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E-MOBILITY
A L L I A N C E



KENYA E-MOBILITY BATTERY INITIATIVE (KeEBI)

Kenya's EV Battery Stock and Retirement Outlook

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Acknowledgements

We acknowledge the support received from the Climateworks Foundation towards the completion of this project. ClimateWorks Foundation is an organisation dedicated to advancing sustainable energy solutions globally. Through their DriveElectric campaign, ClimateWorks has been instrumental in promoting the 100% adoption of electric vehicles (EVs) globally as a means to reduce greenhouse gas emissions, improve air quality, health and drive sustainable economic growth. They have set themselves a short to medium-term target of having 100% of EV sales of new buses, two and three-wheelers by 2030, light trucks, pickups, SUVs & light vans by 2035 and commercial medium & heavy-duty freight trucks by 2040¹. In Kenya, the rapid uptake of e-mobility solutions, particularly in urban areas, is highlighted by a recent jump in EV registrations in the recent years within the country from 475 in 2022 to 43,324 in 2025. This underscores the need for a comprehensive framework to manage the lifecycle of EV batteries in an environmentally and economically sustainable manner.

Africa E-mobility Alliance(AfEMA) is a non-governmental organisation and think tank focused on connecting stakeholders in electric mobility ecosystems across Africa. AfEMA actively drives awareness, activates markets and catalyses advocacy efforts to transform the transportation landscape into a zero-emission sector. AfEMA envisions that by 2030, 30% of all new vehicles sold in Africa will be electric. Its work informs and accelerates that transition. The project is also supported by a working group of members, each aligned with the goal of achieving a zero-emission transport sector and also focused on developing sustainable management pathways and policies to govern them. The group has provided input, critiqued and suggested on the content of the report to encompass the gaps that need to be investigated in the next phase of the project.

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List of Acronyms

Ah - Ampere-Hours
BESS - Battery Energy Storage Systems
BMS - Battery Management System
EMCA - Environment Management and Coordination Act
EMS - Energy Management System
BoL - Beginning of Life
EoL - End of Life
EPR - Extended Producer Responsibility
EPRA - Energy and Petroleum Regulatory Authority
EPROK - Electronic-waste Producer Responsibility Organization of Kenya
ESG - Environmental, social, and governance
ESS - Energy Storage System
EV - Electric Vehicle
EU - European Union
HAPROK - Hazardous-waste Producer Responsibility Organization Kenya
GBA - Global Battery Alliance
GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit
ICE - Internal Combustion Engine
ICT - Information, Communication and Technology
IEA - International Energy Agency
IoT - Internet of Things
KeEBI - Kenya E-Mobility Battery Initiative
kWh - Kilowatt-hour
LFP - Lithium Iron Phosphate
MtCO₂e - Megatons of Carbon Dioxide Equivalent
MWh - Megawatt-hour
NEMA - National Environment Management Authority
NFPA - National Fire Protection Association
NDC - Nationally Determined Contributions
NMC - Lithium Nickel Manganese Cobalt Oxide
NTSA - National Transport and Safety Authority
OEM - Original Equipment Manufacturer
PPE - Personal Protective Equipment
RUL - Remaining Useful Life
SOC - State of Charge
SOH - State of Health
UPS - Uninterruptible Power Supply
USA - United State of America
V - Volts

Definition of Terms

Beginning of Life	The initial phase of an EV battery's lifecycle, starting from its manufacture, assembly, and deployment in its first application.
End of first life:	The point in an EV battery's lifecycle is when its capacity and performance have declined, rendering it unsuitable for continued use in its initial application.
End of Life:	The final phase in an EV battery's lifecycle when it can no longer be used effectively for any purpose, including second-life applications
Reuse:	The process of repurposing an EV battery, after its initial use, in a different but functional application without extensive alteration
Repurposing:	The process of adapting and modifying an EV battery after its primary use for new applications that are less demanding than its original purpose.
Recycling:	The process of breaking down and recovering valuable materials from end-of-life EV batteries, such as lithium, cobalt, nickel, and copper, to be reused in manufacturing new batteries or other products.
Thermal runaway	A hazardous phenomenon in lithium-ion batteries where excessive heat generation exceeds the battery's ability to dissipate heat, causing a rapid and uncontrollable increase in temperature.
Circular economy	An economic model designed to eliminate waste and maximize resource efficiency by keeping materials, products, and resources in use for as long as possible through reuse, repair, recycling and regeneration, creating a sustainable cycle that minimizes environmental impact.
State of Health	A metric that indicates the current condition and performance of a battery relative to its original specifications, typically expressed as a percentage, and used to determine its remaining capacity and suitability for continued use or repurposing.

Executive Summary

The Kenya E-Mobility Battery Initiative (KeEBI), funded by the ClimateWorks Foundation and led by the Africa E-Mobility Alliance (AfEMA), delivers this final endline report at the conclusion of its two-phase effort to establish evidence-based pathways for EV battery circularity in Kenya. Phase 1 (baseline, December 2024) mapped the emerging second-life market landscape. Phase 2 (endline) advanced quantitative modelling of battery stock, degradation, and retirement flows, producing this report alongside two companion publications in July 2025: a technical brief on residual battery value as an alternative EV financing lever, and a market guidebook on second-life opportunities.

Kenya's EV fleet has grown explosively to 43,324 registered units by end-2025 (NTSA data), up from 475 in 2022, with electric motorcycles (31,869 units) accounting for 74% of the total. This surge aligns with the National E-Mobility Policy (launched 2025) and supports Kenya's updated Nationally Determined Contributions (NDCs, April 2025), which target a 35% emissions reduction (75 MtCO₂e abatement) below business-as-usual by 2035, with e-mobility as a cornerstone transport strategy.

Using NTSA registrations and segment-specific pack-size assumptions, KeEBI estimates an installed battery stock of 176.7 MWh (effective 180.3 MWh including swapping-network excess). Near-term retirements (2026–2033) reach 173.7 MWh cumulative under the Base Case, peaking sharply at 84 MWh in 2030 due to the 2025 motorcycle cohort reaching end-of-first-life after a 5-year lifespan. Two-wheelers dominate (82–87% of total retirements), creating a narrow 3–5-year window to build circularity infrastructure.

Chemistry allocation (fleet-wide): LFP 47% (high second-life suitability), Lead-Acid 10% (environmental risk), NMC & other lithium-ion 3% (critical mineral value), Unknown 40% (data gap). Approximately 109.6 MWh of retiring capacity is projected suitable for repurposing ($\geq 75\%$ SOH, 65% fraction), offering substantial feedstock for stationary storage (solar, mini-grids, commercial backup). Long-term guidebook projections indicate up to 223 GWh EoFL by 2050, with residual value of USD 8.9 billion (KES 1.2 trillion) and potential annual recycling revenues of USD 44 million.

The extreme concentration of retirements in two-wheelers and a single 2029–2030 wave is the defining strategic finding. It demands urgent, coordinated action across policy, market, and investment domains to capture value rather than lose it to informal disposal or low-value export.

Five Key Findings and Proposed Next Steps

1. Near-term retirement volumes are massive and highly concentrated

The existing fleet will retire 173.7 MWh cumulatively by 2033, with 84 MWh (48%) in 2030 alone, almost entirely from 2025-registered two-wheelers (5-year lifespan). This abrupt, 2W-dominated wave creates both acute infrastructure pressure and a homogeneous, high-volume stream ideal for repurposing.

Next step: Scale decentralized collection, SOH testing, and aggregation hubs by 2028 to handle the peak.

2. LFP dominance offers strong second-life potential

LFP (47% of capacity) drives ~74 MWh of cumulative retirements by 2033, with ~109.6 MWh overall suitable for repurposing ($\geq 75\%$ SOH). Swapping fleets produce stable, high-cycle-life LFP packs perfectly suited for solar storage, mini-grids, and commercial backup.

Next step: Develop KEBS-accredited certification and buyer protection mechanisms to de-risk second-life markets by 2027.

3. Critical mineral recovery and legacy risks require targeted recycling pathways

NMC/Li-ion (3%) and Lead-Acid (10%) contribute smaller but high-value (nickel, cobalt) and high-risk (lead toxicity) streams. Without scaled pre-processing and hydrometallurgical capacity, valuable materials will be lost and environmental harm will increase.

Next step: Pilot regional recycling hubs with blended finance, targeting $>85\%$ recovery rates for critical minerals by 2030.

4. Data gaps (40% Unknown chemistry) undermine planning and traceability

The large unspecified share limits precise material forecasting and second-life valuation. Recent high-volume registrations lack systematic battery specification reporting, creating systemic uncertainty.

Next step: Mandate battery specification reporting (chemistry, capacity, serial number) at import/registration by 2027 to close the gap and align with global standards.

5. Policy and market readiness must accelerate to match retirement timing

Current EPR and NEMA frameworks are foundational but insufficient for the 2029–2030 peak. Without coordinated action, significant volumes risk informal disposal; with timely investment, Kenya can capture USD 8.9 billion in residual value by 2050.

Next step: Strengthen EPR enforcement, harmonize EAC labelling/transport rules, and launch concessional financing for repurposing and recycling by 2028.

KeEBI's findings highlight Kenya's pivotal moment: the e-mobility surge offers a pathway to decarbonization and economic resilience, but only if circularity systems are urgently built to manage the impending battery wave. By prioritizing these next steps, Kenya can transform EoFL batteries into a national asset, fostering green jobs, reducing mineral dependence, and setting a regional benchmark for sustainable e-mobility.

1. Introduction

1.1 Project Background

As Kenya accelerates its transition to electric mobility to meet climate commitments, enhance air quality, and reduce fossil fuel dependence, the circular management of electric vehicle (EV) batteries has emerged as a pivotal challenge and opportunity. This is underscored by the government's push for local battery assembly, repurposing, and recycling in the National E-Mobility Policy ² (launched in 2025) and through stakeholder consultations. With EV registrations reaching 43,324 units by end-2025 ³, the need for sustainable end-of-first-life (EoFL) and end-of-life (EoL) battery pathways is urgent. Mishandled batteries risk environmental contamination from toxic elements like lithium, cobalt, and nickel, as well as high-intensity fires. However, when managed circularly, these batteries enable value extension through second-life applications and material recovery, minimizing waste and supporting resource efficiency.

The Kenya E-Mobility Battery Initiative (KeEBI), funded by the ClimateWorks Foundation and implemented by the Africa E-Mobility Alliance (AfEMA), addresses this by developing evidence-based pathways for EV battery repurposing, reuse, and recycling. KeEBI's core objective is to quantify battery flows, assess environmental and socio-economic impacts, and recommend regulatory, technical, and institutional frameworks to achieve circularity. This aligns with Kenya's second Nationally Determined Contributions (NDCs) submitted in April 2025 ⁴, which commits to a 35% greenhouse gas emissions reduction (75 MtCO₂e abatement) below business-as-usual by 2035, emphasizing e-mobility as a key mitigation strategy in transport.

² Ministry of Roads and Transport, Republic of Kenya. (2026). NATIONAL ELECTRIC MOBILITY POLICY: To Promote Development and Enhance Adoption of Electric Mobility in Kenya.

<https://www.transport.go.ke/sites/default/files/Emobility%20Policy%20Final.pdf>

³ Data from NTSA

⁴ Ministry of Environment, Climate Change and Forestry. Republic of Kenya. (n.d.). Kenya's Second Nationally Determined Contribution (2031–2035).

https://unfccc.int/sites/default/files/2025-05/KENYAS%20SECOND%20NATIONALLY%20DETERMINED%20CONTRIBUTION%202031_2035.pdf

KeEBI was executed in two phases:

- **Baseline phase:** Mapped the initial EV battery landscape, culminating in a report published in December 2024.
- **Endline phase:** Advanced data collection on battery performance, degradation modelling, and EoFL-to-EoL forecasting to inform circular pathways. This final report, produced at the phase's conclusion, synthesizes updated findings with a focus on battery stock and retirement modelling.

1.1.1 Accompanying Research Outputs

This final report is supported by three complementary KeEBI publications:

i) *A baseline report on the state of Kenya's EV battery second-life market (December 2024)*⁵
ii) *A technical brief on the residual value of EV batteries and their role in enabling alternative EV financing models (July 2025)*⁶.

iii) *A market guidebook exploring opportunities in the second-life battery sector (July 2025)*⁷.

Together, these outputs provide a comprehensive evidence base and actionable roadmap to ensure Kenya's E-mobility transition delivers environmental, economic, and social benefits through a fully circular battery ecosystem. Immediate, cross-stakeholder action is essential to seize this narrow window and position Kenya as a regional leader in sustainable battery management.

⁵ Mosomi, C., & Wesonga, B. (2024). Kenya E-Mobility Battery Initiative Baseline Report: Investigating the Landscape of Kenya's Electric Vehicle Battery Industry.

<https://africaema.org/wp-content/uploads/2025/04/KeEBI-Baseline-Report-compressed.pdf>

⁶ Wesonga, B., Miranyi, W., & Mosomi, C. (2025). Residual Value: An Opportunity to Improve EV Financing in Kenya.

https://africaema.org/wp-content/uploads/2025/10/Residual-Value_-An-opportunity-to-improve-EV-financing-in-Kenya-1.pdf

⁷ Ahmad, H., Dana, M., King, T., & Liles, M. (2025). Charging Up for Growth A Guidebook for Kenya's Second-Life EV Battery Market.

https://africaema.org/wp-content/uploads/2025/06/Charging-up-for-growth_-Kenyas-Second-Life-EV-Battery-Market-Final.pdf

Globally, EV battery circularity is integral to sustainable transport under frameworks like the Paris Agreement ⁸ and Basel Convention ⁹, which regulate hazardous waste movements and promote material recovery. Leading markets such as EU's Circular Economy Action Plan ¹⁰ and China's Lithium-ion Battery Specifications ¹¹ mandate repurposing and high recycling rates (>85% for critical minerals), reducing resource strain and emissions.

In Africa, EV adoption is rising, but circularity infrastructure lags, with limited recycling and policy gaps risking informal disposal. Kenya has advanced with the National E-Mobility Policy (2025) ¹² and Extended Producer Responsibility (EPR) Regulations (2024) ¹³, alongside KEBS and NEMA standards, but gaps in EoL battery guidelines persist. KeEBI bridges these by evaluating scalable solutions for repurposing and recycling, aligning with regional priorities.

⁸ UNFCCC, "The Paris Agreement," 2018, <https://unfccc.int/documents/184656>.

⁹ UNTC, "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal," March 22, 1989, https://treaties.un.org/pages/viewdetails.aspx?src=treaty&mtdsg_no=xxvii-3&chapter=27&clang=en

¹⁰ Anastasia Popova, "Battery Laws in the Top EV Producing Countries," www.minespider.com, November 22, 2022, <https://www.minespider.com/blog/ev-battery-regulations-around-the-world-what-you-need-to-know>

¹¹ Angela, "Lead Battery's Circular Success Is Central Topic at 2023 National Clean Energy Week Panel Discussion," Battery Council International, November 20, 2023, <https://batteryCouncil.org/news/article/lead-battery-circular-success-2023-national-clean-energy-week/>

¹² Ministry of Roads and Transport, Republic of Kenya. (2026). NATIONAL ELECTRIC MOBILITY POLICY: To Promote Development and Enhance Adoption of Electric Mobility in Kenya. <https://www.transport.go.ke/sites/default/files/Emobility%20Policy%20Final.pdf>

¹³ THE SUSTAINABLE WASTE MANAGEMENT (EXTENDED PRODUCER RESPONSIBILITY) REGULATIONS, 2024, (2024). <https://pakpro.co.ke/wp-content/uploads/2024/11/L.N.-176-177-The-sustainable-Waste-mgt-Extended-Producer-Responsibility-and-Water-quality.pdf>

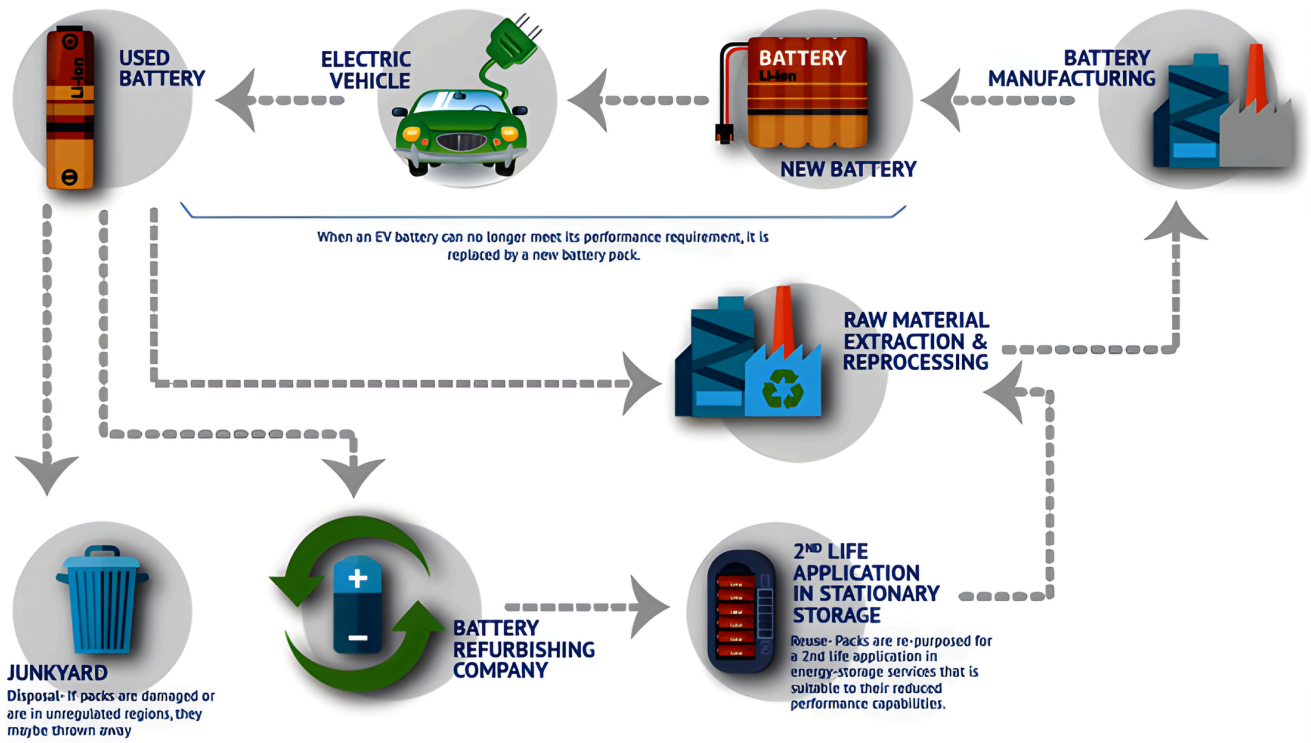


Fig 1.1: EV Battery Circularity Source: Economic Analysis of Lithium Ion Battery Recycling in India

1.2 Problem statement

Kenya's rapid EV adoption is outpacing the country's ability to manage the growing volume of lithium-ion batteries entering and exiting the market. Despite rising EV use across all vehicle segments, Kenya lacks a coherent system to track, diagnose, repurpose, or recycle end-of-life batteries, leading to risks of unsafe disposal, environmental harm and missed economic opportunities. While global leaders have established advanced EPR and battery circularity frameworks, Kenya's regulatory environment, though supported by the 2024 EPR regulations, remains unclear and underdeveloped. Without timely action, the country risks losing the chance to localize battery value chains, create green jobs, and prevent future waste challenges. The core problem is the absence of a structured, data-driven battery circularity framework and baseline understanding of battery stocks, flows, chemistries, and retirement timelines, which is essential for building a sustainable and resilient battery ecosystem that aligns with Kenya's EV transition.

1.3 Objectives of the baseline study

The primary objective of this report is to assess the current landscape of EV batteries in Kenya while glancing at the status of the global and regional sectors. The report aims to highlight a baseline view of the different phases and activities within the industry looking at the following:

- Metrics on electric vehicles in the country (EV battery stock), battery chemistries, growth trends and projections.
- Technology trends and stakeholders mapping of players within the industry.
- Policy frameworks in place designed to improve EV adoption and regulate the battery sector for safety and environmental protection, including the new EPR policy of 2024.
- Challenges and opportunities in EoL management of EV batteries as well as gaps in seamless information sharing that will improve circularity initiatives.
- Analysis of battery lifecycle management dynamics.

This report will act as a guide for stakeholders, government regulators/policy makers and investors to understand the current state of the EV battery sector in Kenya to navigate sustainable pathways to EV battery circularity. The report will highlight, through data collection and benchmark visits, what the current status is in the different phases of the EV battery supply chain (repair, repurposing and recycling), value creation opportunities present, the gaps and scale of support that the industry has received to propel itself towards a circular economy.

The baseline aims to support policy making efforts that will bolster circularity practices by highlighting key challenges in EoL management and recommendations to guide future developments. There were 5,294 new EV registrations in 2024, a significant rise from 2,694 registrations in 2023 and 475 registrations in 2022, but still only 1.4% of national vehicle registrations ¹⁴ . This exemplifies the high growth rate of EV adoption which means, the scale of the problem can potentially balloon if strategies are not devised early on to guide the sector on sustainable management practices.

¹⁴Environment To, "Favourable Regulatory Environment to Underpin Kenya's EV Adoption Ambitions," Fitch Solutions, 2024, https://www.fitchsolutions.com/bmi/autos/favourable-regulatory-environment-underpin-kenyas-ev-adoption-ambitions-15-08-2024?fSWebArticleValidation=true&mkt_tok=NzMyLUNLSC03NjcAAAGWuFuextMsPepvImQ4fhtvjuijuaVhBGGfN-h2AqnCgMDVREfAIWvSOdAMd09gcCWx_cbmEJPEbELoBhCgt9p3pVVCIAWJ5zkC3woXJeQuFJF_iLchlw.

1.4 Scope and limitations

1.4.1 Scope

This baseline study focuses on establishing an evidence-based understanding of Kenya's electric vehicle (EV) battery ecosystem and its circularity potential. The scope of the project covers:

- **Geographical scope:** Kenya, with attention to high-adoption regions such as Nairobi, Mombasa, and Kisumu, while situating Kenya's progress within a broader African and global context.
- **Vehicle categories:** Two-wheelers, three-wheelers, passenger cars, vans, buses, and trucks, reflecting the diversity of EV adoption in the country.
- **Battery technologies:** Predominantly lithium-ion chemistries (NMC, LFP), but also other forms in use (lead-acid, emerging solid-state and sodium-ion) to understand future implications.
- **Lifecycle coverage:** From importation and first use, through mid-life applications such as battery swapping and refurbishment, to end-of-first-life (EoFL) and subsequent repurposing or recycling.
- **Stakeholders:** Mapping and analysis of actors across the value chain, including government agencies (NEMA, NTSA, KEBS, MoE), private sector innovators, recyclers, financiers, civil society, and the informal sector.
- **Policy and regulatory environment:** Review of Kenya's evolving legal frameworks (e.g., Finance Acts, VAT and duty exemptions, 2024 EPR regulations), complemented by lessons from regional and global best practices.
- **Modelling component:** Projection of battery stocks, flows, and retirements over short-, medium-, and long-term horizons, to estimate volumes available for repurposing and eventual recycling.

1.4.2 Limitations

While comprehensive, the study faced several limitations:

Data availability:

- Reliable, disaggregated data on EV registrations and battery imports is limited, with NTSA records and customs data often incomplete or inconsistent.
- Industry actors were reluctant to disclose commercially sensitive data (e.g., battery pricing, failure rates, state-of-health test results).

Limited primary data:

- Much of the analysis relied on desktop research, supplemented by a small number of site visits and stakeholder consultations.
- Broader surveys and large-scale empirical testing of end-of-life batteries were beyond the project's scope and resources.

Informal sector opacity:

- Informal repairers, refurbishers, and small-scale recyclers play a significant role in Kenya's battery ecosystem but operate outside formal reporting systems. Their contributions and risks are therefore only partially captured.

Uncertainty in projections:

- Battery modelling assumptions (lifespan, usage intensity, charging cycles) were based on global averages and limited local validation, introducing uncertainty into long-term projections

Rapidly evolving policy and market environment:

- Kenya's EV and circular economy policies are in flux, with ongoing developments that may quickly outdate parts of this report.

Despite these limitations, the study provides a robust baseline for understanding Kenya's battery circularity landscape and identifies clear areas for future research, data collection, and policy refinement.

1.4.3 Challenges observed during data collection

The data available for analysis of the Kenya EV battery status is limited by a few factors. The main challenges observed facing the sector include:

- Lack of approved frameworks for data collection
- Limited infrastructure e.g R&D centres and testing facilities
- Low market penetration of EV's and very recent adoption
- High cost of data collection due to need for specialised tools and equipment
- Limited specialised technical expertise
- Lack of cross border data sharing

The regulator, KEBS, currently collects EV data as per KS1515:2019 (Road vehicles-Inspection of road vehicles-Code of practice) upon vehicle import. The data collected that is attached to the certificate of roadworthiness includes: ¹⁵

- Customs Entry Number
- Make of Vehicle
- Importer details
- Model of Vehicle
- Chassis Number
- Certificate of Road Worthiness(COR) Number
- Engine Number

The regulator has also set a minimum SOH value of 80% for used electric vehicle imports, however this information is collected from the battery management system.

Data collection is done by way of the following documents:

- *Certificate of Road Worthiness from the country of Origin (COR)*
- *Import Declaration Form*

Some shortfalls need to be addressed to accommodate the characteristics of EVs and their batteries. This is the starting point for data collection where EV batteries enter the country. Establishing a complete and comprehensive set of data parameters for collection will develop a traceable flow of information across the circularity stream. Another observation arising from currently collected vehicle registration data is the lack of clear separation of hybrid and battery electric vehicles (BEV). These are areas that can be explored further to assist the regulators to improve their systems.

¹⁵ Information from KEBS representative on inspection requirements for vehicle imports, including EV's

2. Methodology

2.1 Research design

The KeEBI baseline study adopted a multi-faceted research design to build a comprehensive understanding of Kenya's EV battery ecosystem, particularly around end-of-life (EoL) management. The approach combined desktop research, direct data requests, industry visits, stakeholder engagement, and benchmarking to provide a balanced view of current practices, policy gaps, and opportunities.

- **Desktop research**

An extensive review of academic literature, industry reports, policy frameworks, and international case studies on battery chemistry, recycling, and repurposing technologies. Global best practices from leading regions such as the EU and China were examined alongside Kenya's National E-Mobility Policy, the Sustainable Waste Management Act (including Extended Producer Responsibility regulations) and relevant international frameworks such as the Basel Convention and Paris Agreement. This provided a comparative lens for identifying Kenya-specific gaps and opportunities.

- **Direct data requests**

Targeted requests were sent to e-waste management companies, E-mobility providers and government agencies to obtain data on battery volumes, chemistries, and EoL practices. While some organizations shared useful insights, confidentiality concerns and weak record-keeping limited access to complete datasets.

- **Industry visits**

Field visits were conducted at the WEEE Centre, Enviroserve and Acele Africa. These visits enabled direct observation of battery handling processes and provided first-hand insights into existing capabilities, repurposing practices, and operational challenges.

- **Benchmarking**

Comparative learning was built into the research design through continuous engagement with international experts and case studies from other regions, including Germany and Seychelles. This allowed for the identification of adaptable best practices and alignment of Kenya's battery management strategies with global standards.

2.2 Data sources

The study relied on a blend of primary and secondary data sources, including:

- **Primary data:** Information from site visits (WEEE Centre, Enviroserve, Acele Africa), stakeholder interviews, surveys, and working group sessions.
- **Secondary data:** Literature reviews, industry reports, government policies, NTSA registration data, NEMA and KEBS documentation, and global best practices.
- **Comparative benchmarks:** International regulatory frameworks (EU Battery Regulation, China's EPR model, Basel Convention) and case studies from global OEMs and recyclers (Renault, VW, CATL, Redwood Materials, etc.).

2.3 Limitations and data gaps

While the research design ensured broad coverage, several limitations constrained the study's depth.

- **Data Access Limitations:** Some companies and organisations were reluctant to share certain information which they considered proprietary, which restricted our access to comprehensive insights into industry wide battery management practices.
- **Lack of E-Mobility Data in Africa:** There is a significant lack of data specific to e-mobility within the African context, which created challenges in understanding localised trends and best practices, making it difficult to establish a fully contextualised baseline for the project.
- **Inconsistent Government Data:** We encountered difficulties in obtaining consistent and complete data from government institutions, which further impacted the ability to gather accurate baseline data on EV battery usage and management.
- **Limited Recorded Data on EV Batteries in Kenya:** There is very little recorded data on EV battery life cycle practices within Kenya, and the limited data that exists was often not accessible, this constrained the project's ability to establish a clear view of current battery management and recycling practices.
- **Time Constraints:** The project operated under strict timelines, which limited the time available for in-depth data collection and analysis. Due to these constraints, some data sources remained unexplored

Overall Mitigation Approach:

To address these challenges, the study relied on publicly accessible and voluntarily shared data, cross-referenced government and industry sources to fill gaps and enhance accuracy, and conducted targeted manual research to validate findings, ensuring a robust baseline despite the identified limitations.

3. Kenya's EV Adoption & Battery Landscape

3.1 EV Adoption Trends in Kenya

Kenya's E-mobility sector has experienced rapid and sustained growth, driven by supportive policies, fiscal incentives, and strong political commitment to decarbonizing transport as part of national climate action. According to National Transport and Safety Authority (NTSA) data, total electric vehicle registrations rose from just 284 units in 2021 (the baseline year for the KeEBI research) to 43,324 units by the end of 2025. This represents a cumulative increase of more than 150× over four years, with particularly explosive growth in 2025 alone (28,754 new registrations).

The table below summarizes NTSA-registered EVs by type and year:

Table 3.1: Electric Vehicle Registrations in Kenya (NTSA Data, 2018–2025)

Type of EV	2018–2022	2023	2024	2025	TOTAL
Electric Bicycles	321	1,353	3,850	4,000	9,524
Electric Motorcycles	678	2,557	4,862	23,772	31,869
Electric Tuk-Tuks	100	39	185	517	841
Electric Passenger Cars	156	47	123	282	608
Electric Buses & Mini Buses	3	19	32	106	160
Electric Other Vehicles	120	33	92	77	322
Total EVs Registered	1,378	4,048	9,144	28,754	43,324
Total (excl. Bicycles)	1,057	2,695	5,294	24,754	33,620

Year-on-year growth rates (total EVs): 173% (2023), 226% (2024), 314% (2025).

3.1.1 Key trends:

- **Two- and three-wheelers dominate**, accounting for 92–95% of all registrations in recent years. Electric motorcycles alone comprised 83% of the 2025 total (23,772 units), reflecting their central role in the boda-boda sector, last-mile delivery, and commercial urban mobility. Their growth is supported by affordability, daily high utilization, battery-swapping models, and favorable assembly policies.

- **Electric bicycles** are gaining traction in informal last-mile and delivery services, though many remain informally registered or untracked in NTSA data. Typical ranges are 40 km (fully motorized) to 70 km (pedal-assist) per charge.
- **Four-wheel EVs** (passenger cars, buses, mini-buses) remain modest in volume (~768 units cumulative by 2025), but show steady fleet-based adoption, particularly commercial operations (e.g., BasiGo buses) benefiting from lower total cost of ownership compared to private ownership.
- **Geographic concentration** is heavily urban: Nairobi accounts for nearly 60% of registrations, followed by Mombasa and Kisumu. Rural uptake remains limited due to grid constraints, low population density, and infrastructure investment barriers ¹⁶.

The overwhelming concentration in two-wheelers, signals both the primary driver of Kenya's e-mobility transition and the dominant future source of EoFL battery retirements in the near term (2029–2030 peak, as modelled in Chapter 4). This pattern underscores the need for circularity pathways tailored to high-volume, small-format batteries while preparing for secondary growth in larger four-wheel and bus packs.

3.1.2 Battery Ownership Models

Battery ownership models play a central role in shaping battery lifecycle management, affordability and circularity outcomes in Kenya's E-mobility sector. Two dominant models are observed: fixed battery ownership and battery swapping / Energy-as-a-Service (EaaS).

i) Fixed Battery Ownership Model

The fixed battery ownership model is most prevalent in four-wheeler electric vehicles, particularly private passenger cars. Under this model, the end user owns both the vehicle and the battery, assuming full responsibility for charging, maintenance, and end-of-life management.

Batteries under this model typically experience moderate usage cycles, with an expected first-life duration of 6–8 years. However, high upfront battery costs estimated at KES 500,000 to 1,500,000 (USD 3,800–11,500) significantly constrain adoption among private consumers, particularly for personal vehicles. ¹⁷

From a circularity perspective, fixed battery ownership presents notable challenges. End-of-first-life (EoFL) batteries often lack clear collection and take-back pathways, increasing the risk of informal storage or disposal. Kenya currently has only 14 licensed e-waste handlers, none of which are fully equipped for advanced lithium-ion battery recycling, limiting safe recovery and material reuse under this model. ¹⁸

ii) Battery Swapping and Energy-as-a-Service (EaaS) Model

The battery swapping model dominates the two-wheeler and three-wheeler segments, particularly in the commercial boda-boda sector. This model is led by operators such as Spiro and Ampersand, who retain ownership of batteries and provide energy services through pay-as-you-go (Pay-Go) or Energy-as-a-Service (EaaS) arrangements.

¹⁶ Electric Mobility Association of Kenya (EMAK). (2025). Electrifying Kenya's Transportation Sector. Fiscal Benefits and Policy Measures to Promote Electric Mobility. In E-mobilitykenya.org. <https://e-mobilitykenya.org/downloads/>

¹⁷ National Transport and Safety Authority (NTSA). (2025). Motor vehicle registration data and electric vehicle statistics, Kenya. Government of Kenya. Nairobi.

¹⁸ National Environment Management Authority (NEMA). (2024). Register of licensed e-waste handlers and waste management facilities in Kenya. Government of Kenya. Nairobi.

Riders pay approximately KES 200–300 (USD 1.50–2.30) per battery swap, eliminating the need for high upfront battery investment. Commercial riders typically swap batteries one to two times per day, resulting in high utilisation rates that support daily income generation while maintaining affordability.

Centralised battery ownership allows operators to conduct continuous State of Health (SOH) monitoring, optimise charging cycles, and remove underperforming batteries before failure. As a result, batteries in swapping fleets generally reach end-of-first-life after 4–5 years, with many retaining sufficient residual capacity for second-life applications, including stationary solar energy storage.

As of 2025, Spiro operates approximately 300 battery swapping stations across Kenya, and are looking to scale up to 3,000 swap stations, enabling large-scale battery aggregation and traceability.¹⁹ However, swapping infrastructure remains concentrated in urban and peri-urban areas, with limited rural coverage, presenting challenges for nationwide scalability.

iii) Implications for Battery Circularity

Overall, battery swapping models offer stronger foundations for circularity due to centralised ownership, traceability, and aggregation, while fixed battery models remain fragmented and more difficult to regulate. Addressing EoFL risks under fixed ownership will require targeted policy interventions, improved recycling infrastructure, and stronger enforcement of Extended Producer Responsibility (EPR) frameworks.

3.2 Fiscal Impacts on Adoption

Fiscal policy has been central to shaping Kenya’s EV market trajectory.

- **Finance Act 2019²⁰** : Reduced excise duty on all EVs from 20% to 10%, marking Kenya’s first major e-mobility incentive.

¹⁹ ESI Africa. (2023). Battery swapping and electric mobility expansion in East Africa. ESI Africa Magazine and Online Platform.

²⁰ Government of Kenya, “Finance Act 2019,” November 7, 2019,
http://kenyalaw.org/kl/fileadmin/pdfdownloads/AmendmentActs/2019/FinanceAct_No23of2019.PDF

- **Finance Act 2023** ²¹ :

1. Amended the VAT Act 2013 to zero-rate electric motorcycles, bicycles, and buses.
2. Amended the Excise Duty Act 2015 to exempt electric motorcycles from the USD 100 excise duty per unit.
3. Reduced corporate income tax to 15% (from 30%) for the first five years for companies establishing assembly plants with CKD parts, extendable if local value addition reaches 50%.

- **The Finance Act 2025** provides fiscal incentives to support the uptake of e-mobility, including VAT exemption for electric buses and electric motorcycles, improving affordability and near-term market adoption. ²²

These measures lowered costs and accelerated adoption, especially of electric motorcycles.

3.3 Challenges and Opportunities in Kenya's Battery Circularity Journey

Kenya's transition toward electric mobility presents a critical opportunity to establish a circular battery economy. However, scaling second-life and recycling pathways faces interconnected technical, market, policy, and institutional challenges that must be addressed to avoid environmental risks, stranded assets, and lost local value.

Key Challenges

3.3.1 Technical and infrastructure constraints remain a primary barrier. State of Health (SOH) diagnostics are scarce, non-standardised, and largely informal, undermining confidence in second-life batteries and complicating insurance and financing. Accredited laboratories, affordable portable testers, and clear grading thresholds are largely absent. In parallel, Kenya has limited certified capacity for battery repair, refurbishment, and safe module-level disassembly. While early actors such as Enviroserve, WEEE Centre, and Acele Africa provide foundational services, large-scale, OEM-aligned remanufacturing is not yet established. These gaps increase reliance on informal handling, heightening fire, environmental, and public health risks associated with lithium-ion batteries.

²¹ Government of Kenya, "Finance Act 2023," June 26, 2023, <https://www.kra.go.ke/images/publications/The-Finance-Act-2023.pdf>.

²² Government of Kenya, Finance Act 2025, June 27, 2025

3.3.2 Market and financial barriers further constrain scale-up. Battery repurposing and recycling are capital-intensive, requiring investment in diagnostics, pre-processing, and advanced recycling technologies. Access to concessional finance, guarantees, and blended capital remains limited, and bankable project pipelines are still emerging. Insurance products for EV batteries and second-life systems are nascent, largely due to the absence of standardised SOH certification needed for risk pricing. In addition, fragmented resale markets and unclear residual value frameworks depress prices for retired batteries, reducing incentives for take-back and formal aggregation. Low awareness among consumers and small operators further limits participation in collection and reuse schemes.

3.3.3 Policy and institutional challenges persist despite recent progress. Kenya's Extended Producer Responsibility (EPR) and Sustainable Waste Management regulations establish an important foundation, but enforcement has been uneven and subject to legal and administrative delays, creating uncertainty for investors and producers. The informal e-waste and repair sector continues to handle a significant share of battery flows without adequate oversight, training, or incentives to formalise. Weak battery-level data and traceability, particularly gaps in chemistry, capacity, and serial number reporting, undermine monitoring, compliance, and accountability across the lifecycle.

Collectively, these challenges risk slowing circularity uptake, entrenching informal and unsafe practices, and weakening the economic case for local investment.

Strategic Opportunities

Despite these constraints, Kenya is well positioned to advance battery circularity through pragmatic, phased interventions. The country's strong off-grid solar and backup power markets create immediate demand for second-life batteries in telecoms, schools, clinics, and commercial facilities, offering near-term offtake for repurposed packs. Incentives for local assembly and recent manufacturing financing provide an opening to develop domestic pack assembly, module repair, and pre-processing capabilities, supporting job creation and reducing import dependence.

Regionally, Kenya can pursue an East African aggregation and pre-processing hub model, building scale for recycling investments or structured export of pre-processed materials while avoiding premature stranded assets. A growing ecosystem of local firms and innovators, combined with partnerships with international recyclers, insurers, and technology providers, offers a platform for piloting modular designs, low-cost diagnostics, and warranty-backed second-life business models.

<https://new.kenyalaw.org/akn/ke/act/2025/9/eng@2025-06-25>

4. Battery Stock & Retirement Modelling

This chapter quantifies Kenya's current EV battery stock based on National Transport and Safety Authority (NTSA) registration data up to 2025, projects near-term retirement volumes (2026–2033) from the existing fleet, and evaluates implications for second-life applications and recycling. Projections are grounded in a cohort-based survival model that ages registered vehicles according to segment-specific lifespans, with no future sales assumed in the near-term horizon. Longer-term context (to 2050) draws from the guidebook "Charging Up for Growth: A Guidebook for Kenya's Second-Life EV Battery Market."²³

The analysis reveals a significantly large installed battery stock, driven by explosive registration growth, particularly in electric motorcycles, reaching 43,324 total EVs by end of 2025. If you exclude bicycles, this number drops to 33,620 EVs. This high vehicle stock substantially raises projected retirement volumes and underscores the urgency of building circularity infrastructure in the coming 5–8 years.

Overview of Dominant Battery Cell Chemistries

Kenya's EV fleet remains predominantly lithium-ion, with chemistry preferences tightly linked to segment and usage intensity²⁴:

- **Nickel-Manganese-Cobalt (NMC)** Historically preferred for two-wheelers (2W) and three-wheelers (3W) due to high energy density (150–200 Wh/kg), which supports acceptable range in compact, high-utilization urban applications (boda-boda services, delivery, passenger tricycles).
- **Lithium Iron Phosphate (LFP)** Increasingly dominant in buses, mini-buses, and a growing share of 2W (especially swapping fleets such as Roam, Ampersand, and Spiro). LFP is favored for superior thermal safety (runaway threshold 270–300 °C), exceptional cycle life (>5,000 cycles), lower toxicity, and improving cost-competitiveness.

²³ Ahmad, H., Dana, M., King, T., & Liles, M. (2025). Charging Up for Growth A Guidebook for Kenya's Second-Life EV Battery Market. https://africaema.org/wp-content/uploads/2025/06/Charging-up-for-growth_Kenyas-Second-Life-EV-Battery-Market-Final.pdf

²⁴ Mostafa, A., Oni, O. E., Longe, O. M., & Lanre Olatomiwa. (2024). Comparison of Battery Chemistries for Electric Vehicle Applications. Proceedings of the International Conference on Industrial Engineering and Operations Management. <https://doi.org/10.46254/af05.20240159>

- **Lead-Acid** Persists in low-cost conversions (mainly 3W and some light commercial vehicles) but continues to decline due to poor cycle life, high weight, and environmental risks.
- **Unknown / Unspecified** A large proportion of recent registrations lack detailed chemistry data, creating uncertainty for precise material recovery forecasting.

Battery Cell Form Factors in the Kenyan Market

Kenya's fleet mirrors global trends but with local climate and circularity implications:

- **Cylindrical cells** (e.g., 18650, 21700) Common in smaller 2W models. Advantages: mechanical robustness, cost-effective mass production. Limitations: lower volumetric efficiency and more complex thermal management in repurposed systems.
- **Prismatic cells** are prevalent in buses, mini-buses, and many Chinese imports. Advantages: high packing density and efficient stacking. Limitations: swelling risk under stress.
- **Pouch cells** Found in select passenger vehicles and some storage/bus modules. Advantages: lightweight, flexible packaging, space-efficient. Limitations: sensitive to swelling, punctures, and heat; require excellent thermal control in Kenya's warm climate.

Prismatic and pouch formats generally offer superior disassembly and module-level repurposing potential, provided thermal management is addressed.

4.1 Modelling Approach and Assumptions

4.1.1 Modelling Approach

The analysis follows three sequential steps:

- **Stock Estimation**

Battery stock is quantified from NTSA registrations (43,324 EVs up to 2025) using segment-specific average pack sizes. Installed capacity is calculated as:

$$\text{Total Capacity (MWh)} = \frac{\sum (\text{Number of Units} \times \text{Average Pack Size per Segment (kWh)})}{1,000}$$

- **Retirement Modelling**

A cohort survival model ages the fleet: retirement occurs in registration year + segment lifespan. Three scenarios adjust lifespans:

- A. Base:** Standard usage
- B. Accelerated:** 1 year shorter (intensive cycling)
- C. Conservative:** 2 years longer (milder conditions)

- **Circularity Allocation**

Retired batteries are split: $\geq 75\%$ SOH assumed suitable for repurposing (second-life); below allocated to recycling. A conservative average fraction of 65% is applied for repurposing suitability.

4.1.2 Key Assumptions

Vehicle Lifespans (Base Case)

1. Motorcycles (2W): 5 years base, reflecting high-intensity boda-boda operations.
2. Three-wheelers (3W): 6 years base, accounting for cargo and passenger loads.
3. Passenger cars (4W): 8 years base, assuming urban private use.
4. Buses and minibuses: 8 years base, with commercial fleet maintenance.
5. Light commercial vehicles (forklifts, vans): 7 years base, tied to duty cycles.

Average Pack Sizes

1. Bicycles: $\sim 1.8\text{--}2.0$ kWh
2. Electric motorcycles: 3.0 kWh
3. Three wheelers: 5.0 kWh
4. Passenger cars: 50.0 kWh
5. Buses & mini-buses: 105.0 kWh
6. Other: 3.6 kWh

Annual Cycling

- 2W: 300–400 cycles/year, driven by daily swaps.
- 3W: 200–300 cycles/year.
- Passenger cars: 70–200 cycles/year. Cycles are high for commercial vehicles (taxis) and low for privately used vehicles
- Buses: 250–350 cycles/year.
- Light commercial: 150–300 cycles/year. Light commercial vehicles in high-intensity applications often experience "high cycle" usage. Many commercial vehicles operate on a cycle of roughly 15%–35% depth of discharge per day, which equates to a full cycle every 3–6 days.

SOH & Repurposing $\geq 75\%$ SOH viable for second-life; 65% average fraction assumed suitable.

Excess Swapping Batteries +3.6 MWh added for network ratios $>1:1$.

4.1.3 Data Gaps and Limitations

NTSA records lack per-vehicle capacity and chemistry detail, necessitating segment averages. Informal imports and unregistered vehicles are excluded (potential 10–20% understatement). Near-term projections omit future sales; long-term context relies on external guidebook scenarios.

4.2 Data Inputs

4.2.1 Vehicle Registrations

NTSA data show rapid adoption:

- Total EVs registered by end-2025: **43,324**. If you exclude bicycles, the figure drops to **33,620**
- Dominant growth in electric motorcycles (23,772 units registered in 2025 alone)
- Registrations surged post-2023, reflecting tax incentives and market maturity

4.2.2 Battery Chemistries

Based on specified capacity:

- LFP accounts for approximately 47%
- Lead-acid represents around 10%
- Lithium-ion (including NMC) accounts for roughly 3%
- Chemistry is unspecified for approximately 40% of registered capacity

The dominance of LFP enhances second-life potential due to its thermal stability and cycle life, while the presence of lead-acid raises disposal and environmental risk concerns.

4.3 Results

4.3.1 Installed Battery Stock

The updated analysis estimates an installed EV battery stock of **176.7 MWh** (excluding excess swapping batteries). Adding **3.6 MWh**, roughly 2%, (for excess swapping network batteries yields a total effective stock of **≈ 180.3 MWh**.

4.3.2 Overall Retirement Volumes

Near-term (2026–2033) retirements from the existing fleet reach **≈173.7 MWh cumulative** under the Base Case, nearly the entire stock, driven by short 2W lifespans.

Long-term context (from the Market Guidebook ²⁵): optimistic scenarios project up to **223 GWh** cumulative end-of-first-life capacity by 2050, with annual retirements exceeding **20 GWh/year** by mid-century.

The table below summarizes the projected annual and cumulative retiring capacity (Base Case)

Table 4.1: Projected Annual and Cumulative EV Battery Retirements (MWh) – Base Case, 2026–2033

Year	Retiring Capacity (MWh)	Cumulative Retirements (MWh)
2026	0.50	0.50
2027	0.43	0.93

²⁵ Ahmad, H., Dana, M., King, T., & Liles, M. (2025). Charging Up for Growth A Guidebook for Kenya’s Second-Life EV Battery Market. https://africaema.org/wp-content/uploads/2025/06/Charging-up-for-growth_-Kenyas-Second-Life-EV-Battery-Market-Final.pdf

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Year	Retiring Capacity (MWh)	Cumulative Retirements (MWh)
2026	0.50	0.50
2027	0.43	0.93
2028	19.85	20.78
2029	26.33	47.11
2030	7.26	138.47

²⁵ Ahmad, H., Dana, M., King, T., & Liles, M. (2025). Charging Up for Growth A Guidebook for Kenya's Second-Life EV Battery Market. https://africaema.org/wp-content/uploads/2025/06/Charging-up-for-growth_-Kenyas-Second-Life-EV-Battery-Market-Final.pdf

2031	7.26	138.73
2032	9.79	148.52
2023	25.23	173.75

Retirements remain modest until 2028, then accelerate dramatically. The **2030** peak (~84 MWh) is overwhelmingly driven by the 2025 motorcycle registrations reaching end-of-life after 5 years. Cumulative retirements approach the full stock by 2033, highlighting the narrow window for circularity infrastructure readiness.

Retiring Capacity (MWh) and Cumulative Retirements (MWh)

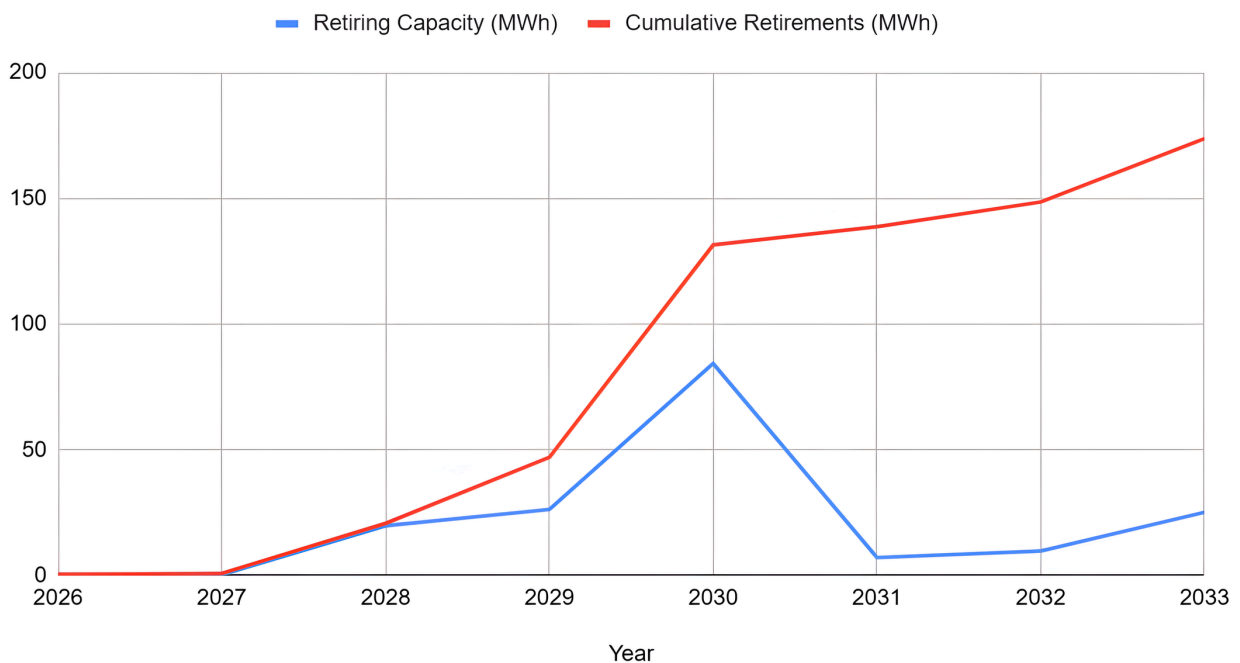


Figure 4.1: Projected EV Battery Retirements in Kenya (Near-Term, 2026–2033)

4.3.3 Segment-Level Projections

The near-term retirement profile (2026–2033) is overwhelmingly dominated by two-wheelers (2W), which include both electric motorcycles and electric bicycles. Under the Base Case scenario, 2W vehicles account for 80–92% of total retiring battery capacity during the peak retirement years (particularly 2029–2030). This extreme concentration is the direct result of two powerful structural factors:

- **Extremely high registration volumes**

The massive influx of electric motorcycles, especially the 23,772 units registered in 2025 alone, represents the single largest cohort in the entire registered fleet. This cohort will reach end-of-first-life almost simultaneously after the assumed 5-year lifespan.

- **Short operational lifespan**

The commercial intensity of boda-boda and last-mile delivery operations (300–400 cycles/year, daily usage, frequent swapping or fast charging) drives rapid battery degradation, justifying the conservative 5-year base lifespan assumption for the 2W segment.

In contrast, passenger cars and buses & mini-buses contribute much later and in significantly smaller absolute volumes.

- Passenger vehicles (longer 8-year assumed lifespan + much lower registration numbers) begin to appear meaningfully only from 2028–2031.
- Buses and mini-buses follow a similar delayed pattern, with their larger pack sizes (90–105 kWh) meaning that even small numbers of vehicles can still contribute noticeable capacity, but their total impact remains modest compared with the sheer volume of 2W.

The following table provides the exact annual retiring battery capacity (MWh) by vehicle segment for the Base Case scenario.

Table 4.2: Annual Retiring Battery Capacity by Vehicle Segment (MWh) – Base Case, 2026–2033

Year	2W – Motorcycles	2W – Bicycles	3W – Tuk-Tuks	Passenger Cars	Buses & Mini-buses	Other Vehicles	Total Retiring (MWh)
2026	2.24	0.00	0.50	0.00	0.00	0.48	3.22
2027	8.44	2.44	0.23	0.00	0.27	0.13	11.51
2028	16.05	6.93	1.11	7.02	0.43	0.37	31.91
2029	78.45	7.20	3.10	2.12	2.88	0.31	94.06
2030	0.00	0.00	0.00	5.54	9.54	0.00	15.08
2031	0.00	0.00	0.00	1269	0.00	0.00	12.69
2032	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cumulative	105.18	16.57	0.00	27.37	13.12	1.29	168.57

Segment Contribution to Annual Battery Retirements (2026–2033) – Base Case

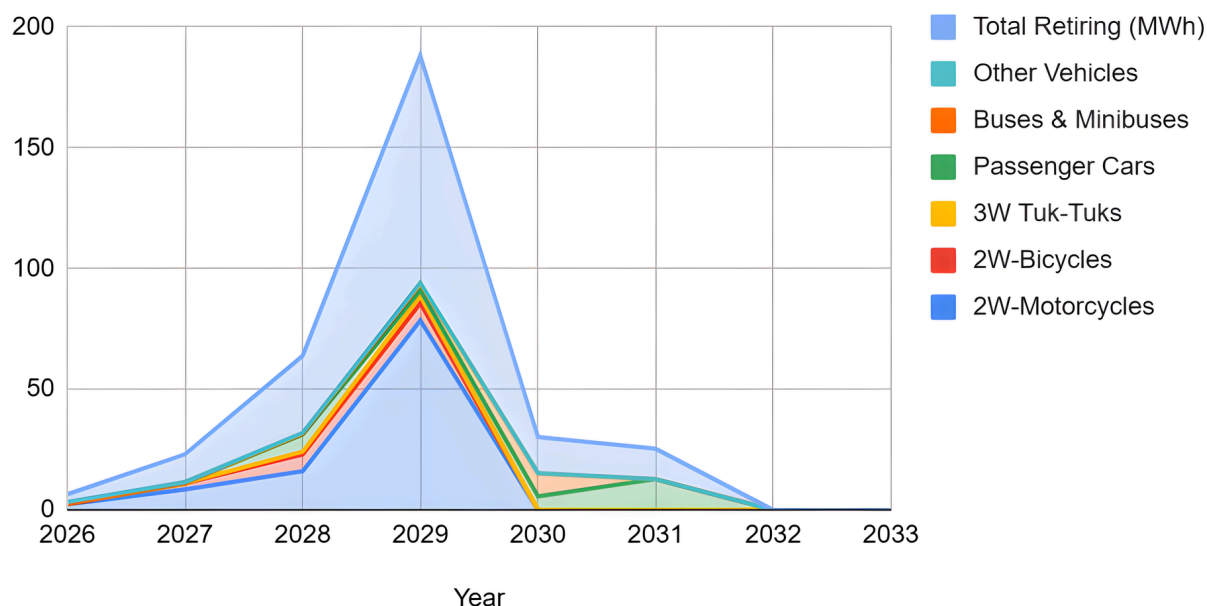


Table 4.2: Annual Retiring Battery Capacity by Vehicle Segment (MWh) – Base Case, 2026–2033

4.3.4 Detailed Segment-Level Analysis

The retirement profile depicted in Figure 4.5 reveals a highly concentrated pattern that carries profound strategic implications for Kenya’s emerging battery circularity ecosystem.

- **Two-wheelers (2W) – Motorcycles and Bicycles**

Electric motorcycles alone account for the **vast majority** of retiring capacity across the entire near-term horizon, contributing approximately **62%** of cumulative retirements by 2033 and **up to 93–95%** in the peak year of 2030. When combined with electric bicycles, the 2W segment as a whole is responsible for **~82–87%** of total retirements over the 2026–2033 period. This extreme concentration arises from two structural realities:

- The sheer volume of recent registrations, notably the **23,772 electric motorcycles registered in 2025**, creates an exceptionally large cohort.
- The short assumed lifespan of 5 years for 2W vehicles (reflecting intensive commercial usage in boda-boda and delivery services) causes this cohort to reach end-of-first-life almost simultaneously in 2030.

The result is a dramatic, narrow retirement wave peaking at **~84 MWh in 2030**, of which the overwhelming share originates from motorcycles. This pattern is not gradual; it is abrupt and highly concentrated, placing significant pressure on collection, testing, and repurposing infrastructure within a compressed 3–5-year window.

- **Three-wheelers (3W – Tuk-Tuks)**

Three-wheelers contribute a comparatively modest but consistent flow, representing **~3–5%** of annual retirements in most years and **~3%** cumulatively. Their intermediate 6-year lifespan produces a more dispersed retirement profile than 2W, with small but noticeable volumes appearing from 2028 onward. While not a dominant segment, 3W retirements still represent a meaningful secondary stream, particularly from commercial passenger and cargo operations.

- **Passenger Cars and Buses & Mini-buses**

Larger vehicles (passenger cars and buses/mini-buses/vans) play a surprisingly limited role in the near-term retirement landscape. Passenger cars contribute **~16%** cumulatively, with visible but still modest volumes emerging after 2028 as earlier registration cohorts complete their 8-year lifespan. Buses & mini-buses, despite their large individual pack sizes (90–105 kWh), account for only **~8%** of cumulative retirements due to their low unit numbers (only 160 registered by end-2025). Their contribution becomes relatively more visible after 2029–2030 as the recent bus fleet expansion matures, but remains secondary in absolute terms throughout the projection period.

- **Other Vehicles**

The “Other” category adds only a negligible and diffuse contribution (<1% cumulatively), reflecting its small and heterogeneous nature.

4.3.5 Strategic Implications

The extreme skew toward 2W, and particularly electric motorcycles, in Figure 4.5 is one of the most consequential findings of this modelling exercise. It creates both an urgent priority and a unique strategic opportunity:

- **Urgent priority** Circularity infrastructure (decentralized collection points, low-cost SOH diagnostics, accredited repurposing certification, aggregation hubs, and initial pre-processing capacity) must be operational and scaled by 2028–2029 to absorb the sudden, high-volume influx of predominantly small-format 2W batteries in 2029–2030. Any delay risks large-scale informal disposal, environmental harm, and lost economic value.
- **Strategic opportunity** The concentration in 2W (especially LFP-equipped swapping motorcycles) produces a relatively homogeneous, high-volume stream of batteries that are well-suited for second-life applications, particularly stationary storage in solar home systems, mini-grids, commercial & industrial backup, and off-grid resilience. If affordable testing, certification, and market mechanisms are established in time, this wave could become a foundational feedstock for a national second-life battery sector.

4.3.6 Chemistry-Level Projections

Given the absence of granular per-vehicle chemistry data in the NTSA registration records, the projections in this chapter apply a consistent chemistry distribution based on the best available aggregated evidence from earlier detailed KeEBI modelling and specified capacity analysis. The following breakdown is used across the entire registered fleet:

Chemistry	%
LFP	47%
Lead Acid	10%
Lithium-ion (including NMC)	3%
Unspecified chemistries	40%

These percentages are applied uniformly to the calculated retiring capacity in each projection year, providing a conservative and transparent basis for chemistry-level analysis while acknowledging that actual distributions may shift as newer LFP-heavy swapping and bus models continue to dominate incremental registrations.

Table 4.3: Cumulative End-of-First-Life Battery Capacity by Chemistry (MWh) – Base Case, 2026–2033

Year	LFP (47%)	NMC & Li-ion (3%)	Lead- Acid (10%)	Unknown (40%)	Total Cumulative (MWh)
2026	1.51	0.10	0.32	1.29	3.22
2027	5.41	0.35	1.15	4.60	11.51
2028	15.00	0.96	3.19	12.76	31.91
2029	44.21	2.82	9.41	37.62	94.06
2030	54.46	3.47	11.59	46.36	115.88
2031	61.95	3.95	13.18	52.73	131.81
2032	61.95	3.95	13.18	52.73	131.81
2033	73.80	4.71	15.70	62.83	154.04

Cumulative Retiring Battery Capacity (MWh)

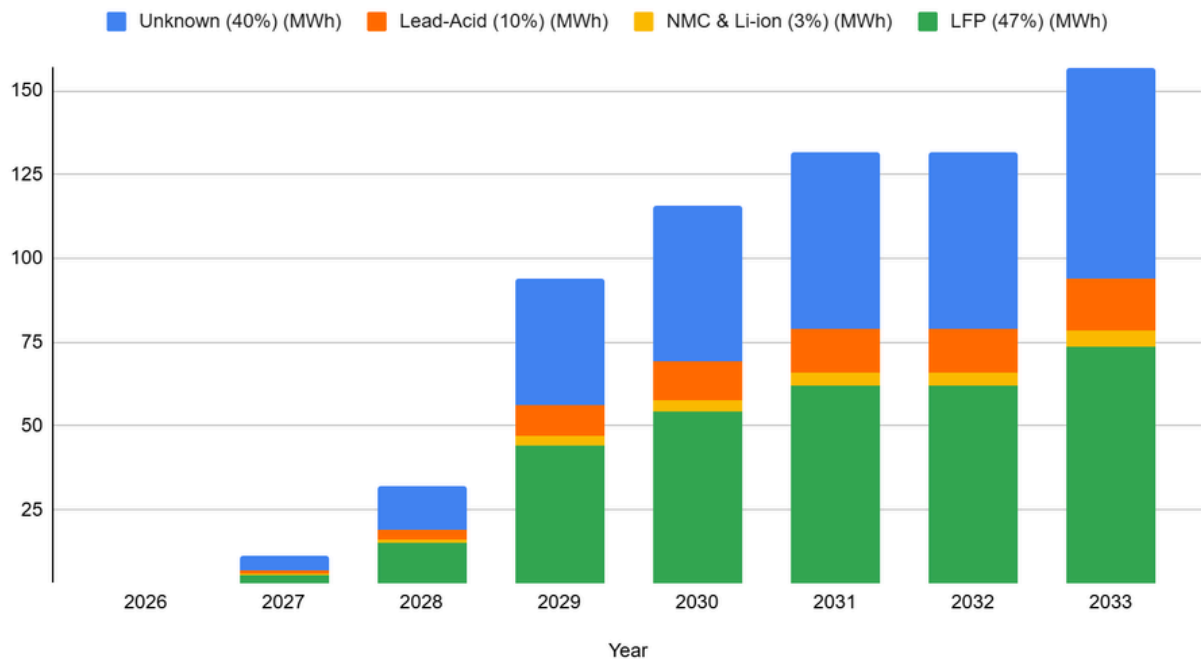


Figure 4.3: Cumulative EoFL Battery Capacity by Chemistry (MWh, 2026–2033)

4.3.7 Analysis

Table 4.3 and Figure 4.3 illustrate a steep escalation in cumulative retiring battery capacity after 2028, reaching **~157 MWh** by the end of 2033, nearly the full estimated stock, with the bulk of this volume concentrated in the 2029–2030 retirement wave driven by the 2025 motorcycle cohort.

In aggregate, the chemistry distribution shown in Figure 4.3 and Table 4.3 reveals a lithium-ion-dominated retirement wave (LFP + NMC/Li-ion $\approx$ 50%) with strong second-life potential (especially LFP) alongside recycling requirements for critical minerals (NMC) and legacy risks (Lead-Acid). Addressing the large “Unknown” fraction through improved data standards will be essential to convert these projections into precise investment and policy decisions. The dominance of LFP in the later years reinforces the strategic opportunity to position Kenya as a regional hub for second-life battery applications, provided affordable SOH diagnostics, certification protocols, and market mechanisms are established before the 2029–2030 peak.

4.4 Sensitivity Analysis

Three lifespan scenarios test uncertainty:

- **Base Case:** Standard lifespans → 173.7 MWh cumulative by 2033
- **Accelerated Case:** 1 year shorter → front-loaded, higher early volumes
- **Conservative Case:** 2 years longer → back-loaded, delayed peak

Table 4.4: Sensitivity Analysis – Annual Retiring Capacity (MWh) under Three Scenarios

Year	Accelerated (MWh)	Base (MWh)	Conservative (MWh)
2026	0.93	0.50	0.43
2027	11.51	0.43	0.50
2028	31.91	19.85	7.26
2029	94.06	26.33	19.85
2030	15.08	84.36	26.33
2031	12.69	7.26	84.36
2032	0.00	9.79	7.26
2033	0.00	25.23	9.79
Cumulative by 2033	166.18	173.75	155.78

The Base Case shows the most balanced ramp-up, with a pronounced 2030 peak. Accelerated shortens 2W life, pushing more volume into 2028–2029. Conservative delays the motorcycle wave, spreading retirements more evenly but reducing cumulative slightly due to fewer full lifecycles within the horizon.

Sensitivity Scenarios – Annual Retirements by Volume (2026–2033)

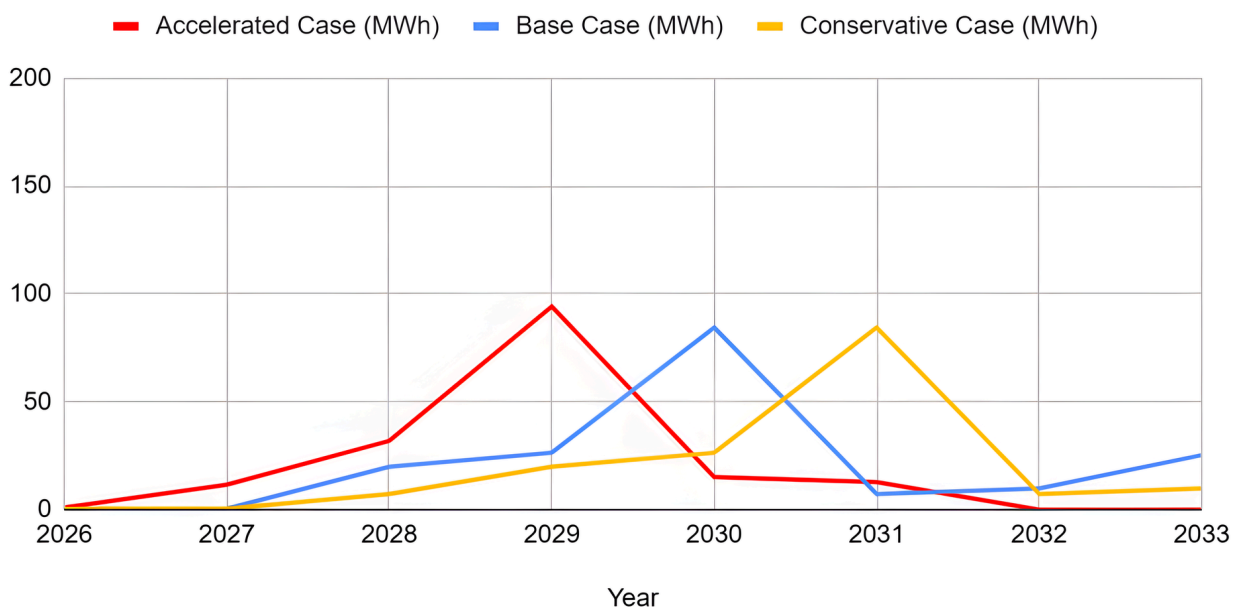


Figure 4.4: Sensitivity Scenarios – Annual Retirements by Volume (2026–2033)

4.5 Implications for Circularity

4.5.1 Repurposing Potential

If the numbers are readjusted to align with the much more recent models coming into the market (higher 2025 registrations and updated segment capacities), near-term repurposing volumes become dramatically larger. Under the Base Case, **≈109.6 MWh** of retired batteries could remain suitable for second-life applications by 2033 (65% fraction $\geq 75\%$ SOH). This represents a major opportunity for stationary storage in solar home systems, mini-grids, commercial backup, and off-grid resilience, potentially powering tens of thousands of rural households or businesses.

Long-term, the Market Guidebook projects up to 223 GWh cumulative end-of-first-life capacity by 2050, with residual value estimated at USD 8.9 billion (KES 1.2 trillion), assuming effective collection and certification.

4.5.2 Recycling Timelines

Near-term recycling demand remains modest (pilot scale viable from ~2028 at 1–2 MWh/year initially). However, the 2030 retirement surge (~84 MWh in Base Case) requires scaled pre-processing and aggregation capacity by 2029–2030. By mid-century, annual recycling flows could exceed **3 GWh/year**, with potential revenues of **USD 44 million** annually from recovered materials (cobalt, nickel, lithium, copper).

4.5.3 Policy and Market Readiness

The scale and timing of retirements, dominated by 2W in 2029–2030, demand urgent action:

- Affordable, decentralized SOH testing and certification to unlock second-life markets
- Aggregation hubs linked to swapping networks for efficient collection
- Strengthened Extended Producer Responsibility (EPR) and import standards requiring battery passports (chemistry, serial numbers, capacity)
- Regional cooperation (EAC) on labelling, transport rules and mutual certification recognition

Delays risk large-scale informal disposal and lost value; timely investment positions Kenya as a regional hub for battery circularity, job creation, and emissions reductions.



Repurposing vs. Recycling Potential, 2026–2033 (MWh)

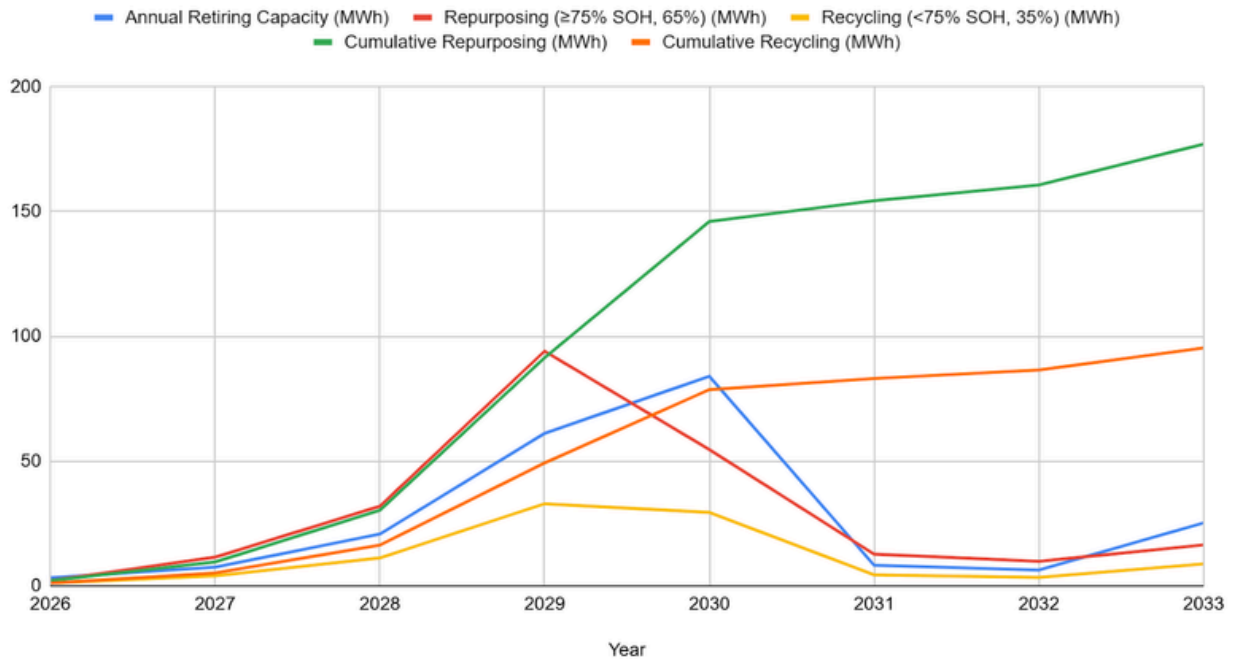


Figure 4.5: Repurposing vs. Recycling Potential, 2026–2033 (MWh)

5. Recommendations

To translate modelling insights into actionable circularity, KeEBI proposes the following phased recommendations, prioritized for implementation by 2027–2028 to address the 2029–2030 retirement peak:

5.1.1 Strengthen Policy and Regulatory Frameworks

- Enforce and expand the 2024 EPR Regulations to include mandatory battery take-back schemes, with clear responsibilities for importers, OEMs, and assemblers.
- Record battery passport data at import/registration, requiring chemistry, capacity, serial number, and lifecycle data to enable traceability and reduce the 40% "Unknown" share.
- Align with EAC partners on harmonized labelling, transport rules, and mutual certification recognition to build regional scale for recycling exports.

5.1.2 Build Technical Infrastructure and Standards

- Develop affordable, decentralized SOH diagnostics and certification protocols, with KEBS-accredited labs for module-level testing to de-risk second-life markets.
- Establish aggregation hubs linked to urban swapping networks (e.g., Spiro stations) for efficient EoFL battery collection, pre-processing, and sorting.
- Invest in pilot-scale hydrometallurgical recycling facilities, targeting LFP/NMC recovery rates >85% for critical minerals.

5.1.4 Enhance Data, Awareness and Capacity

- Mandate NTSA/KEBS reporting on battery specs to close data gaps and improve retirement forecasting.
- Roll out awareness campaigns for informal sector actors (boda-boda operators, repairers) on safe handling and collection incentives.
- Build technical expertise through training programs for e-waste handlers and regulators on lithium-ion risks and circular practices.

These recommendations, if implemented, could unlock USD 44 million in annual recycling revenues by mid-century while creating green jobs and reducing emissions.

6. Conclusion

Kenya's E-mobility sector has achieved remarkable scale, with 43,324 EVs registered by end-2025, marking a transformative shift toward cleaner transport and alignment with the updated Nationally Determined Contributions (NDCs) that commit to a 35% greenhouse gas emissions reduction (75 MtCO₂e abatement) below business-as-usual by 2035. This growth, concentrated in two-wheelers (31,869 electric motorcycles), underscores the urgency of battery circularity to prevent environmental risks from EoFL retirements while unlocking economic value through repurposing and recycling.

KeEBI's two-phase analysis, baseline mapping (December 2024 report) and endline modelling, reveals an installed battery stock of 176.7 MWh (effective 180.3 MWh including swapping excess), with near-term retirements (2026–2033) reaching 173.7 MWh cumulative under the Base Case. Volumes peak dramatically at 84 MWh in 2030, driven by the 2025 motorcycle cohort's 5-year lifespan, with 2W dominating 82–87% of flows. Chemistry allocation (LFP 47%, Lead-Acid 10%, NMC/Li-ion 3%, Unknown 40%) highlights LFP's strong second-life suitability, enabling ~109.6 MWh for repurposing (65% fraction $\geq 75\%$ SOH) in solar storage, mini-grids, and backup systems. Long-term projections from the Charging Up for Growth guidebook (July 2025) indicate up to 223 GWh EoFL by 2050, with residual value of USD 8.9 billion (KES 1.2 trillion) and annual recycling revenues of USD 44 million.

This final KeEBI report, complemented by the July 2025 technical brief on battery residual value for EV financing, emphasizes actionable pathways: enforce EPR with battery passports for traceability, develop affordable SOH diagnostics and aggregation hubs, and foster public-private investments in regional recycling. By prioritizing these, Kenya can mitigate informal disposal hazards, create green jobs, reduce critical mineral dependence, and position itself as an African circularity leader, ensuring e-mobility's growth powers sustainable, resilient development.

Working Group Members





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