brooms or any other means that generate dust. A sound factory layout and floor cover, as well as a well organised facility (incl. immediate surroundings) are a crucial precondition for effective housekeeping (see aspects above) | • Regular wet cleaning is a central part of this requirement.<br>• Cleaning water must be treated (e.g. in settling ponds to capture and recycle lead dust), but may be reused in the operation.<br>• More information is given in SOP A.2.5 |
| Sourcing strategy | The sourcing strategy shall be no means encourage the delivery of dry (drained) lead-acid batteries and the factory management must be able to demonstrate that at least 25% of the received ULABs arrive complete with acid. This percentage value is considered as a low value and shall be increased stepwise by increments to 90%. | A sourcing strategy promoting battery drainage and breaking prior to delivery causes pollution along the supply chain of ULABs and is therefore unacceptable. |
| Controlled battery breaking | Battery breaking must either refer to semi-automated or fully automated systems. Manual battery breaking (cutlasses, axes etc.) is unacceptable. More information can be found in | • Manual battery breaking (e.g. with cutlasses, axes) is unacceptable.<br>• Fully automated hammer mills have multiple advantages over semi-automated |

| Subject | Measure | Further comments |
|---|---|---|
| | SOP B.2.1. In case of semi-automated processing (battery saw), the system must be fully encapsulated and equipped with a conveyor so that operators cannot get into contact with acid and the battery blades. | systems (battery saws) as the separation done by hammer mills is a precondition for multiple hygiene and efficiency gains in the subsequent recycling steps (e.g. separate treatment of elementary lead and lead-oxide). |
| Encapsulated and ventilated furnaces | All furnaces must be encapsulated or covered with a fume hood. The systems must be ventilated to an off-gas treatment system with a baghouse filter plant. The housing / fume hoods must be designed in a way and with sufficiently strong suction to capture all fume and dust during charging, smelting and tapping of the furnace. | • Furnaces that are not encapsulated or equipped with strong fumes hoods over charging and tapping ports are not acceptable.<br>• Most fume and dust emissions occur during tapping. Thus, compliance verification should observe the tapping process to verify if all fumes and dust are effectively captured.<br>• Compliance verification should gauge and document the face velocity at the opening of each housing / fume hood. |
| Automated charging | Furnace charging should only be conducted by either fully automated or semi-automated methods in line with SOP B.2.5. In case semi-automated methods are used (e.g. forklift truck) the driver's cabin must be fully encapsulated and equipped with a High-Efficiency Particulate Air filter (HEPA-filter) protecting the operator from fume and dust generated during charging. | • Manual furnace charging is not acceptable.<br>• (Forklift) trucks without enclosed cabin with a filtered air supply (see section left) are unacceptable for charging. |
| Complete off-gas treatment system with well controlled recycling of captured dust | Off-gas treatment systems installed at furnaces shall consist of cooling towers baghouse filter plants, a wet scrubber and a stack (see SOP B.4.1). The systems must be monitored and maintained (see SOP B.4.2). Captured filter plant dust must be protected from wind and rainfall and workers should never come into direct contact with this dust (see SOP B.4.3). | Leakages of filter plant dusts are unacceptable. Such leakages can be identified as white/yellow powder that – in case of leakages – surrounds the outlets of the cooling towers and filter plants. |
| Refining | Kettles for lead refining must be covered and ventilated to a baghouse filter plant. Kettle sides must be at least 1 m high (see SOP B.2.8). | Refining kettles with lower sides and/or systems that are not covered and ventilated to a baghouse filter are not acceptable. |
| Casting of refined lead | Casting must refer to an automated casting machine. The casting temperature must be controlled and kept below 500°C all the time. See B.2.9 | • Manual or semi-manual casting of refined lead must be avoided.<br>• Casting above 500°C must be avoided to minimise fugitive lead emissions to the workplace. |
| Storage and management of slags | Smelting/furnace slags must always be stored in fully sheltered systems (paved and impermeable floor, walls, and a roof) that shelter all slag material from wind and rainfall and effectively prevents any dissipation in the nearby surroundings.<br>Slags must be disposed off in a well-controlled manner and in-line with national guidelines and | • Slags must never be stored outdoors or used as soil-like filling material in or outside the factory premises.<br>• Slags must never be disposed uncontrolled (hazardous waste)<br>• More information is given in SOP B.4.4 |

| Subject | Measure | Further comments |
|---|---|---|
| | regulations. Evidence of sound slag disposal must be kept and provided upon request at inspections. | |
| Effluent treatment | There must be an effective system to capture all liquids/effluents from the operations. Electrolyte (battery acid), process and cleaning water must be channelled to an effluent treatment plant (ETP), where it is treated with particulate and heavy metal removal and neutralisation.<br>Rainwater from the factory roof and immediate surrounding must be channelled to a series of settling ponds allowing particles to settle. Particulate sludge from these ponds must be recycled through the furnace. | • A release of untreated liquids is unacceptable.<br>• The effluent treatment plant (ETP) must be large enough for the treatment of predominantly wet lead-acid batteries (ULABs arriving complete with electrolyte / acid). |
| Cleaning of plastic cases | Recycling of plastic cases must involve various washing steps, including at least one using an alkaline solution to effectively remove all lead and lead-oxide before plastic is passed-on to further operators (see SOP B.3.2). | • Improper cleaning of plastic causes contamination of lead and lead-oxide into other facilities and plastic products such as furniture. |

## Annex II: ProBaMet conference invitation and programme flyer

Hosted by:

**18.-19. March 2025 Abuja Continental Hotel Abuja, Nigeria**

# Upgrading the Lead-acid Battery Recycling Sector in the African Region

Used Lead Acid Battery Recycling is one of the leading causes of lead poisoning in Africa, causing grave impacts on human health and environment. Countries in East and West Africa are taking steps to address this problem, but the road is long and much can be learnt from each other.

We invite stakeholders from industry, civil society, governments and academia to join us and learn about latest developments in Nigeria and the wider African region. This first ever regional conference on the topic will provide a forum for exchange on good practices, policy approaches and necessary next steps to substantially reduce lead exposure from unsound battery recycling.

### Day 1: ULAB recycling in Nigeria

- Challenges of battery recycling
- Regulatory responses
- Industry perspectives
- Community perspectives
- Visioning workshop

### Day 2: Situation in the African Region

- Feasibility of a Pan-African sector strategy
- Inputs by key stakeholders from
  - Kenya
  - Ghana
  - Tanzania
  - Cameroon

For registration, please send an email to **probamet@oeko.de**
Recommendations on hotel and local transport can be provided after registration.

**The conference is organised by the Partnership for Responsible Battery and Metal Recycling (ProBaMet).**
The project supports upgrading the used lead-acid battery recycling sector through training on environmental health and safety in battery recycling, supporting regulatory authorities, and creating business opportunities for high-standard recycling. The project is funded by the Federal Ministry for Economic Cooperation and Development (BMZ), supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and implemented in Nigeria.

Organised by: Öko-Institut e.V., SRADev Nigeria, Alliance for Rural Electrification, Plattform Blei

## Annex III: Call for Action on Africa's Lead-acid Battery Recycling Industry

Driven by the rise of a growing middle class, increased vehicle ownership, decentralized energy storage systems, and other emerging trends and use cases, the demand for lead-containing batteries is steadily increasing across the African continent. While the use of such batteries is known to be relatively save, end-of-life management is associated with severe risks to human health and the environment if not conducted properly. Despite various regulatory efforts, unsound lead-acid battery recycling is widespread in African countries and includes informal activities in battery collection and reverse logistics, as well as large scale sub-standard industrial lead smelting and refining. While not being the only source of lead emissions and human exposure, numerous pollution cases in the African region suggest that unsound lead-acid battery recycling is a major contributing factor with severe health implications for workers and local communities.

According to the World Health Organization, lead exposure contributed to over 1.5 million deaths worldwide in 2021 (WHO 2024) and recent health studies conclude that it is one of the most relevant environmental factor impacting public health globally (Brauer et al. 2024a). Children are known to be the worst affected population group as childhood lead exposure causes severe and permanent damage to the brain and central nervous system. While the world community via the United Nations Environment Assembly has committed to take effective steps to reduce lead-exposure from unsound battery recycling in 2017 (UNEP/EA.3/Res. 9[19]), the situation is still far from being resolved on the continent.

While acknowledging the need for recycling capacities for lead-acid batteries in African countries, this call for action aims at stimulating a systematic push for improvements in this field and calls upon all stakeholders to join forces towards the common goal for a safe and healthy environment, as well as fully responsible end-of-life management of batteries in Africa.

Battery recyclers:

- Companies and investors active or planning to get active in the recycling of used lead-acid batteries shall apply best practices to mitigate emissions of lead to the workplace and the environment and to provide safe and healthy working conditions.
- Companies and investors should strive for continuous improvement as well as full compliance with the Basel Convention Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries, as well as other recognised industry guidance documents such as the Standard Operating Procedures for Environmentally Sound Management of Used Lead-acid Batteries.
- Companies and investors are responsible for the occupational health of their employees as well as the health of communities living and working close to the plant. In that context battery recyclers shall organise regular health monitoring of workers' and neighbouring communities – including blood lead testing – through capable independent bodies. Results must be provided to the respective persons and – in case elevated blood lead levels are detected – appropriate action must be taken to reduce exposure and to restore the affected persons' health. In the case of any harm caused to persons' health, adequate compensation shall be paid to the affected persons and their relatives.
- Companies and investors must engage with and inform all their workers (including casual workers) as well as neighbouring communities on the nature and hazards of involved materials and processes. Companies and investors must have adequate systems in place where stakeholders can voice concerns and where these concerns lead to meaningful action to address them.

[19] The resolution of the United Nations Environment Assembly on eliminating exposure to lead paint and promoting environmentally sound management of waste lead-acid batteries can be accessed here: https://docs.un.org/en/UNEP/EA.3/Res.9.

- In countries with strong informal waste and recycling networks, companies shall ensure that interlinkages with these networks encourage informal operators to refrain from own battery recycling and/or battery breaking and (acid) draining operations.
- Companies and investors shall have financial and logistical reserves to finance and conduct clean-up and remediation activities during or after closure of their operations. It is the companies' responsibilities to keep the environment free from lead and any other pollutant that may emit in the course of their operations.
- Companies and investors must be willing to use (part of) their profits to finance all investment needs and operational costs required to achieve the points above.
- Best performing ULAB recyclers are encouraged to engage in a multi-stakeholder initiative (sketched below) and play an active role in sector reform strategies.

Governments:

- Governments are called to prioritise the ULAB recycling sector and – if not yet available – introduce ambitious and binding minimum standards and enforceable national policy frameworks for ULAB recycling based on the Basel Convention Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries, as well as other recognised industry guidance documents such as the Standard Operating Procedures for Environmentally Sound Management of Used Lead-acid Batteries.
- Governments should introduce strict import policies to prevent the dumping of second-hand lead-acid batteries in Africa.
- Government agencies in charge of environmental and health-related licensing, monitoring and enforcement shall enforce minimum standards and ensure that non-compliant informal and formal ULAB recycling is effectively sanctioned and banned. Type and level of sanctions must ensure that non-compliant ULAB recycling turns significantly less competitive than high standard compliant recycling.
- Government agencies involved in industry planning and licencing shall ensure that activities around ULAB recycling and lead processing are well removed from populated areas and sensitive functions such as agriculture and food processing. Moreover, government agencies shall apply a sector strategy aiming at a limited number of high standard ULAB recycling facilities. Highly competitive situations with many competing plants are commonly prone to eroding standards and a growing number of contaminated sites.
- Government agencies in charge of environmental and health-related licensing, monitoring and enforcement shall be equipped with adequate know how and resources to fulfil their monitoring tasks, which should include (but may not be limited to) repeated unannounced plant inspections.
- Government agencies responsible for environmental and health-related licensing, monitoring and enforcement should be aware that – by the act of issuing operating licenses – they take co-responsibility in a way that they confirm that a plant operates according to legal requirements and industry standards.
- Country judicial systems shall ensure that victims from unsound ULAB recycling (employees, communities…) can present their cases in court and file for remediation and compensation of caused harm and in accordance with the polluters-pay-principle. Cases are to be treated according to high legal standards. Adequate systems must be implemented to address limitations and support underprivileged groups, such as providing access to scientific experts for investigating and presenting findings in court, as well as ensuring legal representation to effectively argue cases during hearings.
- Whistle blowers informing about shortcomings in the sector are to be protected so as to encourage reporting of illegal or unsafe recycling practices.

Producers, traders, and owners of batteries:

- Players placing batteries on the African markets should introduce consumer buyback programs, offering incentives to return used batteries to best performing recyclers in the respective country or region[20].
- Owners of large battery volumes (e.g. government agencies, telecom providers, corporates) shall ensure that all their waste batteries are exclusively given to and treated by recycling companies that have been proven to be best performers in the respective country or region.
- In case such best performers are not available, shipments of batteries to high standard facilities in other countries shall be considered. All transboundary shipments shall fulfil the requirements of transboundary movement of hazardous wastes as specified in the Basel Convention.
- Companies shall keep track off used and disposed battery volumes, including evidence for sound management and recycling.

Buyers of lead and lead-alloys:

- Buyers of lead, lead-alloys and any other commodity produced from used lead-acid batteries should conduct due diligence of their supply chains, including but not limited to occupational health, safety of workers and environmental aspects. Buyers shall follow a strict no-buy policy for lead from informal and unregulated operations.
- Purchasing practices shall be tailored to benefit best performing lead-acid battery recyclers in a country or region. Buyers of lead and lead alloys should push for higher environmental and health standards.
- Buyers of lead and lead-alloys shall keep track of bought volumes, sources and related risk assessments and mitigation measures to ensure responsible sourcing.
- Buyers of lead and lead-alloys are encouraged to engage in a multi-stakeholder initiative as sketched below and play an active role in sector reform strategies.

Civil society:

- It is acknowledged that civil society groups act as important interlink between workers, affected communities, and national, regional, and global attempts to reduce human lead exposure.
- Civil society organisations are encouraged to maintain and expand networks with affected communities and workers and to support them to understand associated risks, to voice their concerns and to articulate demands for protecting human and environmental health as well as people's livelihoods.
- Civil society shall continue to engage for sector improvements and guide sector reform strategies and implementation on a national, regional, and international level.

Academia:

- Academia shall support sector upgrades by applied research that is based on the vast already existing knowledge on waste management, metallurgy, emission controls, human- and eco-toxicity and economics.
- Scientific support-needs appear to be particularly relevant in the field of time and cost-effective monitoring methods for recycling processes and their potential human and environmental health impacts (e.g., through remote monitoring of emission controls).
- Academia should prioritize research into environmentally sound energy storage solutions that are free from hazardous substances.

[20] Best performers in the fields of occupational health, safety, and environmental aspects.

Call for a multi-stakeholder initiative:

- The actions to be taken by the various stakeholder groups can be catalysed by a multi-stakeholder initiative with the following goals and characteristics:
    - Support governments, government agencies and ULAB recycling plants in developing, adopting, and implementing ambitious industry standards.
    - Support civil society groups in their work with local communities and workers and with a view to act as an interlink between affected people and the regional and global debate around human lead exposure reduction.
    - Develop, implement, and continuously update an independent benchmarking system that informs the public about best performing ULAB recycling plants operating in the African region (positive listing).
    - Facilitate the cross-boundary exchange between stakeholders working on ULAB recycling sector reform and advocate for policy alignment to prevent pollution from moving across borders due to weak national policies and enforcement.
    - Document and publish regional sector reform updates, including case studies on effectiveness of measures.
- The initiative should be based around a core group of active stakeholders with due representation of perspectives from the African region, as well as sector expertise and may be attached to the African Union or similar regional bodies.
- The initiative should be equipped with adequate resources to fulfil the tasks above over a minimum period of five years.

The Call for Action is a joint initiative of the SRADeV Nigeria and PAN-Ethiopia developed under the framework of the Partnership for Responsible Battery and Metal Recycling (ProBaMet) project. To submit comments or provide feedback, please contact:

Dr. Leslie Adogame
info@sradev.org

Dr. Tadesse Amera
Pan.ethiopia@gmail.com

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