Charging Up for Growth

A Guidebook for Kenya's Second-Life EV Battery Market

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AFRICA E-MOBILITY ALLIANCE

climateworks FOUNDATION

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Project Introduction

As Kenya embraces electric mobility to address climate change, improve air quality, and reduce reliance on fossil fuels, the life cycle management of electric vehicle (EV) batteries is becoming a critical area of focus. This is evident from the government's emphasis on supporting local battery assembly, manufacturing, repurposing, and recycling outlined in the Draft National E-Mobility Policy. With the increasing adoption of electric vehicles in the country, there is a growing need to plan for the sustainable handling of end-of-life (EoL) batteries.

Improper management of EV batteries poses significant environmental risks due to toxic elements, such as lithium, cobalt, and nickel, which, if mishandled, can lead to soil, water, and air pollution. EV batteries also run the risk of high intensity fires, which have been a concern for consumers and policymakers alike globally. However, if managed properly, EV batteries can provide additional value through their subsequent lives and be mined for valuable minerals when they can no longer store energy economically. This challenge, therefore, also presents an opportunity to build a robust framework for the responsible repurposing, recycling, and disposal of EV batteries to support Kenya's sustainable energy future.

The Kenya E-Mobility Battery Initiative (KeEBI), supported by the ClimateWorks Foundation and led by the Africa E-Mobility Alliance (AfEMA), is designed to address this challenge. The primary objective of KeEBI is to develop and propose pathways for managing EV batteries beyond their first life by focusing on repurposing, reuse, and recycling. KeEBI aims to shed light on the potential environmental and socio-economic impact of e-mobility batteries from their subsequent life applications to the recycling value chain.

Guidebook Overview

This market guidebook serves as a practical, action-oriented companion to the KeEBI Baseline Report.[1] It reveals evidence-based opportunities for second-life batteries and provides a jumping-off point for stakeholders in government, civil society, and the

[1] Africa E-Mobility Alliance. (2025). *Kenya EV Battery Initiative Baseline Report*.

private sector who are ready to engage with Kenya's emerging second-life EV battery market.

As electric mobility gains momentum, the need for accessible guidance on market entry and end-of-life waste management has become urgent. This guidebook clarifies opportunities, simplifies complexities, and aims to spur systems-level change. It maps challenges, outlines available resources, and presents possible futures to help stakeholders move from awareness to action in unlocking the potential of EV battery reuse, repurposing, and recycling in Kenya.

While the KeEBI Baseline Report established a vital reference point for the current landscape of EV battery management and regulatory structures in Kenya, this guidebook focuses on what comes next. It supports NGOs, policymakers, and investors in making informed decisions that will shape a thriving second-life battery (SLB) market. Drawing from global best practices and local insights, it explores key leverage points for market development, introduces plausible scenarios, and offers tailored recommendations.

Who Is This For?

This guidebook is for anyone with a stake in Kenya's EV transition and the circular economy — and especially those who have the influence or resources to shape the emerging SLB market.

- **Policymakers** will find guidance on regulatory priorities, international best practices, and pathways to stimulate market development while protecting public and environmental health.
- **NGOs** will discover opportunities for advocacy, program design, and partnership building that advance equitable access, community resilience, and sustainability outcomes.
- **Development Financial Institutions and early market investors** will gain insight into the market's trajectory, key barriers to scale, and the enabling conditions that could unlock value in battery reuse and repurposing.
- **Entrepreneurs** will discover opportunities for unique new businesses in a potentially high growth industry that is being actively advanced through the National E-Mobility Policy.
- **Researchers, educators, and community leaders** will find a window into an unfolding sector with the potential to generate jobs, reduce emissions, improve energy access, and position Kenya as a leader in circular innovation.

Whether you're a funder considering investments, a policymaker designing regulations, or an NGO advocating for economic development opportunities, this guidebook will help you create forward-looking strategies that unlock the full potential of Kenya's EV battery ecosystem.

How to Use This Guidebook

This guidebook is designed to be both a compass and a roadmap for stakeholders looking to engage with Kenya's EV SLB market. It begins by grounding you in the global transition to electric mobility (referred to throughout as *e-mobility*), offering the broader context necessary to understand the urgency and opportunity of battery circularity. From there, it zooms in on Kenya's EV market and the conditions shaping the future of battery reuse, repurposing, and recycling.

At the core of the guidebook is a scenario planning framework built on two critical uncertainties: the strength of Kenya's second-life battery market ecosystem and the trajectory of global battery prices. The four scenarios presented here offer market stakeholders a way to locate themselves in the evolving landscape and assess what actions they can take, now and in the future, to seize the opportunities ahead and influence the direction of the market.

The remainder of the guidebook provides sector-specific guidance for NGOs, policymakers, investors, and innovators — helping each group move from insight to impact, with clear recommendations for action and further exploration.

If you are new to EVs and EV battery technology, be sure to read the appendix entitled **EV Battery Technologies: An Overview** at the end of the guidebook for an introduction to the essentials.

Glossary of Terms

2W/3W/4W – two-wheel, three-wheel, and four-wheel vehicles.

African Continental Free Trade Area (AfCFTA) – The world's largest free trade area, bringing together the 55 countries of the African Union (AU) and eight Regional Economic Communities (RECs) in a single market.

Battery disassembly – The process of safely dismantling a battery for testing, reuse, or recycling.

Battery Electric Vehicle (BEV) – A fully electric vehicle that runs exclusively on rechargeable batteries without an internal combustion engine.

Battery Energy Storage System (BESS) – A system that stores energy in batteries for later use, typically in grid, industrial, or backup applications.

Battery Management System (BMS) – A system that monitors and manages the performance, safety, and longevity of a battery.

Battery passport – A digital record of a battery's origin, composition, and use history, used to facilitate reuse or recycling.

Business-to-business (B2B) – Business models that focus on selling to other businesses rather than end consumers.

Circular economy – An economic model aimed at minimizing waste and making the most of resources by keeping materials in use as long as possible.

Commercial & Industrial (C&I) – The sector of the economy that encompasses businesses, corporations, and industrial activities.

Concessional capital – Below market rate finance provided to developing countries by major financial institutions, such as Development Finance Institutions, to accelerate development goals.

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) – Germany's international development agency providing services in international development.

Development Finance Institution (DFI) – A specialised financial institution that provides risk capital for economic development projects.

East African Community (EAC) – An intergovernmental organisation comprising countries in East Africa working toward regional economic integration. It comprises eight partner states: Burundi, the Congo, Kenya, Rwanda, Somalia, South Sudan, Uganda, and Tanzania.

End-of-life (EoL) battery – A battery that has reached the end of its usable lifespan in its original application.

Extended Producer Responsibility (EPR) – A policy approach that holds manufacturers responsible for the disposal or recycling of their products at end-of-life.

Energy and Petroleum Regulatory Authority (EPRA) – Kenya's regulatory body overseeing the energy and petroleum sectors.

Electric Vehicle (EV) – A vehicle that uses one or more electric motors for propulsion rather than an internal combustion engine. This category includes Plug-In Hybrid Vehicles (PHEVs) and Battery Electric Vehicles (BEVs).

Internal Combustion Engine (ICE) – A heat engine that burns fuel to create power for vehicle propulsion.

Internal Combustion Engine Vehicle (ICEV) – A vehicle that uses an internal combustion engine.

Kenya Bureau of Standards (KEBS) – Kenya's national standards body responsible for developing and enforcing quality standards.

Kenya Off-Grid Solar Access Project (KOSAP) – A government initiative aimed at expanding access to electricity through off-grid solar solutions.

Kenya Power and Lighting Company (KPLC) – Kenya's national electricity distribution company responsible for power transmission and retail.

Lithium Iron Phosphate (LFP) – A type of lithium-ion battery chemistry known for its thermal stability and longer life cycle.

Micro, Small, and Medium Enterprises (MSME) – Small businesses that form a significant part of developing economies.

Microgrid/minigrid – A small-scale electricity grid that can operate independently or in conjunction with the main grid.

National Industrial Training Authority (NITA) – Kenya's regulatory body responsible for industrial training and skills development.

Nickel Manganese Cobalt (NMC) – A lithium-ion battery chemistry commonly used in EVs due to its high energy density.

Off-grid solar (OGS) – Solar systems that operate independently of the national electricity grid. Solar home systems (SHS) are a subset of the OGS sector.

Peak shaving/load shifting – The strategic practice of reducing electricity consumption during high-demand periods (peak shaving) and/or moving energy usage to different times (load shifting) to avoid premium pricing and reduce strain on the electrical grid.

Product-as-a-Service (PaaS) – A business model where customers pay for using a product rather than purchasing it outright.

Public-private partnership (PPP) – A cooperative arrangement between public and private sectors for the delivery of services or infrastructure.

Recognition of Prior Learning (RPL) – A process to certify skills acquired outside formal education, often through work experience or informal training.

Recycling – The process of breaking down a battery to recover valuable materials for reuse.

Repurposing – Adapting a product for an application other than its original use, e.g. retrofitting an EV battery for use as storage in a solar energy system.

Residual value – The monetary or functional worth that a battery contains after it is no longer suitable for use in its original application.

Rural Electrification and Renewable Energy Corporation (REREC) – Kenya's government agency tasked with expanding electricity access in rural areas.

Second-life battery (SLB) – A battery that is repurposed for a new application after it is no longer suitable for its original use (e.g., in EVs).

State of Health (SoH) – A measure of a battery's current condition and performance relative to its original capacity. Typically expressed as a percentage.

Sustainability-linked loan (SLL) – A loan with terms tied to the borrower's achievement of sustainability performance targets.

Technical and Vocational Education and Training (TVET) – Education and training programs focused on providing practical and job-specific skills.

Thermal management – Techniques to control battery temperature and ensure safe and efficient operation.

Executive Summary

Kenya stands at a pivotal moment to establish itself as a regional leader in the emerging circular economy for EV batteries. This market guidebook outlines the opportunities, challenges, and pathways for developing a robust second-life EV battery (SLB) ecosystem in Kenya.

Key Opportunities

Kenya possesses unique advantages to lead in EV adoption and battery management:

Growing EV market: Kenya's EV sector is experiencing remarkable growth, with an 86% compound annual growth rate between 2020-2024. With strong government support and continued economic growth, the EV market could reach 15 million vehicles and 100% market penetration by 2050. In this scenario, over 10 million EVs in Kenya will have reached end-of-first-life by 2050, representing 223 GWh of battery capacity and USD 8.9 billion (KES 1.2 trillion) in combined residual value. Of these batteries, approximately 10 GWh will have reached end-of-second-life and be ready for recycling, adding another USD 157 million (KES 20 billion) to the market opportunity.

Circular economy potential: Kenya's well-established technology and startup ecosystem provides an innovation culture that can be leveraged to create a dynamic and cross-sector circular economy for EV batteries.

Strategic regional position: As East Africa's economic hub with established trade networks and the Port of Mombasa, Kenya is uniquely positioned to become a regional center for EV battery collection, processing, and distribution.

It is critical for Kenya to begin planning for end-of-life EV battery management now to capture this economic opportunity and avoid the environmental, health, and economic risks that come with improper disposal.

Market Development Roadmap

Successful market development requires strategic investment in a supportive ecosystem:

Short-term (2025-2030): Focus on pilot projects, micro, small, and medium enterprises (MSMEs), and

developing trained workforce for 2-wheel/3-wheel battery repurposing.

Medium-term (2030-2040): Scale successful business models, develop specialised applications across multiple sectors, increase 4-wheel battery repurposing, and plan recycling infrastructure investments.

Long-term (2040-2050): Implement regional recycling partnerships and establish Kenya as a circular economy hub for battery value chains.

Strategic Recommendations

The development of a thriving SLB market will be shaped by several critical factors:

Workforce development: Invest in specialised training programs for battery handling, diagnostics, repurposing, and recycling across technical institutions.

Policy development: Create clear regulations for battery ownership, liability, safety standards, and cross-border movements.

Regional cooperation: Establish East African Community (EAC) partnerships to achieve economies of scale in recycling infrastructure.

Finance innovation: Create sector-specific financing mechanisms and public-private partnerships to de-risk investments in battery collection, testing, repurposing, and recycling infrastructure.

Critical Timing Considerations

For Kenya to capture maximum value from this emerging sector:

- Investment decisions for recycling infrastructure must be made by the mid-2030s to ensure facilities are operational by 2040.
- Early market development should prioritize repurposing applications in sectors with established demand: solar home systems, microgrids, backup power for institutions, and telecommunications.

By taking strategic action now, Kenya can transform potential environmental challenges into economic opportunities, create skilled jobs, support clean energy deployment, and establish itself as a leader in Africa's circular economy transition.

The Global EV Revolution Comes to Africa

EVs are becoming central to transportation decarbonisation globally, and EV adoption has been accelerating rapidly in most regions of the world over the past decade.[2] California's Zero Emissions Vehicle mandate in 1990 set an early precedent for broad policy interventions, but the EV market did not take off in earnest until the US and China — home to some of the world's largest automakers — established the first EV tax credits to incentivize consumer adoption in 2008 and 2014. The 2015 Paris Agreement further accelerated such policy initiatives, as more and more countries began to integrate decarbonisation goals into their transportation sectors. China now leads global adoption, accounting for approximately 60% of global sales, while the US has seen significant growth following the passage of the Inflation Reduction Act. In the European Union, momentum continues to build, with 2.4 million new EVs sold in 2023 and a strong emerging policy environment that includes battery regulations and extended producer responsibility (EPR) policies.[3]

While the African continent has lagged behind Europe, China, and North America, EV adoption is accelerating rapidly and African regions are developing distinctive strategies that reflect their unique economic contexts, policy frameworks, and market conditions.

South Africa, which already leads sub-Saharan African in overall vehicle manufacturing capacity, is seeing growth in its EV market and recently committed USD 54 million to support local EV production. It has also launched a comprehensive Green Transport Strategy aimed at addressing the 11% of national emissions from transport.

East Africa is a home to innovators, where pioneers like Kenya, Rwanda, and Uganda are exploring new models for EV adoption with a strong focus on 2W vehicles and public transport. Rwanda has established comprehensive measures including reduced electricity tariffs for EVs, zero VAT on EV consumables, and rent-free land for charging stations, and a ban on petrol motorcycles for public transport registrations in Kigali. Ethiopia made headlines in February 2024 by becoming the first country in the world to ban non-EV imports. Kenya — the "Silicon Savannah" — hosts a number of

[2] Bond K. and Butler-Sloss S. (2023). "The EV Revolution in Five Charts and Not Too Many Numbers". Rocky Mountain Institute.
[3] International Energy Agency. (2024). *Global EV Outlook 2024: Trends in electric cars*.

innovative electric 2W and bus startups and is on the verge of adopting its draft National E-Mobility Policy.

North Africa is developing manufacturing capacity in the EV sector, and Morocco recently signed a USD 6.4 billion battery factory agreement with Chinese manufacturer Gotion High-Tech Co, one of the world's largest battery manufacturers. This positions Morocco to become a key player in the global EV supply chain, leveraging its proximity to European markets.

In **West Africa**, Nigeria is investing heavily in electric public transport infrastructure and recently approved USD 100 million in contracts to deploy electric buses, tricycles and charging infrastructure in the country's North-East region.

The EV transition in Africa is still in its early stages, with each region showing different strengths and areas of focus. As sub-Saharan Africa's total vehicle fleet grows from 25 million vehicles today to an estimated 58 million by 2040 in South Africa, Kenya, Rwanda, Uganda, Ethiopia, and Nigeria alone,[4] the continent's diverse regional approaches may eventually converge into a uniquely African model of EV adoption that addresses local challenges while creating economic opportunities and environmental benefits.

[4] Conzade J., et al. (2022). "Power to move: Accelerating the electric transport transition in sub-Saharan Africa". McKinsey & Company.

The Kenyan EV Landscape

In Kenya, the EV market is in its early stages, but the country is emerging as a leader in e-mobility innovation through strategic policy initiatives and business model development. As of the end of 2024, approximately 4.6 million vehicles were registered in Kenya, with battery electric vehicles (BEVs) accounting for around 0.12% of the total vehicle population (5,294 total units). Despite this small percentage, EV adoption has experienced remarkable growth, with an 86% Compound Annual Growth Rate (CAGR) between 2020-2024 (an 1103% overall increase).[5]

This growth has been driven by a number of policy initiatives at the national level:

- The National Energy Efficiency and Conservation Strategy (2020) established a target of 5% of all vehicle imports being electric by 2025.
- The Finance Act of 2019 reduced excise tax on imported EVs from 20% to 10%.
- E-mobility was integrated into the Fourth Medium Term Plan 2023-2027 of the Kenya Vision 2030 Agenda, with a specific focus on developing electric motorcycle manufacturing and charging infrastructure.

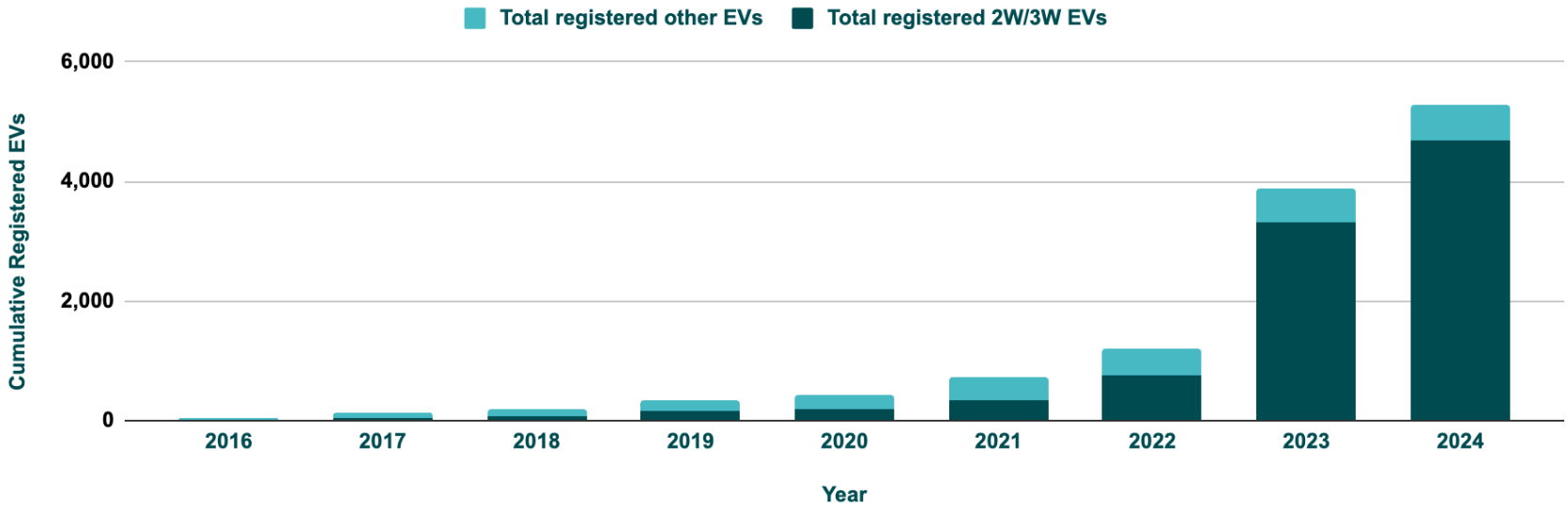
[5] Africa E-Mobility Alliance, *Kenya EV Battery Initiative Baseline Report.*

- The Finance Act of 2023 zero rated VAT on e-buses, electric motorcycles and lithium-ion batteries.
- In early 2024, Kenya's Electric Mobility Task Force launched a draft National E-Mobility Policy, which seeks to position Kenya as a leader in the e-mobility transition in Africa. It also commissioned global heavyweight consulting firm McKinsey & Company to study the costs and benefits of Kenya's transition to EVs.
- In April 2024, Kenya Power & Light Company (KPLC) committed USD 1.9 million to building EV charging infrastructure, with 45 charging stations set to roll out in 2025-2026.

The tax incentives listed above were subsequently reversed in the Finance Act 2024, but the impact on the EV market was swift, particularly in the 2W/3W segment.

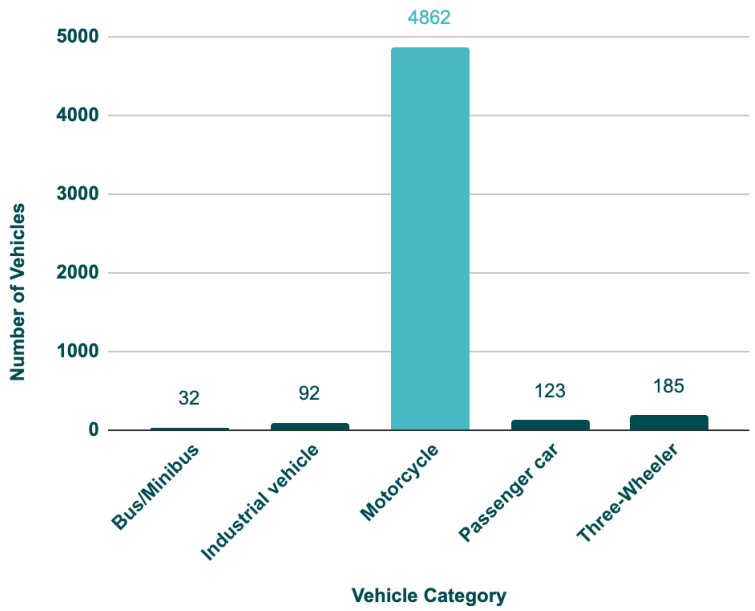
Kenya EV Registrations, 2016-2023

Impact of 2023 Finance Act on EV adoption



Registered EVs in Kenya by Type

As of 31 December 2024



Outside of the public sector, Kenya's entrepreneurs have turned their attention to the EV market, with a number of innovative business models and partnerships showing promising growth and attracting significant investment. Electric bus startup BasiGo raised USD 42 million to assemble 1,000 electric buses by 2027, Afrigreen Automobile and Chinese EV manufacturer Chery are developing a USD 20 million assembly plant, and electric motorcycle manufacturer Roam opened a 10,000 square-meter plant in Nairobi with a planned annual capacity of 50,000 units.[6] Meanwhile, two-thirds of electric motorcycles sold in Kenya are financed by M-Kopa's buy-now-pay-later model, which has been pivotal in advancing adoption in other sectors like mobile phones and solar home systems.[7]

For NGOs, policymakers, and investors, it's important to understand both Kenya's local market dynamics and its place in the larger African and global context. While EV adoption may start slower in Kenya, the country stands to benefit from the overall global transition to EVs through technology transfers, regulatory best practices in more developed markets, international climate finance, regional partnership opportunities, and global realignments in international trade that will cause capital to seek new markets. These factors could cause Kenya's nascent market to "leapfrog" along the adoption curve and accelerate quickly. The challenge will be to design policy, infrastructure, and investment models that are responsive to Kenya's unique mobility patterns, energy grid dynamics, and economic constraints — while also ensuring environmental and safety standards for EVs throughout their life cycle.

For a comprehensive look at the current state of EV adoption in Kenya, consult the KeEBI Baseline Report.

[6] Doll S. (2023). "ROAM opens East Africa's largest electric motorcycle plant during visit from Kenya's president". Electrek.
[7] Dosunmu D. (2024). "A buy-now-pay-later company is behind the explosion of EVs in Kenya". Rest of World.

EV Battery Accumulation: An Emerging Risk

While increased EV adoption will certainly provide economic and environmental benefits, the batteries that power these vehicles do come with inherent challenges. When an EV battery degrades to approximately 80% of its original capacity (usually after 5-10 years), it is no longer suitable for the demands of vehicle traction. At this stage in its life cycle, there are a few optimal pathways it can take:

1. The battery's remaining 80% capacity can be given a "second life" and repurposed to power a less energy intensive technology.

2. The battery can be disassembled and broken into subcomponents, which are then collected for recycling and sold for reuse.

Unfortunately, neither of these pathways will be viable without a robust market ecosystem. Without the necessary workforce, policies, entrepreneurs, investments, customers, and infrastructure, there is a high risk that batteries will be stockpiled indefinitely, discarded improperly, or handled by informal e-waste collectors without adequate safety protocols.

This poses significant environmental and health risks because improper disposal of EV battery minerals — cobalt, nickel, lithium, manganese, copper — creates hazards for humans, plants, animals, soils, and waterways. Additionally, batteries can catch fire under certain conditions, threatening people, property, and the environment. These challenges are especially acute given that, until 2023, most EVs imported into Kenya were used 2W and 3W vehicles with shorter battery lifespans and uncertain safety standards.

This landscape is beginning to change as EV adoption increases and more vehicles are manufactured locally, creating new market opportunities in end-of-life battery management. While recycling is a familiar concept, it requires significant capital investment and battery volume to be commercially viable — making it challenging as a first step for Kenya's emerging EV economy.

A more strategic approach recognizes the **residual value** in end-of-first-life batteries and creates a circular economy that keeps batteries operating at their highest value for as long as possible through second-life applications. This is EV battery second life.

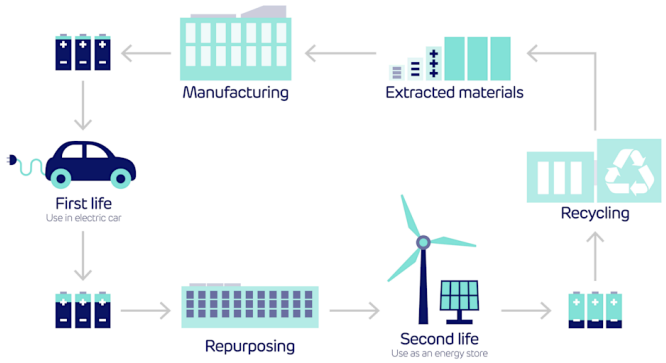
Market Opportunities for Second-Life Batteries

Keeping Battery Value in the Loop

With growing EV adoption, Kenya has a unique opportunity to become a leader in developing a **circular economy** for EV batteries. The goal of a circular economy is to keep products and materials in circulation at their highest value for as long as possible. The reason is simple: the longer that customers can use a battery, the more valuable it is to them and the greater the economic, environmental, social benefit in their local economy.

To ensure that the value contained in EV batteries in the Kenyan market is maximised, battery manufacturers, policymakers, and the manufacturers who incorporate batteries in their products should consider the following priorities in all of their activities.

1. **Extend first life.** Design batteries and EVs for longevity and ease of repair.
2. **Optimize for second life use.** Develop second life market incentives, collection and buyback mechanisms, cross sector partnerships, and circular design practices that allow for efficient disassembly/recycling. Given that EV batteries have a potential second life of 10-20 years, this strategy buys Kenya critical time to allow capital-intensive and time-intensive recycling facilities to be built.
3. **Recycle only as a last resort.** Return batteries to the beginning of their life cycle only when there is no remaining useful life left in them (around 50% SoH). If damaged or degraded batteries are ready for recycling before industrial recycling is commercially viable, stockpile them to prevent environmental damage or economic leakage of valuable minerals.



Source: Drax

Short-Term Market Outlook: 2025-2030

Because of the relatively recent adoption of EVs in Kenya, there are currently only around 200 2W/3W vehicles with batteries that are at or near end of life, and no 4W vehicles that are at or near end of life. As a result, there is only a tiny artisanal market for second-life EV batteries in Kenya, comprising small enterprises, researchers, pilot projects, and hobbyists.

With increasing EV adoption, however, the number of used batteries will grow alongside the EV market. Assuming a 5-year first life for 2W/3W vehicles and a 10-year first life for 4W EVs, approximately 20,000 2W/3W vehicles and 250 other EVs (light duty vehicles, heavy duty vehicles, buses, etc) will have reached the end of their first life by the end of 2030 based on current adoption patterns. These used batteries represent about **136 MWh of capacity**, with an aggregate residual value of approximately **USD 8.4 million / KES 1.1 billion** (Net Present Value of USD 5.5 million / KES 723 million). Realistically, some batteries might not be fit for repurposing, but ideally, recycling is only used as a last resort once there is no possibility of repair and no viable use for the batteries in other applications.

This early supply of SLBs will be dominated by lower capacity 2W/3W EV batteries (99% of total) as a result of cost factors and government incentives that have led to a much more rapid adoption of 2W/3W EVs in Kenya compared to larger passenger vehicles. Many of these smaller EV batteries are likely to have Lithium Iron Phosphate (LFP) battery chemistries due to their lower cost, better thermal stability in hot climates, less toxic chemical composition, and longer life cycles (2-3x the number of charging cycles compared to NMC).[8] These LFP batteries are not currently very profitable to recycle using current recycling technology due to transportation costs, the location of recycling facilities, the volume of input required, and the low global commodity price of lithium.[9] However, LFP batteries do have a lengthy potential second life — up to 30 years depending on intensity of use and proper maintenance.

These factors suggest that in the 2025-2030 timeframe:

- MSMEs will continue to drive the early market on both the supply and demand side of EV battery second life.

[8] Ramasubramanian B. et al. (2024). *Ten major challenges for sustainable lithium-ion batteries*. Cell Reports Physical Science, *5*.
[9] Lander, L. et al. (2021). *Financial viability of electric vehicle lithium-ion battery recycling*. iScience, *24*.

- Focused pilot projects and investment in MSMEs will be important in validating business models for potential second life pathways. The Fourth Medium Term Plan of the Kenya Vision 2030 agenda specifically includes the MSME economy as one of its five pillars, so there is high potential for synergy here.
- Recycling should be deprioritised in the short term, but should still be pursued on a longer time horizon.

The importance of MSMEs in the early market will likely hold across multiple EV adoption scenarios, because small entrepreneurs are the pioneers in any nascent market.

Long-Term Market Outlook: 2030-2050

Global EV adoption trends are currently following the technology adoption S-curve that has been common with many new technologies, from television to the internet.[10] Assuming continued focus on market ecosystem development, economic growth of approximately 5% per year, and a steady decline in the global price of batteries, Kenya's EV market will likely follow a similar S-curve pattern in the 2030-2050 timeframe. Adoption may be slower than in more developed economies due to affordability issues, but this can be countered through strong policies, widespread access to financing, and efforts to shift consumer mindsets.

In the most optimistic scenario, Kenya could be positioned to replace all internal combustion engine vehicles (ICEVs) with EVs by 2050 in line with its draft National E-Mobility Policy[11] and the Energy Transition and Investment Plan.[12] In this scenario there would be over 15M EVs on the road in Kenya by 2050, split roughly 50/50 between 2W/3W EVs and 4W EVs, in line with the current ratio between those categories in the ICEV market.

In that same timeframe, 10.2M EVs (70% 2W/3W and 30% 4W) will have reached the end of their first life, representing **223 GWh of SLB capacity** and **USD 8.9 billion / KES 1.2 trillion** in combined residual value (USD 1.5 billion / KES 194 billion net present value when discounted to 2025). Of these 223 GWh of SLBs, a total of 10 GWh will have reached the end of second life and will be ready for recycling, adding another USD 157 million / KES 20 billion (net present value USD 35

[10] Bond K. and Butler-Sloss S., "The EV Revolution in Five Charts and Not Too Many Numbers".

[11] Kenya E-Mobility Task Force. (2024). *Kenya Draft National e-Mobility Policy*.

[12] Kenya Ministry of Energy & Petroleum. (2023). *Kenya Energy Transition and Investment Plan 2023-2050*.

million / KES 4.5 billion) to the longer-term market opportunity.

If Kenya fails to develop a market around SLBs, it would not only lose out on significant market opportunity, it would also lose out on the social, environmental, and economic development benefits that come with keeping these resources in circulation as long as possible in the local economy and recycling them back into the manufacturing value chain at the end of their useful lives. Just the lithium carbonate equivalent contained in the 223 GWh of SLBs that will be at the end of first or second life in Kenya by 2050 represents approximately USD 132 million / KES 17 billion in social and environmental benefit compared to traditional lithium mining.[13]

In the 2030-2050 timeframe, the market will look very different from the short-term timeframe:

- Larger businesses will emerge alongside the MSMEs that drove the early market. Some MSMEs will become larger businesses themselves.
- Scaling business models will take priority over pilot projects.
- Commercial recycling infrastructure and regional recycling and manufacturing partnerships will begin to develop, particularly after 2040.
- New market risks will arise as technology advances (solid state, sodium ion) and as predicted critical mineral shortages arrive. The International Energy Agency (IEA) projects that global lithium supply will only meet 60% of global demand in 2035,[14] which could have a destabilizing effect on first and second life battery markets unless other technologies supersede lithium-ion battery chemistries.

Repurposing

Repurposing is the act of collecting a product at the end of its first life and retrofitting it for a different use case. This differs from repair and remanufacturing, which are focused on restoring a product to a condition where it can be returned to the same use case (e.g. vehicle traction, in the case of EV batteries).

Because the energy demands and charging behaviors in e-mobility are more intense than other battery applications, repurposing EV batteries involves modifying aspects of the battery to ensure that it can meet the specifications of its second-life use case and

[13] Buzwani M. et al. (2024). "Battery Recycling: How Accounting for Social and Environmental Benefits Boosts Returns". Rocky Mountain Institute.

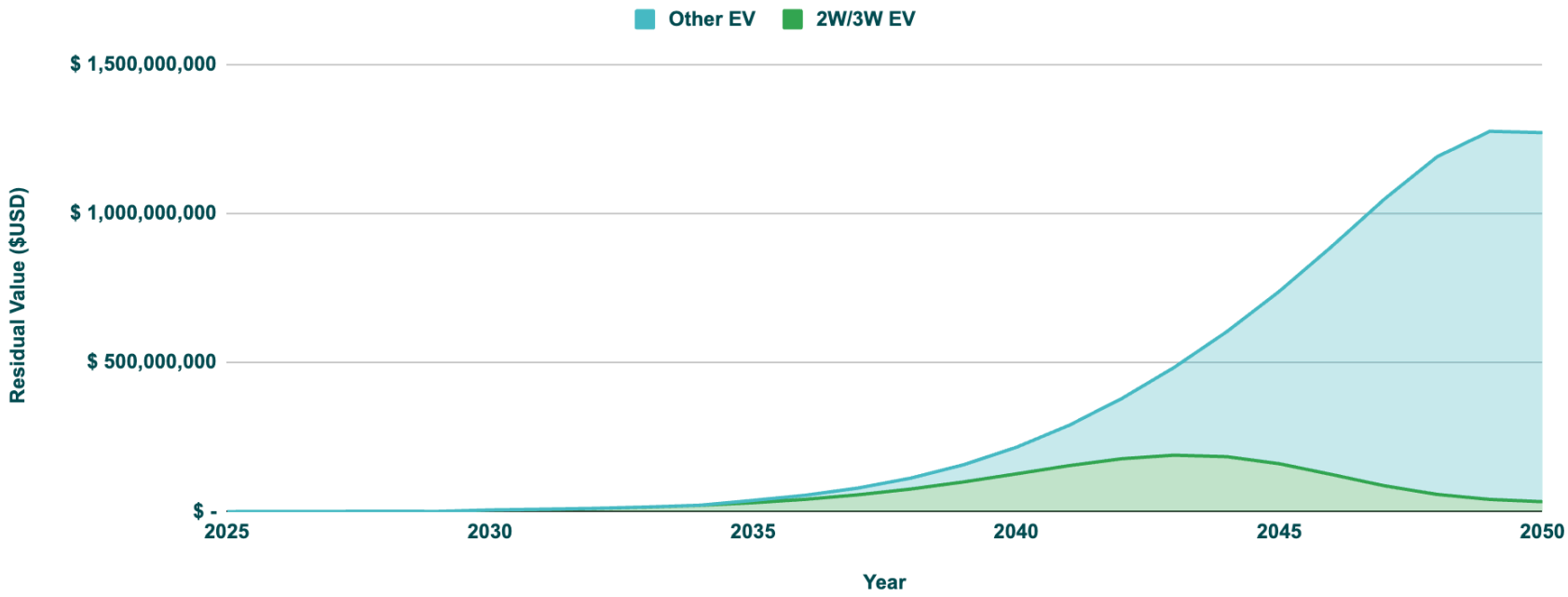
[14] International Energy Agency (2024). *Global Critical Minerals Outlook 2024: Outlook for key minerals*.

be operated safely. This may require modifications to the Battery Management System (BMS), cooling systems, voltage, structure, or other characteristics of the battery and will require skilled technicians that are familiar with both EV batteries and one or more industries that use batteries for stationary storage. Developing Kenya's technical workforce will thus be a critical precursor for repurposing and deploying second life batteries (SLBs) at scale.

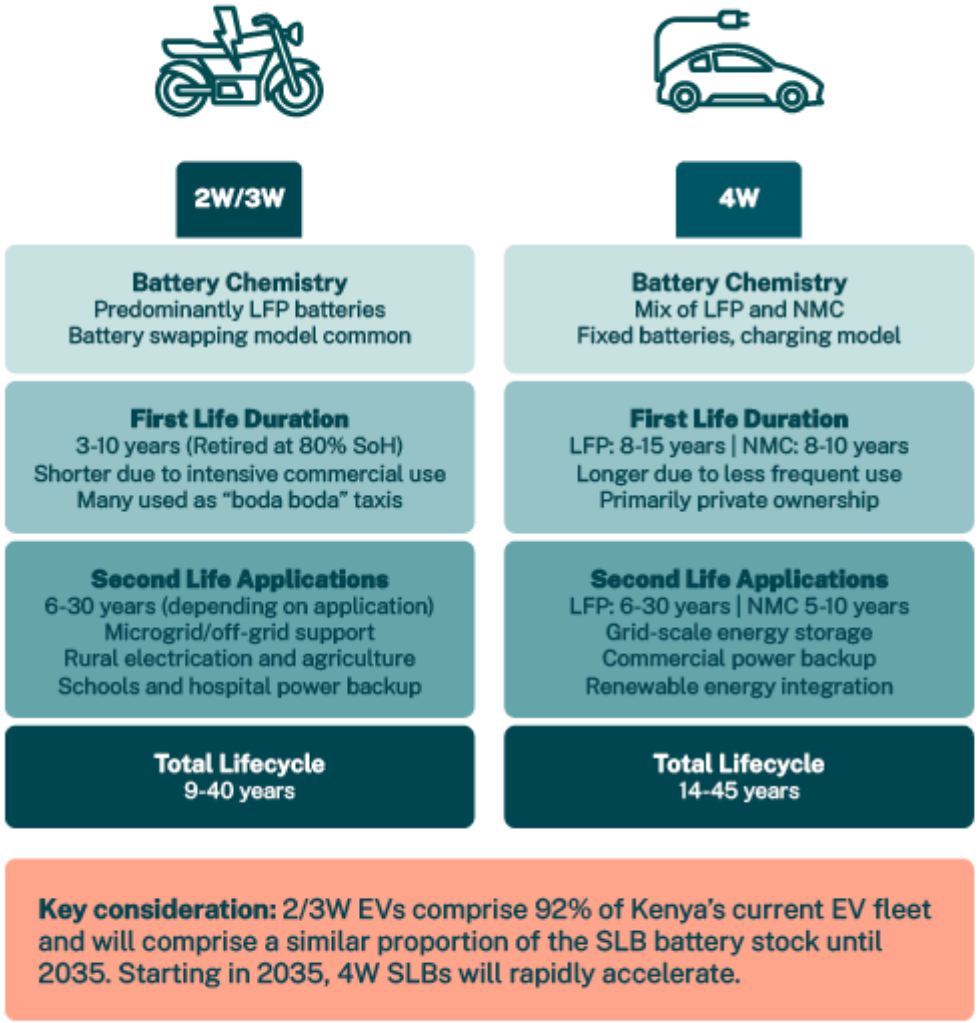
Repurposing represents a significant opportunity for Kenya to unlock the USD 8.9 billion / KESS 1.2 trillion in residual value contained in SLBs, but it also serves a strategic role.

Second Life EV Battery Residual Value

Estimated value of second life batteries being retired each year, 2025-2050



The long potential second life of batteries (6-30 years depending on the chemistry, initial SoH, and application), buys Kenya crucial time to build recycling facilities and accumulate a large enough stock of retired batteries for those facilities to be commercially viable investments. Additionally, an initial focus on developing a workforce for SLBs will prepare Kenyans to easily participate in recycling job opportunities once those become available.



Key Pathways for Repurposing

EV batteries with SoH lower than 80% are no longer suitable for the high demands of vehicle traction, so their second life pathways will be focused on applications that are less demanding and require fewer charging cycles per year (e.g. low-speed vehicles, communications base stations, and stationary storage). Battery Energy Storage Systems (BESS) in particular have proven to be the most profitable and practical pathway, and research has shown that government, light industrial, and commercial BESS applications that use LFP batteries provide the greatest total profit for second life applications due to LFP's longer lifespan and higher efficiency compared to nickel manganese cobalt (NMC) and other chemistries.[15]

A BESS is a system that stores electrical energy, typically in the form of batteries, and releases it during high demand periods. A BESS provides a number of important benefits, including grid stabilisation, renewable energy integration in activities that require energy reliability, backup power, reduced need for grid infrastructure, and peak shaving/load shifting (drawing energy from batteries during high demand to reduce costs).

The global BESS market is expected to grow by 21% annually through 2030 based on demand for renewable energy,[16] but BESS applications also play an increasingly important role in Kenya. Ninety percent of Kenya's electricity comes from renewable sources (20% from solar and wind), and the government has engaged in an aggressive electrification initiative through the Rural Electrification and Renewable Energy Corporation (REREC), which aims to achieve 100% electrification by 2030. These national electrification goals and the high levels of solar and wind energy in the national energy mix mean that there will be many potential customers for BESS systems in a variety of Kenya's business sectors.

Solar Home Systems

Solar home system (SHS) companies provide standalone solar home systems and lanterns to households without grid access. These companies are increasingly integrating larger battery storage capacities to enable customers to power more appliances and extend usage hours. There were USD 3.8 billion in systems sales globally in 2023 — including a 117% Compound Annual Growth Rate for solar water pumps in Kenya from 2019-2022 — suggesting a strong opportunity in this customer segment for used 2W/3W

[15] Ma R. et al. (2024). *Pathway decisions for reuse and recycling of retired lithium-ion batteries considering economic and environmental functions*. Nature Communications, 15.

[16] Nsitem N. (2024). "Global Energy Storage Market Records Biggest Jump Yet". Bloomberg NEF.

EV batteries whose energy profiles are well suited for these small scale applications.[17] Major players include Bboxx, which recently secured a USD 20 million investment to expand to Kenya, and d.light, which offers SHS solutions throughout Kenya. Public and public-private off-grid solar initiatives include REREC's rural electrification initiatives and the World Bank funded Kenya Off-Grid Solar Access Project (KOSAP), which aims to electrify 14 remote and traditionally underserved counties that represent 20% of the population.

Microgrid/Minigrid Operators

Microgrid operators — another important part of the off-grid solar market — deploy local electricity generation systems that can operate independently from Kenya's national grid, particularly in rural and underserved areas. These operators require reliable energy storage solutions to balance intermittent renewable generation and provide consistent power to their customers. Examples include PowerGen Renewable Energy, which operates microgrids across Kenya and other East African countries, and Powerhive, which serves western Kenya with solar-powered microgrids and electric motorcycles using a battery swapping model. In the public sector, both REREC and KOSAP include microgrids in their proposed solutions for rural electrification. Committed funding for microgrids and minigrids exceeded USD 2.5 billion globally in 2023, and the share of solar systems in this market increased from 14% to 59% between 2018 and 2024, so there will likely be a strong demand for batteries in this sector.[18]

Municipalities, Universities, Schools and Hospitals

Kenya's many municipalities, universities, schools and hospitals (collectively referred to in some countries as the "MUSH" sector) face persistent power reliability challenges that impact essential services. These institutions increasingly deploy BESS to ensure continuous operations during outages and reduce electricity costs through peak shaving. Examples include Strathmore University in Nairobi, which integrated a solar system with a BESS, Kenyatta National Hospital, which has implemented backup power systems for critical systems such as its oxygen plant, and Top Care Nursing Home, a hospital on the outskirts of Nairobi that was able to maintain power during Kenya's record nationwide power blackout in August 2023 via a solar BESS. The Clinton Health Access Initiative and Swedish International Development Cooperation Agency have been active in

[17] ESMAP. (2024). *Off-Grid Solar Market Trends Report 2024*.

[18] Sustainable Energy for All (2024). *State of the Global Mini-Grids Market Report 2024*.

funding similar installations for hospitals across Africa, so this segment could provide reliable customers for companies who are scaling or building niche products using larger SLBs. Kenya currently has 230 hospitals, 68 universities, and over 93,000 schools that could be served by the SLB market.

Charging Infrastructure Providers

Charging infrastructure providers are establishing networks of charging stations to support Kenya's nascent electric vehicle market. Battery storage enables these operators to manage grid constraints, reduce peak demand charges, and provide charging services in areas with unreliable grid connections. Examples include KPLC's pilot EV charging stations in Nairobi and its partnership with Swedish-Kenyan EV technology company Roam. Second life applications in charging infrastructure are already being explored in other parts of the world, including the Second-life Battery in Mobile EV Charging Application for Rural Transportation project in the US[19] and the startup Voltfang in Germany.[20] The EV charging infrastructure market in Kenya is at an early stage but is poised to grow rapidly, particularly in a scenario with higher levels of EV adoption across all vehicle types, so this customer segment could benefit both offtakers repurposing SLBs and Kenya's broader e-mobility goals.

Telecommunications Companies

Telecommunications companies in Kenya require reliable power for their extensive networks of cell towers and communication infrastructure, particularly in off-grid and weak-grid areas. Integrated into a mobile telecommunications tower, a BESS can provide backup power, reduce diesel consumption, and lower operational costs. Examples include Safaricom, which has implemented hybrid power solutions including BESS for many of its towers, and Airtel Kenya, which is transitioning towers to cleaner energy systems.

Agricultural Applications

According to the Central Bank of Kenya, the agriculture sector accounts for 20% of GDP and employs over 40% of the total population, including more than 70% of the rural population. As the agricultural sector modernizes and adopts more clean energy and labor saving technologies, it will drive demand for BESS in rural locations. Agricultural applications for battery storage in Kenya include powering irrigation systems, cold storage facilities, and processing equipment. BESS helps farmers extend productive hours, reduce post-harvest losses, and decrease reliance on expensive diesel generators. Examples include

[19] Virginia Clean Cities. (2024). *SMART: Second-life Battery in Mobile EVCharging Application for Rural Transportation*.
[20] Peters A. (2024). "This startup uses old EV batteries to power new charging stations". FastCompany.

SunCulture, which provides solar-powered irrigation systems with battery storage to Kenyan farmers, and Solar Freeze, offering solar-powered cold storage solutions.

Source: IWMI/Jeffery M Walcott

Kenya Electricity Generating Company (KenGen)

KenGen is 70% government owned and owns and operates ⅔ of Kenya's installed electricity capacity. KenGen has also been designated as the implementing agency for Kenya's BESS project within the World Bank-funded Kenya Green and Resilient Expansion of Energy (GREEN) program. The project aims to store excess energy from geothermal plants and address grid instability arising from intermittent power sources, with pilot installations being considered for several key regions including Central Rift, Coastal Region, Mount Kenya, Nairobi, North Rift, and Western Kenya. KenGen's market dominance and purchasing power could make it a critical partner for SLB pilot projects and startups in need of reliable customer revenue, however KenGen's BESS project might require larger capacity 4W EV batteries, which will not be available in the second life market in larger quantities until 2030.

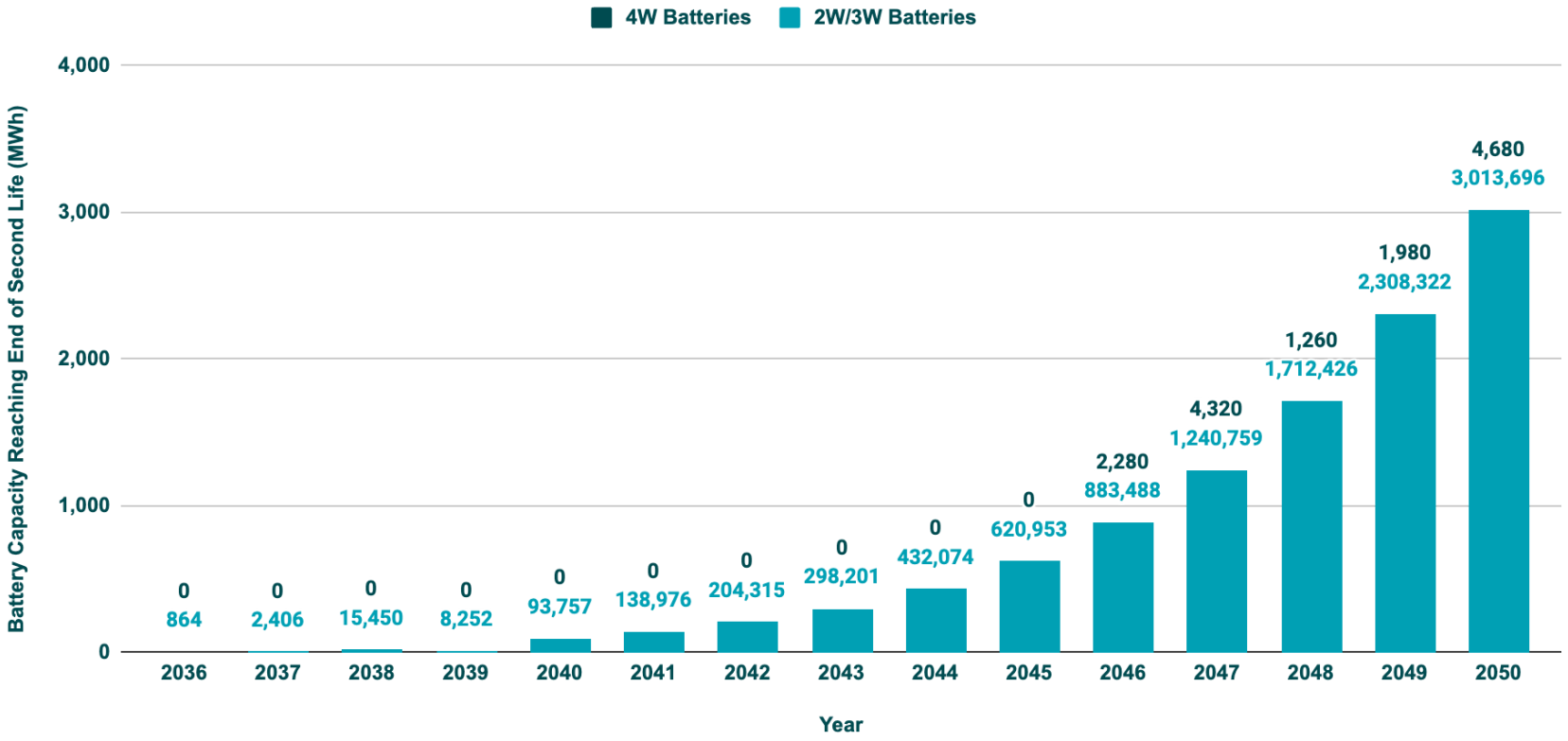
Commercial and Industrial Solar

The Commercial and industrial (C&I) sector represents only 5% of Kenya Power and Light's customer base, yet the largest 6,000 of these customers are responsible for 60% of national power consumption. These businesses face significant energy reliability challenges and high electricity costs that impact operations and profitability, so they are beginning to deploy solar systems with BESS to ensure business continuity during outages, reduce peak demand charges, and integrate renewable energy systems. Examples include Bidco Africa, which implemented a 1.2MW solar system at its facility in Thika, and major cement producer Bamburi Cement (Kenya's second-largest electricity consumer), which recently built two solar power plants to provide 30% of its total electricity. The C&I market is a significant opportunity for both 2W/3W and 4W SLBs, which can be

aggregated to create right-sized storage systems while offering an economical alternative to new battery systems for C&I customers concerned with their bottom line. Whatever the pathway, it's important to note that **specific second-life pathways for SLBs should be chosen for each battery type based on its specifications**. Not every battery will be ideal for every use case.

End of Second Life: Battery Capacity to Recycle

99.8% of end-of-second-life battery stock to be recycled will be from 2W/3W EVs in 2050. LFP is the dominant chemistry in these batteries.



Recycling

While the immediate priority should be extending the first and second lives of EV batteries through repair and repurposing, it is also important to consider the eventual end of life for EV batteries. Only about 121 MWh of SLBs will have reached the end of their second life by 2030, but this will accelerate to approximately 3 GWh per year by 2050, so it is imperative to begin planning for recycling as part of the future value chain in Kenya and in the region.

Types of Recycling For EV Batteries

EV batteries are recycled using three main processes: **pyrometallurgical** (smelting), **hydrometallurgical** (leaching), and **direct recycling**. Pyrometallurgical uses high heat to recover metals, while hydrometallurgical uses chemical solutions to leach out metals. Direct recycling — the newest, most profitable, but least common method — aims to recover and reuse battery components, like cathode and anode materials, without significantly altering their chemical structure or morphology.

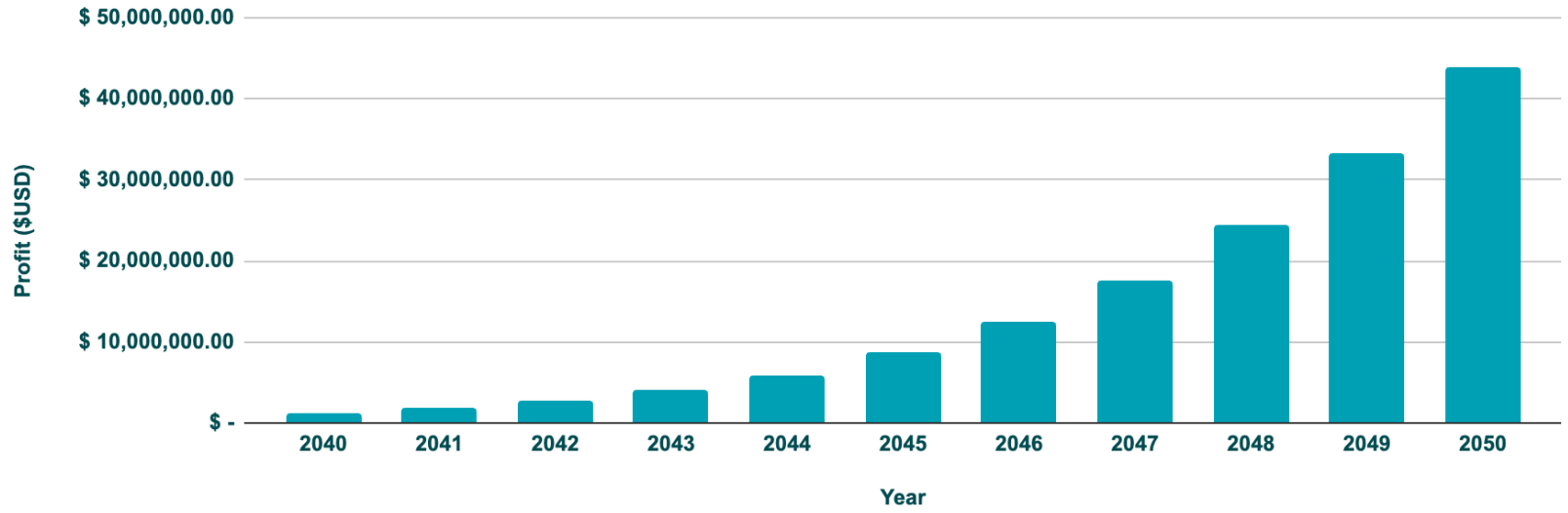
Source: Argonne National Laboratory

Financial Returns of Recycling

In a scenario with strong EV adoption, the recycling market in Kenya will represent a significant economic opportunity in the 2040-2050 timeframe, with annual profits of approximately USD 44 million / KES 5.7 billion by 2050. Though hydrometallurgical and pyrometallurgical recycling are currently unprofitable in many locations due to the high cost of transporting used batteries to the world's limited number of recycling facilities, profitability is expected to increase as more recycling facilities come online and new technologies reach commercial scale. Direct recycling of lithium batteries has proven to be far more profitable than other recycling technologies but is not yet widespread.[21]

Recycled EV Battery Profit Per Year

Direct recycling only, 2040-2050 (undiscounted)



[21] Ma R. et al., *Pathway decisions for reuse and recycling of retired lithium-ion batteries considering economic and environmental functions.*

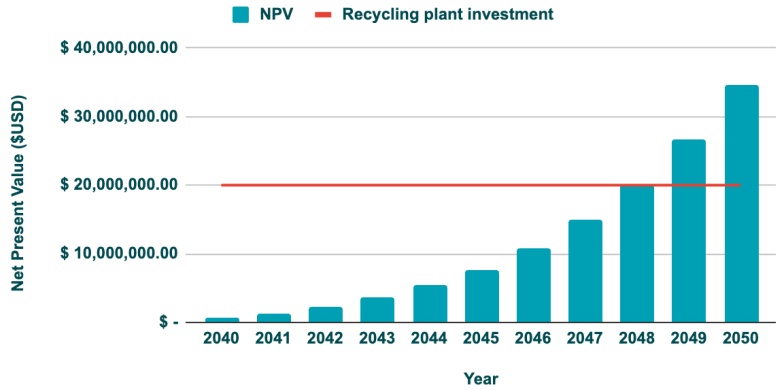
Projected shortfalls in global lithium, nickel, and cobalt supply by 2035 may also result in higher critical mineral prices, which will positively impact recycling profitability.[22] At the same time, these shortfalls may impact the price of new batteries, making EVs less affordable, slowing adoption, and pushing the need for recycling further into the future. Low mineral prices, by contrast, make batteries more affordable and increase adoption but may make recycling unprofitable. This tension between how battery prices impact the first life market and second life market in different ways is a key challenge for the market as a whole.

Investment decisions for recycling infrastructure will need to be made in the mid 2030s to ensure that recycling plants are operational by 2040. Assuming a USD 20 million investment for a small recycling facility with the capacity to recycle 1GWh-2GWh of battery capacity per year, the project would achieve payback of the initial capital investments by 2048 for investments made in 2030, potentially sooner if accumulated batteries from other countries in the EAC can be aggregated. The challenge of spinning up a recycling plant earlier than 2040 is that there will not be enough accumulated battery material to keep the plant operating at optimal capacity.

[22] International Energy Agency, *Global Critical Minerals Outlook 2024: Outlook for key minerals*.

Net Present Value of EV Battery Recycling

Direct Recycling Only, 2040-2050. Discounted to 2030.



Other Benefits of Recycling

Proper EV battery recycling can reduce demand for virgin minerals, which reduces the need for environmentally damaging mining operations while also limiting economic outflows and providing greater resource security for Kenya with respect to minerals that it does not mine itself. EV battery recycling is also a potential engine for job creation, with the potential to create a large number of sustainable jobs spanning collection, transportation, disassembly, testing, mechanical processing, and materials recovery roles. Finally, the environmental benefits of recycling are huge. RMI estimates that recovering all of the lithium, cobalt, and nickel from end-of-life EV batteries worldwide would result in an economic savings of up to USD 25 billion per year by 2040, and could avoid

approximately 16 megatons of CO_2 emissions annually.[23] In Kenya, just the lithium carbonate equivalent contained in the SLBs that will be at the end of first or second life in Kenya by 2050 represents approximately USD 132 million / KES 17 billion in social and environmental benefit compared to traditional lithium mining.[24]

Strategic Approach to Recycling

Kenya and the other members of the EAC should take a strategic approach to recycling to spread out the capital requirements, create shared value across the regional value chain, and **ensure that commercial scale recycling is in place by 2040 at the latest.**

Phased Implementation

Commercial recycling infrastructure does not have to be developed all at once. It can be developed in stages aligned with accumulated battery volumes.

- 2025-2030: Collection and safe storage infrastructure
- 2030-2040: Pre-processing capabilities (dismantling, sorting)
- 2040-2050: Commercial scale recycling, advanced material recovery providing resources to local/regional battery manufacturing

Regional and Cross-Sector Cooperation

Kenyan stakeholders should explore EAC partnerships to achieve economies of scale in recycling infrastructure, allowing specialised facilities to serve multiple countries and even multiple sectors. It will not make economic sense for Kenya to develop large-scale recycling prior to the late 2030s, however the aggregate recycling volume across countries and industries may justify the co-development of a regional recycling facility earlier than 2040, with costs shared across participating EAC countries.

[23] Buzwani M. and Mohanty S. (2024). "Understanding How EV Battery Recycling Can Address Future Mineral Supply Gaps." Rocky Mountain Institute.
[24] Buzwani M. et al., "Battery Recycling: How Accounting for Social and Environmental Benefits Boosts Returns".

The newly created Dongo Kundu Special Economic Zone in the port of Mombasa[25] could provide an ideal location for a regional recycling facility, given its terrestrial transport connections to major regional urban centers, ocean transport connections to foreign ports, and significant tax advantages that will bring down costs.

Develop Key Customer Segments Across Sectors

Cross-sector connections will need to be built to allow recyclers to find offtakers for all of their outputs and create a truly circular economy. To this end, recyclers and industry associations should work to establish linkages between recycling operations and:

- **Local manufacturing**, where recycled materials could supply domestic battery production and manufacturing scrap could serve as additional inputs for recyclers.
- **Construction industry**, where non-recoverable components could be used as additives in construction materials.

Enabling Infrastructure

- **Collection networks:** Leverage existing e-waste collection systems while developing battery-specific processes that maintain cell integrity and safety. Collection networks for batteries at the end of their first life can be used for post-second life collection as well.
- **Safety protocols:** Implement specialised handling guidelines for damaged or degraded batteries that pose higher risks during transportation and storage. These standards may differ from the standards required at the beginning of first life or beginning of second life.
- **Technology transfer:** Partner with established international recycling firms to accelerate technology adoption while developing locally appropriate solutions.

[25] Dongo Kundu Special Economic Zone

Scenario Planning for an Evolving Market

As with all nascent markets and new technologies, there are a host of complexities that make the future dynamics of the EV market and related battery repurposing and recycling markets difficult to predict. The scenario planning exercise included in this section is designed to help stakeholders assess the ways in which Kenya's EV battery market could take shape in the near future.

Scenario planning is a strategic process that enables organisations and policymakers to prepare for alternative future states by examining how different forces might shape their operating environment. Rather than attempting to predict a single outcome, **scenario planning creates multiple plausible narratives about the future that help stakeholders identify risks, opportunities, and strategic options.** This approach is particularly valuable in environments characterised by high uncertainty and rapid change, allowing decision-makers to develop more robust and adaptive strategies.

In the following scenario planning exercise, a list of key factors that influence the direction of the EV battery market in Kenya were identified. Two factors deemed to have the greatest influence were selected as axes for the scenarios:

1. **The price of EV batteries**, which determines EV affordability and adoption as well as the profitability or repurposing and recycling
2. **The level of battery market ecosystem support**, which determines development of the market

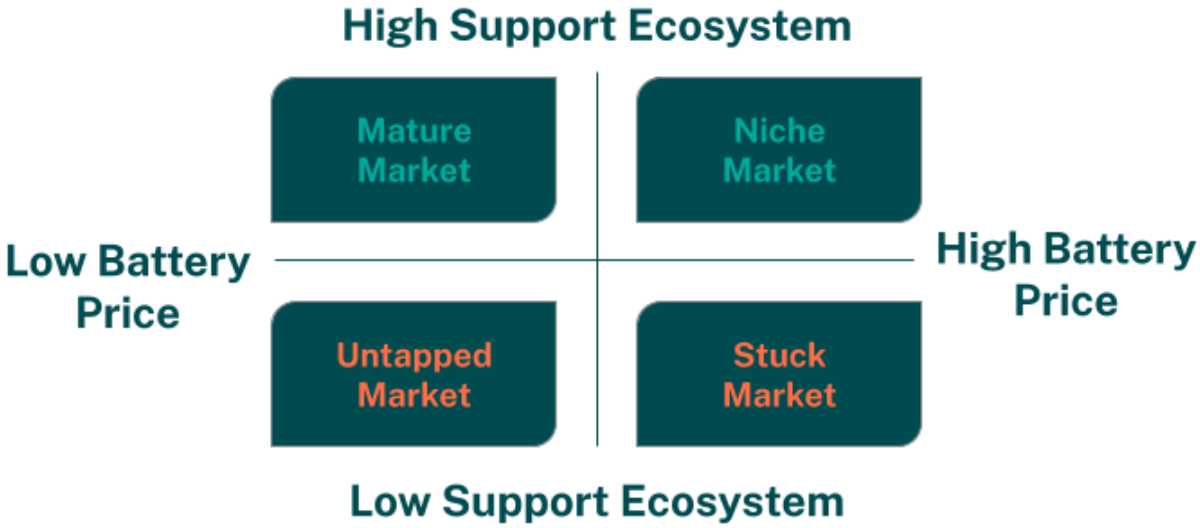
To create a four scenario framework (below), EV battery prices (high price vs. low price) are placed along the x-axis and battery market ecosystem (high support vs. low support) is placed along the y-axis.

Price of EV Batteries

The two sides of the x-axis comprise a relative estimate of low battery price and high battery price in the marketplace. Low battery price is defined as batteries that can be sold at the same price or lower than a similar internal combustion engine. High battery prices are defined as batteries that are more often sold at a level higher than a similar internal combustion engine. Today, batteries would fall into the “high battery price” category. However, as battery technology improves and the EV market grows, prices should fall closer to the low battery price scenarios.

Supportive vs. Unsupportive Ecosystem

The vertical axis depicts the development of the market ecosystem surrounding first-life EV use as well as second-life repurposing and eventual recycling of EV batteries (from unsupportive to supportive). This axis encompasses factors such as policy regarding EVs and SLB use, battery collection and remanufacturing infrastructure, workforce development, consumer sentiment toward EV batteries in first and second life stages, and the financial and investment landscape in this market.



These two axes represent critical uncertainties that create four distinct quadrants, each describing a possible future scenario. However, there is a singular takeaway that should be noted when considering the four scenarios: **Kenyan market participants are generally only able to directly control what happens on the y axis**. While battery prices will play a large role in shaping the SLB and recycling markets, market ecosystem development will be the single most important tool that Kenya can use to move from one scenario to another.

By examining these four scenarios in detail, we can better understand the potential pathways for Kenya's second-life EV battery market development, identify early indicators of which scenario might be emerging, and highlight strategic opportunities within each possible future. This framework provides Kenyan policymakers, NGOs, businesses, and other stakeholders with a structured approach to navigate the complexities and uncertainties of the emerging EV battery ecosystem.

Scenario 1: Stuck Market

Scenario Description

High battery prices, unsupportive ecosystem

This scenario is characterised by little to no second-life EV battery market activity due to high battery prices and an unsupportive ecosystem. Limited EV adoption results in scarce battery supply, while innovation remains fragmented. The workforce lacks key skills and development opportunities, restricting market growth. Business opportunities are confined primarily to B2B transactions in informal sectors, leaving Kenya behind international competitors and unable to capitalize on EV battery recycling and repurposing potential.

Key Indicators

- Low EV adoption rates with corresponding limited battery supply, weak repurposing infrastructure, and no recycling infrastructure
- Lack of political will to create and implement policies
- Fragmented innovation landscape without coherent direction
- Limited investments and financial products for supply and demand sides
- An underdeveloped workforce lacking specialised skills and failure to attract or develop a critical mass of skilled EV battery technicians and innovators within Kenya
- A small number of SLB entrepreneurs focused primarily on commercial customers — very few individual consumers purchasing SLB products
- Kenya falling behind external players in meeting international standards

Market Opportunities

- Small-scale B2B battery applications
- Public-private partnerships to reduce costs and create supportive policies
- Niche financial products, but with high interest rates or uncompetitive terms

Action Items

- Consumer education and awareness initiatives
- Workforce training and development programs
- International cooperation to accelerate knowledge transfer and capacity building
- Strengthening industry voice through industry associations

Scenario 2: Untapped Market

Scenario Description

Low battery prices, unsupportive ecosystem

This scenario represents a transitional market where EV adoption is increasing but the ecosystem remains unsupportive. Battery supply is growing as lower EV prices drive EV adoption, yet policy limitations and technical skill gaps are preventing the development of repurposing and recycling operations. Innovation exists but entrepreneurs struggle with scalability and profitability challenges. Without proper intervention, Kenya risks becoming a dumping ground for an increasing supply of used batteries that have no viable end-of-life pathways, creating environmental and health risks rather than economic opportunities.

Key Indicators

- Increasing EV adoption with growing battery supply
- Limited financing options for recycling operations
- Technical skill shortages in battery recycling and repurposing
- Innovation initiatives struggling to scale profitably
- Rising concerns about improper battery disposal
- International players viewing Kenya as a potential disposal location

Market Opportunities

- Small to medium recycling operations with growth potential
- Battery safety and handling services
- Environmental impact assessment and monitoring services

Action Items

- Consumer and workforce education programs
- Technical training partnerships with international organisations
- Development of inclusive policy for cross-border movement of batteries supporting regional aggregation

Scenario 3: Niche Market

Scenario Description

High battery prices, supportive ecosystem

This scenario represents a specialised market with high battery prices but a supportive market ecosystem. Despite more limited EV adoption and battery supply due to high battery prices, the market has developed focused B2B applications for SLBs. Recycling infrastructure exists but is centralised and limited in scale. B2B SLB transactions for battery energy storage systems thrive, particularly among municipalities, universities, schools, and hospitals, while consumer markets remain underdeveloped. The workforce is well developed through training programs and incentives, but job growth is constrained by limited demand.

Key Indicators

- Limited EV adoption but optimised use of available batteries
- Presence of centralised but limited recycling infrastructure
- Thriving B2B transactions with public sector institutions
- Underdeveloped business-to-consumer market
- Trained and incentivised workforce with specialised skills
- Demand constraints limiting job creation

Market Opportunities

- High-value B2B applications for second-life batteries
- Specialised services for public sector institutions such as municipalities, universities, schools, and hospitals

Action Items

- Workforce development programs focused on specialised battery skills
- Education initiatives to prepare for future market maturation
- Policy advocacy and incentives to promote EV adoption

Scenario 4: Mature Market

Scenario Description

Low battery prices, supportive ecosystem

This scenario is characterised by a fully developed market with low battery prices and a supportive market ecosystem. High EV adoption has created a rapidly increasing battery supply. Recycling operations have become cost-effective, while repurposing applications pursue innovation and automation to better compete with the decreasing prices of new batteries. The market requires a large workforce of battery specialists, creating significant employment opportunities. The ecosystem efficiently manages the full life cycle of EV batteries with strong policy support.

Key indicators

- High EV adoption rates with rapidly increasing battery supply
- Cost-effective recycling operations at scale
- Innovation projects in SLB applications to remain competitive with falling new battery prices
- Large workforce demand in the battery sector
- Well-established battery specialist job market

Market opportunities

- Large-scale recycling infrastructure development and operation
- Second-life stationary storage applications and services
- Research and development for novel battery repurposing applications
- Export of expertise and services to neighboring countries at earlier market stages
- Novel opportunities in secondary materials from recycling

Action items

- Invest in large-scale recycling infrastructure
- Specialised workforce training and certification programs
- Policy development to support innovative second-life applications
- Ramp up enforcement of extended producer responsibility (EPR)

This scenario planning framework provides a structured approach to understanding how Kenya's second-life EV battery market might evolve under different conditions, allowing stakeholders to identify appropriate strategies for each potential future state. Ultimately, it is important to underscore that regardless of the fluctuation of EV batteries in the marketplace, **the opportunity for an EV SLB market to take shape will largely depend on the level of support the market receives from interested stakeholders**.

Developing a Circular Economy for Batteries

The stakeholders in Kenya's EV market will need to take concerted steps to develop a best-in-class **circular economy ecosystem** for EV batteries in order to avoid the stuck market and untapped market scenarios and unlock the economic, environmental, and social benefits of the niche and mature market scenarios.

Critical components of the enabling ecosystem for this circular economy include:

- A reliable customer base and mechanisms to ensure customer confidence in SLBs
- A skilled workforce with access to technical infrastructure and trained in best-in-class battery management standards and practices
- Supportive and consistent policies
- Access to capital

Energizing the Customer Base

The customer ecosystem for second life batteries comprises two broad categories of customers:

- **Offtakers** of EV batteries from the first life and second life owners (e.g. companies focused on repurposing). **They are a key pivot point in the circular economy, ensuring that value stays in the loop**.
- **End customers** of the offtakers' repurposed or recycled products. They may buy these products outright or subscribe to or purchase "products-as-a-service" (PaaS), as in battery-swapping models. Because the market is circular, they might also eventually serve as suppliers to offtakers further downstream (e.g. recyclers).

Though current EV adoption is low in Kenya, it is critical that key stakeholders begin working now to nurture the demand side of the market to position Kenya for success. **Without sufficient demand to meet the anticipated supply, the circular economy will not be able to develop.**

In addition, there are other critical customer ecosystem participants such as policymakers, certification authorities, financiers, and others who help establish

trust among market participants or provide incentives and financing to these customer groups.

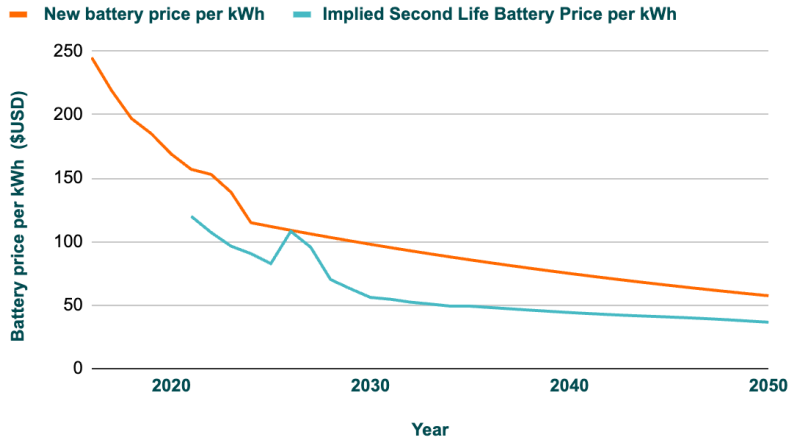
Supporting Offtakers in The Early Market

SLB offtakers are pivotal intermediaries in the market ecosystem, serving as both customers for first-life battery owners selling their used batteries and as suppliers for companies developing second-life applications.

SLB offtakers provide critical collection, testing, and refurbishment infrastructure that enables responsible battery transitions between use phases. Examples of offtakers currently active in the Kenyan market are Enviroserve Kenya, the WEEE Centre, Acele Africa, Ecomobilius, and a variety of small scale operators (detailed profiles can be found in KeEBI's Baseline Report).

These companies face a strategic pricing dilemma: higher global battery prices enhance the value proposition of SLBs compared to new batteries but increase input costs, while lower global battery prices reduce input costs but threaten competitiveness against new batteries that customers might perceive as safer and of higher quality. This dynamic shapes market scenarios — higher battery prices will lead offtakers to focus on niche markets featuring fewer, higher-value products for institutional customers, while lower battery prices will drive offtakers to innovate in order to compete with new batteries. Innovation, in turn, will enable mature markets with diverse, lower-priced options for a broader customer base.

Lithium Ion Battery Price Per kWh
2016-2050



In both scenarios, SLB offtakers face the risk that repurposed SLBs will not be cost competitive with new batteries. SLB prices can generally be expected to move in tandem with new battery prices; similarly, the price that SLB offtakers pay for used batteries as inputs can be expected to be lower than the price of new

batteries due to the lower initial SoH of SLBs. However, other costs of repurposing batteries — labor, testing/certification, transportation, new battery management systems, etc — could cause the price gap between finished SLBs and new batteries to narrow if the ecosystem to provide these other inputs is not developed.

To ensure that the ecosystem of offtakers takes root, market stakeholders should focus on key interventions to de-risk the early market for these entrepreneurs.

Stimulating Market Demand

Creating reliable customer channels will provide revenue certainty for SLB companies and help them develop sustainable business models. Key interventions might include:

- **Public procurement policies** that require government entities or parastatal entities such as Kenya Power and Lighting Company to prioritize energy storage solutions using SLBs.
- **End-user subsidies** for businesses and households that purchase energy storage systems made with SLBs.
- **Demonstration projects** in high-visibility applications like healthcare facility backup, telecom tower support, or rural electrification to drive public awareness and confidence.

Coordinating the Battery Supply Chain

Supply-side constraints could create problems for SLB companies, particularly in the early stages of the market. Mechanisms to ensure a predictable supply of usable batteries will reduce sourcing uncertainties and help offtakers accurately value and process incoming batteries.

Battery passports such as the Global Battery Alliance's Battery Passport[26] and the battery passports required in the EU Battery Regulation[27] are digital tracking systems that record battery provenance, performance history, and refurbishment details and help offtakers assess used batteries so that they can direct them to an appropriate second-life application. To support the development of the SLB market, Kenya's regulatory bodies should require all imported EVs and locally produced EVs to participate in such a system.

Coordinated collection networks should be developed to connect Kenyan and regional EV fleet operators, dealerships, and importers with SLB offtakers. These could be public-private partnerships, with private

[26] Global Battery Alliance. (2024). *Global Battery Alliance Battery Passport: An Overview*.
[27] Centre for European Policy Studies. (2024). *Implementing the EU Digital Battery Passport*.

companies providing the collection infrastructure and the government providing incentives and payments for battery owners to properly dispose of their batteries.

Ensuring Customer Trust and Safety

Even with adequate supply and demand, SLBs face a challenge in the market due to public perceptions of lower quality and higher safety risk compared to new batteries, so it will be critical to establish high levels of trust between buyers and sellers in the SLB market. The initial offtakers must have faith in original equipment manufacturers' product quality and trust that first life operators are selling them quality batteries that have been properly maintained throughout their first life. End customers, in turn, must have confidence that the SLBs they buy from offtakers have been properly inspected, repaired, and retrofitted to ensure safe operation and a long useful life.

Safety and Quality Standards

SLB manufacturers and industry regulators should align with established and emerging international standards. These standards can be developed by Kenya Bureau of Standards (KEBS) in partnership with the East African Standards Committee (EASC) and the African Continental Free Trade Area (AfCFTA) to ensure that they support the development of regional cross-border repurposing and recycling markets while incorporating both international best practices and local conditions such as climate (higher ambient temperatures), available testing infrastructure, and workforce development. Kenya's leadership in bringing these standards to the AfCFTA level could help unlock the benefits of e-mobility and EV battery repurposing and recycling for the 1.3 billion people who live in the world's largest free trade area.

Standards that should be developed include:

- **Standardised testing protocols and grading systems** to assess the quality and remaining capacity of used batteries. These protocols and systems will need to be adapted to usage profiles in Kenya and East Africa where higher ambient temperature may impact battery performance and longevity.
- **A tiered risk assessment framework** based on battery characteristics such as remaining capacity (SoH), chemistry, manufacturer, age, physical condition, and usage history (if known). This risk framework can allow batteries to be routed to their best possible second life use or redirected to recycling facilities if there is no viable and safe second-life use.
- **Installation guidelines** for different second-life application types (residential, commercial,

agricultural, telecom, etc.) with emphasis on thermal management in East Africa's specific climatic conditions.

- **A legal liability framework** that establishes clear guidelines on liability distribution between original equipment manufacturers, first-life owners, refurbishers, installers, and end-users to provide legal certainty.

Existing Standards

There are a number of existing international standards from the International Electrotechnical Commission (IEC) that can be adopted directly or used to inform the creation of locally-adapted safety standards. Since 2022, KEBS has been a National Certification Body of the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE),[28] and IEC's Global Impact Fund has been active in providing direct funding to SLB pilot projects in Kenya's off-grid solar sector.[29] Because of this deep existing relationship with IEC and IEC's influence in countries that supply Kenyan markets, standards development for Kenya's SLB market should be grounded in standards that IEC has already developed.

[28] Mouyal N. (2023). "Spreading the IECEE gospel in Africa." e-tech: News & Views from the IEC.
[29] International Electrotechnical Commission. (2024). "Transforming old batteries into new resources to improve lives in Africa"

IEC 63330-1: This standard provides general requirements for repurposing of cells, modules, battery packs, and battery systems that are originally manufactured for other applications such as EVs.

IEC TR 63330-2: Scheduled to be published in July 2026, part 2 of the 63330 series covers the classification of batteries to be repurposed and safety and performance estimation methods.

IEC 63338: This standard provides general guidance on reuse and repurposing of lithium ion and nickel-metal hydride cells and batteries after extraction from the application for which they were first placed on the market.

IEC 62933-4-4: This standard describes environmental issues when reused batteries are considered for a BESS (Battery Energy Storage System).

IEC 62933-5-3: This standard may be relevant to Kenya's SLB market as it pertains to safety requirements for "non-anticipated modifications" of electrical energy storage systems, e.g partial replacement, changing application, relocation, and loading a reused battery.

Related standards in the North American and Latin American markets are UL 1974, which focuses on sorting, grading and application-specific requirements

of repurposed battery packs, and UL 3601, a standard being developed to measure and report circularity of lithium-ion and other "secondary" (i.e. rechargeable) batteries.

Certifications

Third-party verification: Establish independent testing laboratories authorised to certify SLBs, potentially through partnerships with institutions like KEBS, Kenya Accreditation Service, Kenya Industrial Research and Development Institute, and the Strathmore University Energy Research Centre.

Technician certification program: Create a standardised training and certification program for technicians handling second-life batteries so that customers can have confidence that everyone who handled their SLB during its life cycle was properly trained. Collaborate with other sectors that handle used batteries and with local battery manufacturers to ensure that the certifications are integrated throughout the value chain and promote cross-sector workforce mobility.

Warranties and Insurance

Performance guarantees: SLB manufacturers may be hesitant to issue warranties on their batteries, which may compound trust issues and create additional barriers for customers, particularly institutional customers with strict procurement rules and quality standards. To address this, implement industry-backed performance guarantee funds that can compensate customers if batteries fail to meet minimum performance standards. Require all SLB providers to issue warranties backed by these funds.

Specialised insurance products: Government regulatory bodies and industry associations can partner with insurance providers to develop coverage for:

- Property damage from battery incidents
- Business interruption for commercial applications
- Extended warranties for refurbished systems

These insurance products can leverage the standardised risk assessment and legal liability frameworks mentioned previously in this section.

Powering the Pipeline: Building a Workforce for Battery Second Life

As Kenya heads toward a greener, more electrified future, a unique opportunity is emerging — not just to power homes and vehicles with clean energy, but to power careers, communities, and innovation. The transition to renewable energy and e-mobility is creating a surge in demand for skilled technicians,

engineers, and entrepreneurs that offers Kenya an opportunity to design an entire technical ecosystem that puts local talent at the heart of a national transformation.

A skilled technical workforce isn't a side effect of the EV revolution. It's a battery to power growth. Imagine a future where solar installers are trained in each of Kenya's 47 counties, where young women from rural areas lead microgrid projects, and where battery technicians are just as essential to Kenya's economy as software developers. From hands-on training programs and mobile learning labs to cutting-edge public-private partnerships, the stage is set for a workforce that is not only future-ready, but globally competitive.

The time to invest in workforce development is now, because a skilled and certified workforce will be essential for developing reuse and recycling value chains regardless of the market scenario. Below is a roadmap broken down into key areas to help Kenya develop a skilled and ready workforce to continue the charge ahead.

Identify Value Chain Opportunities

The first step of workforce development will be to identify the value chain opportunities, existing roles, and corresponding skill sets in the SLB ecosystem. Each of these roles will require different skill levels — from technical training to high-level engineering. A sample of value chain opportunities, corresponding roles, and skill sets is included in the table below as a starting point.

Value Chain Step	Roles	Skill Sets
Battery collection & testing	Battery Collection Technician, Battery Intake Coordinator, Field Logistics Operator	Safe handling, basic battery chemistry, diagnostic tools use, logistics coordination
Diagnostics & health assessment	Battery Diagnostic Technician, Battery Health Analyst, EV Battery Inspector	Battery testing tools, SoH/State-of-Charge (SoC) analysis, high-voltage safety, data interpretation

Battery disassembly & refurbishment	Battery Disassembly Technician, Cell/Module Refurbishment Specialist, Hazardous Materials Handling Operator	Mechanical disassembly, PPE use, cell/module inspection, basic electrical rework
Repurposing design	Energy Storage Design Engineer, System Integration Technician, Circular Product Designer	Systems engineering, CAD, solar integration, second-life performance modeling
Safety management	Battery Safety Officer, Environmental Health & Safety Manager, Hazardous Waste Compliance Specialist	Battery safety regulations, fire mitigation protocols, safety audits, standard operating procedure development
Installation & maintenance	Energy Storage Installer, Solar + Storage Technician, Mobile Service Mechanic	System installation, wiring and configuration, preventive maintenance, troubleshooting
Battery Management System (BMS) development	Embedded Systems Engineer, Battery Software Developer, Control Systems Technician	Microcontroller programming, Controller Area Network protocols, real-time monitoring, sensor integration

Develop Specialised Training Curricula

Kenya's educational institutions should develop specialised training curricula on topics such as electric vehicle fundamentals, battery systems and safety, diagnostics and maintenance, charging infrastructure, second-life battery use, and circularity. Curricula can be delivered using a tiered approach to address students of all skill levels and career stages.

Basic

Focus on youth, informal technicians, and mechanics, and offer short-term certifications through TVETs or community-based organisations with hands-on apprenticeship (e.g. "EV 101" mobile mechanic courses).

Intermediate

Target technicians, mechanics, and engineers, offering modular diploma or certificate programs (e.g. TVET battery and charging installation modules).

Advanced

Training for engineers and entrepreneurs that includes degree programs with lab work and industry internship (e.g. Bachelor in EV Systems or Battery Technology).

Cross-Cutting

Provide workshops, toolkits, and online courses for policymakers, NGOs, MSMEs, and entrepreneurs (e.g. battery policy training for county officials).

Kenya currently has a number of initiatives that support these different tiers of curriculum delivery, as outlined below.

Initiative	Format	Focus	Partners & Participants	Outcomes
Technical University of Kenya (TU-K) & Spiro Academy[30]	18-month graduate tech training programme and a one-year EV specialisation course	Hands-on training in EV systems, battery technology, and diagnostics	TU-K, Spiro Academy, and Fleming College	Curriculum development, internships, and industry-based learning for engineering students
AfricaNEV & Advanced Mobility Training[31]	Comprehensive e-mobility training hosted at Roam, an e-mobility company in Kenya	Hands-on experience with electric vehicles, including dismantling and reassembling EVs	Staff from KPLC, National Transport and Safety Authority (NTSA), insurance companies, and EV enthusiasts	Equipped participants with valuable skills and insights crucial for the development of sustainable electric vehicle practices across Africa.
Siemens Stiftung & German Agency for International Cooperation (GIZ) Human-Centered Design Training[32]	3-day immersive workshop on human-centered design principles for e-mobility	Product development and market research in the e-mobility sector	Professionals and entrepreneurs in Kenya's e-mobility scene	Cohort-based learning to facilitate peer exchange and collaboration among industry leaders

[30] The Technical University of Kenya. "Electric Vehicle Training to be Launched at TU-K".
[31] Kuhudzai R. (2024). "AfricaNEV & Advanced Mobility Conclude Successful E-Mobility Training Program in Kenya". CleanTechnica.
[32] Siemens Stiftung. Human-Centered Design Training in Kenya's E-Mobility Sector.

Encourage Public-Private Ecosystem Partnerships

Kenya can increase workforce development by encouraging public-private partnerships between government agencies and state-owned corporations (NITA, EPRA, NTSA, KEBS, Ministry of Energy, KPLC, KenGen, etc), private companies (EV makers, solar firms), NGOs, and international donors. These partnerships can:

- Fund training centers or "battery hubs."
- Subsidize skill development for youth and women.
- Define standards and licensing requirements for authorised practitioners.

There are a number of recent examples of cross-functional multi-stakeholder partnerships in Kenya and neighboring countries in the EAC.

DRIVe Project: The Developing Relevant and Innovative Vocational Skills in E-mobility (DRIVe) project is a joint intervention in Uganda by GOGO Electric and the GIZ WE4D and PREEEP programmes, commissioned by BMZ, in collaboration with the EU and NORAD, and implemented by GIZ.[33]

BasiGo's Electric Bus Initiative: BasiGo, a Kenyan electric bus company, has partnered with the government and private entities to promote electric public transportation. The company assembles electric buses locally and leases them to public service vehicle operators. In collaboration with Kenya Vehicle Manufacturers (KVM), BasiGo aims to produce and deliver 1,000 electric buses between 2024 and 2027.[34] Additionally, BasiGo has secured USD 42 million in funding to scale public transport electrification in sub-Saharan Africa.[35]

Spiro's Expansion and Partnerships: Spiro, formerly MAuto, is an African electric vehicle company headquartered in Nairobi. In 2024, Spiro launched a manufacturing center on Old Mombasa Road in Nairobi and partnered with asset financing company Watu Credit to enhance access to financing for electric motorbikes in Kenya. These efforts aim to reduce the continent's fossil fuel dependency by promoting e-mobility solutions.[36]

[33] GOGO. (2024). "DRIVe 2.0 kicks off with Intermediate level E-Mobility Trainings".

[34] P4G. *BasiGo - Practical Action*

[35] BasiGo. (2023). "BasiGo Secures $42M in Funding to Scale Public Transport Electrification in Sub-Saharan Africa".

[36] Equitane. (2023). "Watu and Spiro Transforming Electric Mobility in Kenya".

Train and Retain the Workforce

Employment for youth and marginalised groups is important across the entire Kenyan economy. Programs to increase inclusion for these groups in the circular battery economy could position these learners for career success in the future. Inclusion programs could include:

- Micro-grants or stipends for learners entering the field
- Recruitment from underserved communities using community-based organisations
- Mobile training units for rural areas where second-life battery use (e.g. solar home systems) is growing

Kenya already has a number of past and present train and retain programs, proving a solid foundation from which to build.

Vocational Training Voucher Program: Launched by Innovations for Poverty Action (IPA) Kenya in 2008, the VTVP provided vouchers to youth to cover the cost of vocational training. Over 2000 youth applied, and about half received vouchers to enroll in courses at 65 different institutions across the country.[37]

Dual Vocational Training Initiative: GIZ is assisting seven national training institutions in Kenya to upgrade to centers of excellence and pilot a dual (cooperative) vocational training model. This approach combines theoretical learning with practical experience, developed in collaboration with industry experts.[38]

SHOFCO's Technical and Educational Vocational Training: Shining Hope for Communities (SHOFCO) has launched a five-year program aiming to enroll 20,000 young people in technical and vocational training. Additionally, the initiative plans to provide business training and grants to nearly 50,000 women, addressing unemployment and promoting economic empowerment.[39]

Establish Standards and Certification for the Workforce

Standards and certifications will help Kenya build a trusted and safe workforce. This will require Kenya to:

- **Develop national standards** for worker qualifications and for operating procedures for SLB handling and reuse.

[37] Hamory J. et al. (2015). *Evaluating the impact of vocational education vouchers on out-of-school youth in Kenya*. 3ie Impact Evaluation Report 37. International Initiative for Impact Evaluation (3ie).
[38] GIZ. Introducing dual vocational training in Kenya.
[39] Rajvanshi A. (2023). "Kennedy Odede is Building Community Power in Kenya". Time Magazine.

- **Scale the Recognition of Prior Learning (RPL)** in alignment with the Kenya National Qualifications Framework (KNQF) to enable individuals with skills acquired outside formal education — such as artisans, gig workers, and informal sector professionals — to obtain nationally recognised certification to ensure that the next generation of workforce can meet safety standards and quality thresholds in the battery market.[40]
- **Develop technical training programs** like the Africa NEV Electric Vehicle Technician Training Program and the NobleProg Kenya EV Training Course.[41]
- **Incorporate e-mobility into TVET programs** by advocating for Kenya's Technical and Vocational Education and Training (TVET) authority to incorporate the technical skills required for e-mobility into national curricula. Key focus areas include battery management, electric powertrains, safety standards, and charging station installation. This will build foundational skills across mechanics, electricians, and energy technicians.
- **Advance design and entrepreneurship training** through offerings such as Siemens Stiftung's training program focused on human-centered design for professionals and entrepreneurs in Kenya's e-mobility sector. The program aims to enhance product development and market research skills, emphasizing user-centric approaches to create sustainable transport solutions.

Tap Into Global Knowledge and Technology Transfer

Kenya can drive local entrepreneurship and innovation by tapping into global knowledge and technology transfer through partnerships with countries already working on SLBs (e.g., China, Germany, India). This includes continuing to leverage international cooperation programs (e.g., GIZ, United Nations Environment Programme) to train local trainers ("train-the-trainer" models), and joining regional alliances like the African Circular Economy Alliance (ACEA).

To incentivize the workforce and advance innovation in the SLB market, entrepreneurship has to be at the forefront. Local-first innovation to drive local-first market opportunities encourages more startups to enter the market and fosters an attractive innovation

[40] Federation of Kenya Employers. (2024). *Employers Role in Recognition of Prior Learning (RPL)*.
[41] NobleProg. Electric Vehicles (EVs) Training in Kenya

ecosystem for potential employees. The goal is to build an innovation ecosystem where entrepreneurs can:

- **Identify opportunities** to develop innovative business models that create and retain more value locally (e.g. companies like BasiGo, Roam).
- **Produce high-leverage products and services** such as affordable testing kits, battery reuse hubs, local battery pack designs, digital platforms to track second-life battery usage, SoH monitoring services, certification courses, and repair/reuse apprenticeship programs.
- **Facilitate innovation and partnerships** by giving entrepreneurs access to incubators, funding, and technical mentorship.

Kenya has a unique opportunity to generate economic growth and regional impact at the same time by developing a best-in-class battery workforce. The expanding renewable energy and e-mobility sectors share many transferable skills, positioning Kenya to maintain leadership in both of these sectors and the broader renewable energy transition in Africa. While the country has already taken important steps to strengthen their workforce, continued investment of time and resources is essential. Targeted training, curriculum development, and inclusive policies will address existing skills gaps, ensuring a competent and diverse workforce capable of sustaining long-term growth in these promising industries.

Shaping the Market Through Policy

Existing Policies

Kenya is actively advancing its renewable energy, electrification, and e-mobility agenda through policy frameworks, fiscal incentives, and infrastructure development. To date, a number of national policies have been adopted:

- The Finance Act of 2019 reduced excise tax on imported EVs from 20% to 10%.
- The National Energy Efficiency and Conservation Strategy (2020) established a target of 5% of all vehicle imports being electric by 2025.
- E-mobility was integrated into the Fourth Medium Term Plan 2023-2027 of the Kenya Vision 2030 Agenda, with a specific focus on developing electric motorcycle manufacturing and charging infrastructure.
- The Finance Act of 2023 zero rated VAT on e-buses, electric motorcycles and lithium-ion batteries.

- In early 2024, Kenya's Electric Mobility Task Force launched a draft National e-Mobility Policy, which seeks to position Kenya as a leader in the e-mobility transition in Africa.

Required Policy Developments

To continue Kenya's leadership position in the e-mobility policy space, policymakers must continue to increase financial support, infrastructure investment, regulatory frameworks, public education, and local manufacturing for electrification and e-mobility related market opportunities. With broad support and a foundation established for e-mobility and electrification, policymakers have an opportunity to steer the country toward the mature market scenario, where Kenya leads East Africa in e-mobility market opportunities and ecosystem development. Looking across progressive clean transport policies in Africa, there are a number of other countries such as Ethiopia, Rwanda, and Uganda that are also establishing national policies and regulation to incentivize the growth of e-mobility markets. Focusing on national policies and cross-country partnerships to position the region as a leader in electrification, e-mobility, and a hub for future investment is an interesting opportunity for collaboration.

As these markets evolve, there are a number of policy interventions that will be necessary to establish a supportive market ecosystem that promotes economic opportunity and impact, best-in-class industry practices for battery life cycle management, and partnerships focused specifically on scaling battery reuse and recycling.[42]

The importance of policy consistency

As Kenya considers various policy interventions to enable the EV market and the market for battery reuse, repurposing, and recycling, it is important to ensure that policies are as consistent as possible across time and remain aligned with Kenya's National E-Mobility Policy and long-term decarbonisation and development goals. Investors take confidence in stable, predictable, and familiar policy environments, so policies should also seek alignment with regional and international policies to incentivise investment and collaboration.

[42] Tankou A., et al. (2023). *Scaling up Reuse and Recycling of EV Batteries: Assessing Challenges and Policy Approaches*. International Council on Clean Transportation.

There are a few clear near-term opportunities for policymakers to have an outsized impact on scaling reuse and recycling pathways for Kenya. These policy levers are included below with area of intervention, details, current policy maturity (nascent, developing, mature), and purpose/impact. **Nascent** denotes a policy is not yet a national strategy. **Developing** denotes a policy in the national strategy or currently under discussion but not implemented at scale. **Mature** denotes a policy that is currently a national priority implemented at scale in real-world use cases.

Area of Intervention	Policy Area	Existing Policy Maturity in Kenya	Purpose/Impact
Battery traceability and collection	Battery removability	Nascent	Removability standards enable safe dismantling for end-of-life batteries.
	Battery traceability mechanisms	Nascent	Ensures that end-of-life (EoL) EV batteries are collected and do not end up in landfill.
	Regulations that clearly define who is responsible for the battery when it reaches end of life	Developing	Supports more effective collection protocols when electric vehicle batteries reach end-of-life. This can be accomplished by (1) Voluntary policy tools to influence behavior such as public-private partnerships or voluntary manufacturing responsibility that place responsibility on electric vehicle and battery manufacturers or importers or (2) Regulations that require a certain behavior, e.g. Extended Producer Responsibility (EPR) regulations. Today, Kenya's EPR policies cover e-waste but lack reuse-specific provisions.

Area of Intervention	Policy Area	Existing Policy Maturity in Kenya	Purpose/Impact
Building domestic capacity for reuse and recycling	Incentives and grants to support the development of domestic capacity for reuse and recycling	Developing	Today, jurisdictions that do not have domestic capacity for recycling end-of-life batteries have to ship batteries long distances. Since the batteries are classified as hazardous waste, safety precautions add to the transportation and logistics costs to process batteries (up to 63% of the total cost of battery reuse or recycling). Developing domestic capacity would significantly reduce costs while stimulating local economies and reducing dependency on international supply chains. Governments could develop incentive programs, create supportive tax and trade provisions, and develop public-private partnerships for reuse and recycling.
Battery information	Regulations for the disclosure of battery information are needed to optimize the battery reuse and recycling process	Developing	Standards to be established to ensure that the region acquires high-quality batteries that can be reused/recycled appropriately based on their characteristics and desired end use-cases (energy storage, boda bodas, etc.).
Battery standards	Standards on battery durability	Developing	Information about technical characteristics, SoH, and operation history is critical for optimizing reuse/recycling practices to ensure safety and reduce risk. Durability standards extend the useful life of the second-life of the battery and enable capture of the most economic value.
	Standards on accuracy and reporting of the SoH metric	Developing	Making this information more readily available can reduce costs associated with reuse or recycling by reducing costly SoH testing and allowing pre-sorting of batteries into more optimised pathways.

Area of Intervention	Policy Area	Existing Policy Maturity in Kenya	Purpose/Impact
	Standards on safety when handling end-of-life batteries	Developing	Crucial for reducing risk during transport, at recycling centers, and during battery reuse. Creating standards will reduce administrative costs and burdens, mitigate environmental risk, and will streamline licensing requirements across regional jurisdictions.
Recycling mandates	Element-specific mandates on proportion of material that need to be recovered	Developing	Kenya should consider mandatory recovery targets to ensure efficient recycling of key battery materials.
	Element-specific mandates on the use of recycled material to be used in new manufactured batteries	Developing	Should Kenya become a hub for battery manufacturing or recycling, requiring a certain amount of recycled material incentivizes local recycling and regional development of processing facilities.
Research and development	Investments in research and development to optimize reuse and recycling process	Nascent	In anticipation of future recycling opportunities related to e-mobility opportunities, public/private partnerships that establish battery recycling hubs can be used to generate consumer excitement, workforce opportunities, and increase local expertise of cutting-edge recycling technologies and processes.

Many other countries face similar challenges in end-of-life battery management and Kenya can learn from how these problems are being addressed through policy in markets where there is more widespread EV adoption. The table below summarizes some key policy interventions in leading markets.

Area of Intervention	Examples of Existing Policy Developments
Battery traceability and collection	**China:** The government released a set of policies that place the responsibility of collecting electric vehicle end-of-life batteries on manufacturers or importers.[43] In 2018, a platform was created to trace batteries throughout their lifetime.[44]
Building domestic capacity for reuse and recycling	**United States:** The Battery Materials Processing Grants makes more than USD 3 billion available to state and local governments, commercial enterprises, nonprofit entities, and national laboratories to support domestic capacity for the reuse and recycling of batteries through project demonstration and other uses.[45]
Battery information	**European Union:** The European Commission proposed a labeling requirement for manufacturers to disclose information on batteries, such as the date of manufacture, chemistry, and hazardous substances. The Commission has developed language for the creation of a battery passport, which links to a digital platform where manufacturers would disclose battery data to facilitate third-party reuse or recycling.[46]
Recycling mandates	**European Union:** The EU Battery Regulation will mandate element-specific recovery rates for battery recycling and element-specific shares of recycled material to be used in the production of new batteries.[47]

[43] Ambrose H. and O'Dea J. (2021) *Electric Vehicle Batteries: Addressing Questions about Critical Materials and Recycling*. Union of Concerned Scientists.
[44] Reuters. (2018). "China launches pilot EV battery recycling schemes".
[45] U.S. Department of Energy. *Battery Material and Processing Grants Program*.
[46] European Commission. (2022). Proposal for a Regulation of the European Parliament and the Council
[47] European Commission. (2022). "Green Deal: EU agrees new law on more sustainable and circular batteries to support EU's energy transition and competitive industry".

Area of Intervention	Examples of Existing Policy Developments
Battery standards	**California:** The Advanced Clean Cars II regulations set battery durability standards that require that batteries in electric vehicles of model year 2026 and later maintain at least 80% of their range for 10 years or 150,000 miles. Furthermore, California proposes an accuracy standard for reporting batteries' SoH.[48] **United States and Canada:** The UL 1974 Standard for Evaluation for Repurposing Batteries sets general safety standards for sorting and grading used electric vehicle batteries and estimating their SoH.[49]
Research and development	**United Kingdom:** Through its Critical Mineral Strategy, the United Kingdom aims to become a scientific knowledge leader on battery material recovery and recycling. Different funding initiatives are being put in place to support a circular economy.[50]

Kenya stands at a critical inflection point — poised not just to adopt emerging battery life cycle management practices, but to lead in shaping them. Developing impactful industrial policies focused on SLBs is both a sustainability imperative and a strategic market opportunity to localize value chains, reduce import dependency, and catalyze green manufacturing and job creation. By investing in forward-looking standards, incentivizing R&D, and enabling circular supply chains, Kenya can position itself as a regional hub for battery reuse, repurposing, and recycling. These foundational policy measures — including fiscal incentives and infrastructure investment — are key to creating a mature market ecosystem that will catalyze a positive feedback loop of innovation and investment. The next generation of policy must be bold, collaborative, and deeply rooted in both global technology trends and local entrepreneurial potential — ultimately unlocking Kenya's leadership in Africa's second life battery future.

[48] California Air Resources Board. *Advanced Clean Cars II Regulations Section 1962.4, Title 13, California Code of Regulations*.
[49] Underwriters Laboratories. UL Standard 1974
[50] UK Department for Business, Energy & Industrial Strategy. (2023). *Resilience for the Future: The UK's Critical Minerals Strategy*.

Financing and Investment

Innovation is always a risky undertaking, and the development of Kenya's SLB market will require a strategic approach to financing in order to address the unique challenges of this emerging sector. Existing companies and new entrants will require up-front capital for piloting new products and services **before the market exists**, but they will also need long-term partners and patient capital to allow them to scale once the market is established. Depending on the type of initiative and scale that is being pursued, the mix of financing tools will be different, but typically the larger the scale, the more financing partners and coordination across stakeholders is necessary. Financing generally falls into a few categories such as grants, debt and equity, but there are also many innovative combinations being developed by impact investors interested in generating positive environmental and social outcomes alongside financial returns.

Early-Stage Financing (2025-2030)

During the market's formative years, when commercial viability is still being proven, funding will primarily come from grants and impact investment tools. MSMEs working on highly innovative approaches should be the focus of this stage, with a focus on pilot projects with high potential for impact in sectors where demand for BESS is growing.

Innovation grants

Initiatives like the World Bank's Lighting Global program and the former USAID Power Africa program[51] provide model funding mechanisms that could be adapted by international development organisations interested in supporting high leverage pilot projects using SLBs. In Kenya, the Hustler Fund — a loan program for MSMEs that has historically suffered from high levels of default — could be re-envisioned as a grant program intended to kickstart small enterprises in critical innovation sectors like end-of-life EV battery management.

Blended finance solutions

These solutions combine concessional capital from Development Finance Institutions (DFIs) with commercial investment to de-risk early ventures. For example, The ChargeUp! Partnership between Energy 4 Impact, ARC Ride, Fika Mobility, Imperial College London, and Strathmore University received USD 295,000 in grant funding from Partnering for Green Growth and the Global Goals 2030 to establish a network of battery swapping stations in Kenya. This

[51] Lee N. (2025). "What We're Losing: Energy, Growth, and Power Africa". Center for Global Development.

unique model combines concessional capital with commercial capital and academic expertise to explore "battery-as-a-service" models and prove viability.[52] Similar models among similar partners could be deployed to develop models for battery repurposing.

Results-based financing (RBF)

RBF models provide payments upon achieving predetermined metrics such as number of batteries refurbished or kWh of storage deployed. The Universal Energy Facility (UEF), for example, is a multi-donor RBF facility established to significantly speed up and scale up energy access across Sub-Saharan Africa. The UEF provides grants to eligible organisations deploying energy solutions through mini-grids and stand-alone solar systems and could be a valuable tool in financing repurposed 2W/3W SLBs for BESS applications.

Impact investment

Investors seeking both financial returns and positive environmental/social impact represent a growing funding source. Off-grid energy access alone attracted USD 1.2 billion in investment during the 2022-2023 period,[53] and it should not be difficult to attract these same investors to SLB enterprises given the high level of overlap with the desired outcomes in the off-grid energy sector.

Growth-Stage Financing (2030-2040)

As the SLB market matures and business models are validated, more sophisticated financing tools will be needed to support expansion.

Commercial debt

Kenya's robust banking sector can be engaged through credit guarantee schemes backed by the government or international guarantee providers such as the newly created Dhamana Guarantee Company[54] to develop specialised loan products for SLB enterprises. These loans could specifically finance advanced battery testing equipment, automated disassembly lines, and commercial recycling infrastructure.

Specialised investment vehicles

Vehicles of this type would follow the model of Mirova, which raised over USD 170 million for its Gigaton Fund, a blended finance debt fund aimed at accelerating the clean energy transition in emerging markets. Similar blended finance debt funds could target the complete EV battery life cycle in Kenya. Recycling facilities

[52] McKinley Lester H. et al. (2023). "How Battery Swaps Are Helping to ChargeUp! Kenya's E-Mobility Transition". The City Fix. World Resources Institute.
[53] ESMAP, *Off-Grid Solar Market Trends Report 2024*.
[54] Private Infrastructure Development Group (2024). Pan-African partnership reaches milestone for long-term climate finance solutions in Kenya".

require particularly high upfront capital expenditure for specialised equipment, making them well-suited for patient capital from blended finance vehicles that can accept longer payback periods in exchange for delivering environmental benefits.

Corporate strategic investment

Companies already operating in adjacent sectors (energy, transport, telecommunications) can serve as sources of capital, technical assistance, and market access. Chinese companies like BYD and CATL may be important partners given China's focus on LFP batteries and recent geopolitical realignments that will incentivize China to fill gaps left in markets by U.S. companies and government agencies. European companies such as Volkswagen, Volvo, and Stellantis are also at the forefront of EV technology and strategic thinking about battery supply chains and could be valuable strategic financial partners.

Enabling Financial Flow Through Policy and Innovation

To overcome investment barriers and de-risk the market, the government and other stakeholders can also provide policies and financial instruments to support the finance ecosystem for SLBs.

Green bonds and sustainability-linked loans

Kenya's expanding green finance market offers promising avenues for EV battery projects. The Kenya Green Bonds Programme[55] could create dedicated instruments for financing battery refurbishment and recycling, with proceeds earmarked specifically for circular economy infrastructure. Sustainability-linked loans (SLLs) — financing instruments that offer variable interest rates tied to achievement of predetermined sustainability targets — are gaining traction in the Kenyan market, as evidenced by Safaricom's recent 15 billion KES SLL from KCB, ABSA, Standard Chartered, and Stanbic in 2024. For the EV battery sector, these SLLs could be structured with performance indicators linked to key metrics like percentage of EV batteries diverted from landfills, quantity of critical minerals recovered through recycling, or carbon emissions avoided through second-life applications, with borrowers receiving more favorable interest rates as they meet or exceed these targets.

Tax incentives

Existing renewable energy and EV tax benefits should be extended to encompass the entire battery value chain. This could include import tax exemptions for

[55] Sustainable Finance Initiative. (2020). *Success of East Africa's Debut Green Bond Issue: The Case of Acorn Holdings*. Kenya Bankers Association.

battery testing and recycling equipment, accelerated depreciation allowances for capital investments in refurbishment facilities, and corporate tax reductions for companies achieving certified levels of material recovery from spent EV batteries. These incentives would improve project economics for investors considering entry into the Kenyan battery market.

Risk mitigation instruments

Specialised insurance products and first-loss facilities should be developed to protect investors from technology and market risks unique to the EV battery sector. These instruments could cover uncertainties such as battery degradation rates, volatility in recovered material prices (particularly lithium, cobalt, and nickel), volatility in battery prices, and supply/demand coordination challenges between EV adoption and second-life applications. A dedicated battery technology risk guarantee fund, potentially backed by DFIs, could significantly increase private sector appetite for investing in battery refurbishment and recycling infrastructure by providing a financial cushion against these emerging market risks.

Key Actions for Kenyan Stakeholders

Below is a list of what key stakeholders in Kenya's EV market can do to promote e-mobility adoption, advance reuse, repurposing and recycling market opportunities, and drive Kenya towards the mature market scenario.

For NGOs and Impact Investors

Pilot funding opportunities: Support early-stage demonstrations of second-life battery applications in solar home systems, e-mobility charging infrastructure, mini grids, and backup power for schools and health clinics, particularly in off-grid and underserved communities.

Partnership models: Facilitate cross-sector collaborations between battery suppliers, recyclers, e-mobility providers, and local training institutions to align environmental, social, and economic outcomes.

Risk mitigation strategies: Offer first-loss capital, blended finance structures, or guarantee schemes to de-risk commercial investment in unproven SLB business models, especially in battery diagnostics, testing, and quality assurance.

For National Government

Policy priorities: Recognize SLBs as a strategic component of the national e-mobility and energy access agenda within climate and industrial policies, and include battery circularity in the National E-Mobility Policy.

Regulatory framework development: Define the legal classification of SLBs and develop rules for ownership, liability, safety testing, and cross-border reuse.

Standards development: Collaborate with KEBS and regional bodies to adopt or adapt IEC standards for battery SoH, durability, and safe handling at end-of-life.

Adoption/investment incentives: Create targeted tax incentives or rebates for local SLB refurbishers, integrators, and end-users in sectors like education, agriculture, and MSMEs using battery-powered equipment.

For Local Governments

Implementation strategies tailored to the local context: Promote SLB deployment in county electrification programs, especially for powering public facilities or boda-boda battery swapping stations.

Resource hubs: Establish county-level "Green Tech Hubs" that provide technical support, storage, and logistics coordination for SLB collection, testing, and reuse.

Capacity building: Partner with TVET institutions and polytechnics to offer technician training focused on safe battery disassembly, diagnostics, and system integration.

For the Private Sector

Buy high-quality batteries and BMS from the start: Prioritize sourcing EV batteries with reliable Battery Management Systems (BMS) and accessible data protocols to extend life cycle value and support downstream reuse.

Ensure data visibility into battery health: Develop interoperable platforms or APIs that allow real-time SoH monitoring and digital tracking for reuse and recycling planning.

Begin mobilizing industry association members to coordinate around existing EPRs (Extended Producer Responsibility): Create working groups to interpret, implement, and improve Kenya's EPR framework in collaboration with recyclers and policy experts.

Formally communicate gaps and opportunities: Leverage industry associations to aggregate and report market-level insights — such as unmet demand for refurbished batteries or testing facility needs — to government and NGOs to shape future interventions.

Conclusion

The SLB market represents an opportunity for Kenya to simultaneously advance its energy transition goals, create skilled employment, and develop a circular economy model that can serve as a template for other emerging markets. The path forward requires a balance of immediate action and strategic long-term planning to unlock the substantial economic value of this sector.

In the short term (2025-2030), the focus should be on developing pilot projects, building technical capacity, establishing safety standards, and creating enabling policies. During this period, the market will likely be driven by MSMEs focusing primarily on 2W/3W batteries with LFP chemistry.

In the medium term (2030-2040), as 4W vehicles begin to enter the second-life market in greater numbers, larger businesses will emerge alongside early market participants, scaling successful business models and developing specialised applications across multiple sectors. This period will also include critical decision points for investments in recycling infrastructure.

By 2050, in the most favorable scenario, Kenya will have developed a mature market ecosystem that efficiently manages the full life cycle of EV batteries, capturing value at each stage while minimizing environmental impact. This circular economy approach will not only reduce dependency on raw material imports but also position Kenya as a regional hub for battery repurposing and recycling expertise.

Successful development of this market will require coordinated effort across multiple stakeholders. The government must provide policy support and regulatory clarity, both for EV adoption and for battery life cycle management. Educational institutions must adapt curricula to develop the necessary technical skills among the workforce. Financial institutions and investors must create innovative financing mechanisms to unlock capital and de-risk investments. Private sector companies must develop and scale viable business models. And civil society organisations must raise awareness and ensure equitable access to the benefits of this emerging market.

The journey to a thriving SLB market in Kenya will not be without challenges. Technological uncertainty, fluctuating battery and raw material prices, and coordination across diverse stakeholders will require

adaptability and persistence. However, by approaching these challenges with a collaborative mindset and a commitment to long-term sustainability, Kenya has the opportunity to not just participate in the global energy transition but position itself at the forefront of a circular battery economy that will power its sustainable development for decades to come.

Appendices

EV Battery Technologies: An Overview

Current Landscape: Lithium-Ion Dominates

The current electric vehicle market is largely powered by lithium-ion battery technology. These batteries have become the backbone of the EV industry due to their exceptional combination of energy density, cycle life, and safety compared to other alternatives. Lithium-ion batteries store and release energy through the movement of lithium ions between a positive electrode (cathode) and negative electrode (anode), with various chemical compositions offering different performance characteristics.

The success of lithium-ion battery technology in the EV market stems from several key advantages. First, these batteries provide sufficient energy density to enable practical driving ranges — modern mid-range EVs can achieve 300-500 kilometers on a single charge. Second, they maintain performance through thousands of charging cycles,[56] supporting vehicle lifespans comparable to conventional automobiles. Finally, contemporary lithium-ion batteries incorporate sophisticated battery management systems that mitigate safety risks like thermal runaway, though they still contain flammable electrolytes.

Within the lithium-ion family, several chemistries have gained prominence in EV applications. Lithium Nickel Manganese Cobalt Oxide (NMC) offers high energy density and has become common in passenger vehicles, particularly in North American markets. Lithium Iron Phosphate (LFP) has lower energy density compared to NMC, but provides enhanced safety and longevity at lower cost. Lithium Nickel Cobalt Aluminum Oxide (NCA) delivers excellent specific energy but with higher costs and more stringent safety requirements.

Globally, LFP batteries are gaining prominence and have become central to Kenya's 2W and 3W EV market, where mixed terrains, warmer ambient temperatures, and affordability give them a distinct advantage. As of 2023, LFP batteries make up approximately 40% of the global supply – more than double the number in 2020 — with nickel-based batteries such as NMC and NCA making up the majority of the remainder. Though China has historically controlled most LFP battery

[56] Ramasubramanian B. et al. (2024). *Ten major challenges for sustainable lithium-ion batteries*. Cell Reports Physical Science, *5(6)*.

production, core patents on LFP technology expired in 2022, resulting in increased investment in LFP production in other parts of the world. In particular, Morocco's large phosphate reserves have attracted over USD 15 billion in investment from key battery manufacturers such as Gotion, LG, and CNGR Advanced Material.[57]

The form factors of these batteries have evolved alongside chemistries. Perhaps the most recognizable form factor for a battery is the cylindrical cell, found in common household items and in most of Kenya's 2W EVs, while modern 4-wheel EV designs increasingly favor prismatic cells (rectangular metal-cased batteries) or pouch cells (flexible, flat batteries sealed in polymer-aluminum pouches). These are typically arranged in modules, which are in turn assembled into complete battery packs with integrated cooling systems and electronic controls.

Emerging Battery Technologies

For developing markets like Kenya's SLB market, understanding this technological trajectory is crucial for strategic planning. While immediate second-life applications will predominantly involve conventional lithium-ion batteries, future repurposing and recycling infrastructure must anticipate the eventual arrival of new battery technologies with different material compositions, safety profiles, and economic values in secondary markets.

Solid-State Batteries

Solid-state batteries represent the next evolution in EV power systems, replacing liquid or gel electrolytes with solid materials to fundamentally transform battery performance. This new generation of batteries offers several advantages, including the elimination of flammable components, higher energy densities that enable longer driving ranges, faster charging capabilities, better performance in extreme temperatures, and longer lifespans.

The transition to solid-state technology faces several remaining challenges. Current solid electrolyte materials struggle with issues like low ionic conductivity at room temperature, mechanical stress during charging cycles, and difficulties forming stable interfaces with electrode materials. Manufacturing processes also require refinement to enable cost-effective mass production. Despite these hurdles, major automotive manufacturers and specialised battery companies have invested billions in solid-state research and development. Several companies have announced working prototypes, with limited commercial applications expected by 2025-2027 and

[57] International Energy Agency. (2024). *Global EV Outlook 2024: Trends in electric vehicle batteries*.

mainstream adoption potentially following in the early 2030s.

Sodium-Ion Batteries

Sodium-ion batteries are emerging as an alternative to lithium-ion technology for EVs, primarily due to sodium's greater abundance and significantly lower cost. This technology is being advanced globally, though manufacturing is only at the laboratory or pilot scale outside of China, which has 90% of the global production capacity.[58] Notable projects include the U.S. Department of Energy's USD 50 million LENS consortium led by Argonne National Laboratory[59], the EU-funded SIMBA project, and Germany's ENTISE project.

Despite their potential, sodium-ion batteries currently face several technical challenges limiting widespread use in EVs, most notably their lower energy density and shorter driving ranges compared to lithium-ion batteries. While Stanford University's STEER program analysis suggests mass commercialisation may be viable by the 2030s,[60] battery manufacturer CATL recently announced second-generation sodium-ion batteries planned for 2025 that feature improvements in energy density, safety, cold-weather performance, and charging speeds.[61]

EV Battery Life Cycle Management

Regardless of the form factor of an EV battery, the lithium-ion battery life cycle, when managed with a focus on repurposing, represents a comprehensive circular economy approach that maximizes value and minimizes environmental impact throughout a battery's life. Initially, new batteries power EVs during their primary application phase, typically lasting 1000-3000 charging cycles (3-10 years depending on chemistry and charging frequency) before capacity degradation renders them suboptimal for mobility purposes.

At this point in the life cycle, batteries should undergo thorough assessment and characterisation to determine their remaining capacity and health status. Batteries retaining 50-80% of original capacity can enter valuable second-life applications rather than immediate disposal. These repurposed batteries represent solutions for stationary energy storage applications such as grid stabilisation, renewable energy integration, backup power systems, and microgrids — applications

[58] International Energy Agency, *Global Critical Minerals Outlook 2024: Outlook for key minerals*.
[59] Argonne National Laboratory. (2024). "A new era for batteries: Argonne leads $50M sodium-ion innovation push".
[60] Yao A., et al. (2025). *Critically assessing sodium-ion technology roadmaps and scenarios for techno-economic competitiveness against lithium-ion batteries*. Nature, *10*.

[61] CATL. (2025). "Naxtra Battery Breakthrough & Dual-Power Architecture: CATL Pioneers the Multi-Power Era".

where weight and volume constraints are less restrictive than in vehicles.

Batteries unsuitable for second-life applications, along with those reaching the end of their second life (around 50% SoH), enter the recycling stream. Recycling processes recover critical materials including lithium, cobalt, nickel, manganese, and copper. These recovered materials can then be redirected into the battery manufacturing supply chain, reducing dependency on virgin material extraction and completing the circular economy loop, thereby significantly lowering a battery's life-cycle emissions.

This integrated approach creates multiple value capture opportunities while addressing environmental concerns related to battery disposal. By extending useful life through second-life applications and ultimately recovering materials through recycling, this life cycle approach transforms potential waste into continued economic and environmental value.

Company profiles

Acele Africa

Nairobi, Kenya | www.aceleafrica.com

Acele Africa is advancing Kenya's EV battery sector by creating innovative second-life batteries for off-grid solar systems. After discovering that about 75% of used battery cells remain viable for reuse, the company developed unique glue-free battery pack designs for easier disassembly and established a responsible disposal system through licensed facilities like Enviroserve and the WEEE Centre.

Ampersand

Kigale, Rwanda | www.ampersand.solar

Ampersand is a Kigali-based electric mobility company focused on replacing fuel-powered motorcycle taxis in East Africa with electric alternatives. Founded in 2016, it offers affordable e-motorcycles and operates a network of battery-swap stations that reduce costs and downtime for riders. With over 5,700 bikes in Rwanda and Kenya, Ampersand enables cleaner transport and higher driver earnings, and aims to deploy 40,000 e-motorcycles by 2026.

ARC Ride

Nairobi, Kenya | arcrideglobal.com

ARC Ride is a Nairobi-based EV company specializing in the design, assembly, and deployment of electric two- and three-wheelers tailored for Kenya's urban transport needs. They offer locally assembled electric motorbikes and operate a proprietary Battery-as-a-Service (BaaS) swapping model at over 100 automated stations. ARC aims to scale to 1,000 vehicles and 300 stations by 2025 to support Kenya's clean transport goals.

BasiGo

Nairobi, Kenya | www.basi-go.com

BasiGo is a Nairobi-based electric mobility company transforming public transport in Kenya by providing electric buses and charging infrastructure. Launched in 2021, the company offers a pay-as-you-drive model that lowers upfront costs for bus operators by bundling leasing, charging, and maintenance into a daily fee. By

replacing diesel buses with cleaner electric alternatives, BasiGo aims to reduce urban emissions, improve air quality, and support the transition to sustainable transit across Africa.

Connected Energy

Newcastle, UK | connected-energy.co.uk

Connected Energy builds commercial energy storage systems using second-life EV batteries from automakers like Renault. Their modular E-STOR units are deployed at bus depots, charging stations, and commercial sites to reduce energy costs and support grid stability. The company is a leader in OEM-aligned, circular energy solutions in Europe.

DriveElectric

Nairobi, Kenya | drivelectric.co.ke

DriveElectric is advancing Kenya's e-mobility sector through innovation projects, including a prototype storage solution that repurposes second-life Nissan LEAF battery cells into modular home energy systems that can provide affordable energy storage for areas with unreliable grid access. These storage systems help stabilize power demand and reduce household energy costs, demonstrating practical applications of battery circularity beyond an urban setting.

Ecomobilus

Nairobi, Kenya | ecomobilus.com

Ecomobilus uses materials like old laptop batteries to develop affordable, modular battery solutions for electric motorbikes and utility vehicles like e-mkokoteni carts that deliver up to 100 km per charge. Their vehicles provide small businesses with clean, cost-effective transport options that significantly reduce fuel and maintenance expenses while enhancing energy independence in regions with unreliable electricity.

Enviroserve

Nairobi, Kenya | enviroserve.co.ke

Since 2017, Enviroserve has established itself as a key player in Kenya's e-waste sector, housing 30 tonnes of battery waste in its warehouse, testing up to 1,000 cells daily, and recycling at least 85% of the waste it receives. Through its sustainable, locally-focused business model and collaborations with the informal sector, Enviroserve contributes valuable knowledge for developing effective EV battery policies while creating economic opportunities in Kenya.

Moment Energy

Coquitlam, Canada | www.momentenergy.com

Moment Energy is a Canadian startup that repurposes retired EV batteries into commercial-scale energy storage systems, maintaining partnerships with major automakers like Mercedes-Benz and Nissan for battery supply. The company recently secured $15 million in Series A funding co-led by Amazon's Climate Pledge Fund and Voyager Ventures, which will be combined with a $20.3 million US Department of Energy grant to build the world's first UL certified second-life battery gigafactory in Texas.

REVOV

Capetown, South Africa | revov.co.za

REVOV repurposes second-life EV batteries into stationary energy storage systems for homes and businesses across South Africa. Their affordable “2nd LiFe” products support solar installations and off-grid power, especially in areas affected by load shedding. By extending battery life and reducing waste, REVOV makes clean energy more accessible while supporting energy resilience in Sub-Saharan Africa.

Roam

Nairobi, Kenya | www.roam-electric.com

Roam is a Swedish-Kenyan electric mobility company based in Nairobi that designs and manufactures electric motorcycles and buses for African markets. Founded in 2017, Roam focuses on locally assembled, affordable vehicles like the Roam Air and Roam Rapid, built for efficiency and durability. By integrating solar charging and reducing fuel costs, Roam is driving the shift to clean, accessible transport across the continent.

Spiro

Nairobi, Kenya | www.spironet.com

Spiro is Africa’s largest electric vehicle company, focused on deploying electric motorcycles and battery-swapping infrastructure across the continent. Founded in 2019 and headquartered in Nairobi, Spiro operates in countries like Kenya, Nigeria, Uganda, and Rwanda, with over 30,000 bikes and 600+ battery-swapping stations. Its Battery-as-a-Service model lowers costs for riders while reducing emissions. Backed by major investments from Afreximbank and Société Générale, Spiro also supports local job creation through assembly plants and aims to deploy two million electric motorcycles across Africa by 2030.

Voltfang

Aachen, Germany | voltfang.de

Voltfang is a German startup that creates sustainable energy storage systems by giving second life to used

EV batteries. Founded by engineers from RWTH Aachen University, the company has developed AI-based software to evaluate battery longevity and offers a unique 10-year guarantee on their storage systems. It is currently working on a project to develop EV charging stations from repurposed EV batteries, a true circular economy.

WEEE Centre

Nairobi, Kenya | www.weeecentre.com

The WEEE Centre is a National Environment Management Authority (NEMA) and ISO-certified facility in Kenya that processes 25-30 tonnes of electronic waste annually across East Africa and creates innovative products like concrete building blocks from recovered glass fiber. With over 100 collection points nationwide, battery stockpiling and take-back programs, and a community-based approach, the Centre simultaneously advances circular economy principles and promotes sustainable waste practices to the public.

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About AfEMA

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 vehicles sold in Africa will be Zero-Emission Vehicles (ZEVs). Its work informs and accelerates that transition.

Learn more at **africaema.org**.

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