



Residual Value

An Opportunity to Improve EV Financing in Kenya

KENYA | July 2025



A F R I C A
E-MOBILITY
A L L I A N C E

Executive Summary

Kenya's electric vehicle (EV) market is gaining steady momentum, with new registrations nearly doubling annually over the past seven years to reach 5,294 units in 2024. This is a strong indication of growing adoption and investor confidence. While traditional financing mechanisms such as bank loans and leasing arrangements continue to support the sector's expansion, they have yet to integrate comprehensive approaches to residual value assessment, which could further enhance market maturity. Establishing clear residual value frameworks is not about correcting a failing system, but about unlocking new opportunities: improving EV economics through better risk pricing, expanding complementary industries such as battery repurposing and energy storage, and enhancing environmental outcomes by extending battery life and reducing demand for raw minerals. By embedding valuation transparency into Kenya's fast-growing EV ecosystem, policymakers and financiers can help accelerate both market efficiency and long-term sustainability.

In China and Germany, several companies and initiatives are already integrating residual value considerations into their electric vehicle (EV) battery operations, marking significant progress toward a circular battery economy. Both countries are advancing beyond mere disposal models by embedding mechanisms to evaluate and utilize batteries at end-of-life for second-life applications such as stationary energy storage and industrial use. They are also developing tools to assess battery State of Health (SOH) and remaining lifetime, improving transparency and enabling more accurate valuation across the value chain. These developments have further attracted private capital into reuse and recycling infrastructure, demonstrating growing investor confidence in the long-term viability of end-of-life battery markets. For instance, BMW Brilliance Automotive (China) employs traceable coding and evaluation systems to sort batteries for reuse in forklifts and stationary storage before directing unfit units to recycling, a clear example of operationalizing residual capacity to create second-life markets¹. Similarly, Germany's CarBatteryReFactory project repurposes used EV batteries with remaining capacity into industrial-scale energy storage systems, supported by EU funding, highlighting how policy and private investment can work in tandem to scale second-life applications and strengthen the residual value ecosystem².

¹ BMW creates closed recycling loop for battery raw materials in China. Just Auto (2024). <https://www.just-auto.com/features/bmw-creates-closed-recycling-loop-for-battery-raw-materials-in-china/>

² CarBatteryReFactory: Giving used car batteries a second life. European Climate, Infrastructure and Environment Executive Agency (CINEA) (2024). https://cinea.ec.europa.eu/featured-projects/carbatteryrefactory-giving-used-car-batteries-second-life_en

Without similar progress, Kenya risks remaining reliant on donor-supported residual value pilot projects, rather than developing its own sustainable market mechanisms. While international development partners have played a vital role in early-stage EV demonstrations and capacity building, the absence of locally driven financial instruments, regulatory standards, and valuation frameworks could hinder the transition from pilots to scalable, market-led adoption. Strengthening domestic capacity in residual value modeling and risk assessment is therefore essential to reduce dependency and build investor confidence in Kenya's e-mobility ecosystem

A major bottleneck to unlocking residual value financing in Kenya is the absence of accessible, standardised tools that financiers and insurers can confidently use to evaluate electric vehicle (EV) and battery assets. While residual value is recognised as a critical parameter in determining loan-to-value ratios, lease structures, and insurance premiums, stakeholders currently rely on estimations borrowed from internal combustion engine (ICE) vehicle models or foreign contexts that do not reflect Kenya's market realities.

Discussions with major insurance companies in Kenya revealed that while most now provide comprehensive and third-party insurance for electric vehicles at rates similar to conventional cars, battery coverage remains a major gap. CIC Insurance insures EVs and may offer tailored battery cover only if the batteries are manufacturer-supplied and unmodified, while Direct Line insures EVs but requires an "all risk" clause for battery coverage, especially for PSVs. An "all risk" clause for battery coverage means the insurance will protect the EV battery against any accidental loss or damage unless it is specifically excluded in the policy. Heritage Insurance offers EV cover on a case-by-case basis, excluding PSVs, and ICEA Lion Group provides insurance for both cars and motorcycles but excludes batteries altogether. Recently, Britam launched their EV insurance policy for fully electric and hybrid cars, featuring battery protection, out-of-charge recovery and comprehensive risk coverage. In contrast, APA Insurance does not currently insure EVs, citing a lack of repair infrastructure and battery-related risks, though they are reviewing options for future coverage. Overall, the industry shows cautious engagement, with batteries seen as a high-risk component limiting comprehensive EV insurance offerings

There is a pressing need to develop a contextualised residual value calculator-a digital tool or methodology that reflects Kenya's unique usage patterns, battery chemistries, operational stressors, and market demand for second-life applications. This tool would integrate:

- **State of Health (SOH) data** calibrated to local climate and road conditions;

- **Use-case segmentation**, accounting for commercial vs private usage, battery swapping vs fixed systems;
- **Market demand modelling** for secondary use cases such as mini-grids, telecom towers, or institutional backup;
- **Local cost inputs** for testing, refurbishment, logistics, and disposal.

By embedding such variables into an adaptable, locally grounded calculator, lenders and insurers can apply consistent, evidence-based valuations across the EV value chain. This would build technical confidence, reduce perceived risk, and catalyse innovation in performance-linked financing and insurance products.

Such a tool should be co-developed in partnership with Kenya's insurance sector, battery second-life actors, and regulatory bodies like KEBS or IRA, supported through pilot funding by development partners. Once validated, the calculator will serve as a valuation tool for insurance companies and financiers, helping to standardize residual value assessment and reduce perceived risks in EV lending. In addition, it can accelerate sector growth by supporting related efforts such as training, certification and policy design through the availability of reliable, data driven valuation benchmarks. This tool would be a strategic enabler for scaling EV adoption by translating battery health and lifecycle data into tangible financial metrics.

Introduction

Kenya is committed to transitioning to electric mobility, with the Kenya National Energy Efficiency and Conservation Strategy targeting 5% of newly registered vehicles to be electric by 2025, and a raft of financial incentives has been rolled out over the past several years. While the 5% target has yet to be achieved, EV registrations in the country almost doubled from 2,695 EVs in 2023 to 5,294 in 2024, continuing a seven-year trend of rapid, consistent growth. While the sector is still nascent, representing just over 0.3% of the total registered vehicles in the country, EVs have seen an exponential growth year by year since 2020, and 7% of all new motorcycles last year were electric.³

However, while the e-motorcycle sector has seen high, consistent growth, the electric passenger car (e-car) and electric bus (e-bus) segments have had much slower uptake. A significant growth constraint is that EVs remain more expensive to manufacture and import than their internal combustion engine (ICE) equivalents, primarily due to high battery costs and import-related charges. In Kenya, imported EVs are subject to a 25% import duty, 10% excise duty, a 3.5% import declaration fee, and a 2% railway development levy. However, the government currently waives the 16% VAT for electric and hybrid vehicles, providing meaningful cost relief. Since most e-cars in Kenya are imported as fully built units, these cumulative charges still make EVs considerably more expensive upfront. Local assembly efforts, such as for e-buses, aim to mitigate these costs by leveraging existing tax incentives and reducing reliance on imports, but the overall price gap continues to limit affordability and market expansion. The high cost of EVs is largely a result of the price of the battery, which makes up to 40% of the component parts cost.

As of December 2024, 92% of EVs registered were motorcycles. This indicates that, at present, the majority of batteries - but a lower share of battery capacity (as measured in kilowatt-hours (kWh)), as they have significantly smaller batteries than electric four-wheelers

Total Estimated EV Battery Capacity (Jan 2025)

25,4 MWh

Battery Pack Size Range

2,4 kWh – 110 kWh



Share Attributed to E-Two Wheelers

51% (approx. 13 MWh)



– Onboard Charging Motorcycles



– Battery Swapping Systems

Share of E-Two Wheelers as Share of Total EVs



Over 90%

(E4W). Local consultations and industry studies estimate battery-to-motorcycle ratios of between 1.4 to 2.6 batteries per unit, reflecting the widespread presence of dual-pack systems and additional battery stock held by battery swap companies.



Fig 1. A Roam Air Gen 2 e-bike with 2 battery packs. Source: Roam.

A vehicle battery modelling analysis conducted by KeEBI, utilising vehicle data from the NTSA ending in January 2025, estimates the current battery capacity in the country at approximately **25.4 MWh of EV battery storage**, capable of powering 800 Kenyan households for a month.⁴ Using the average household electricity consumption of 31.11 kWh per month derived from the latest EPRA Bi-Annual Energy & Petroleum Statistics Report for FY 2024/2025, we can calculate how many Kenyan homes 25.4 MWh of electricity can power for one month.

Calculation:

- **Total energy available:** 25.4 MWh = 25,400 kWh.
- **Average monthly consumption per household:** 31.11 kWh.
- **Number of homes powered:**

4

https://www.epra.go.ke/sites/default/files/2025-03/Bi-Annual%20Energy%20%26%20Petroleum%20Statistics%20Report%202024_2025.pdf

$25,400 \div 31.11 \approx 816.46$ homes.

Rounded down to the nearest whole number: **816 homes**.

Over 51 per cent of the total battery capacity, equivalent to approximately 13 MWh, is attributed to electric two-wheelers, which constitute over 90 per cent of all electric vehicles in Kenya.

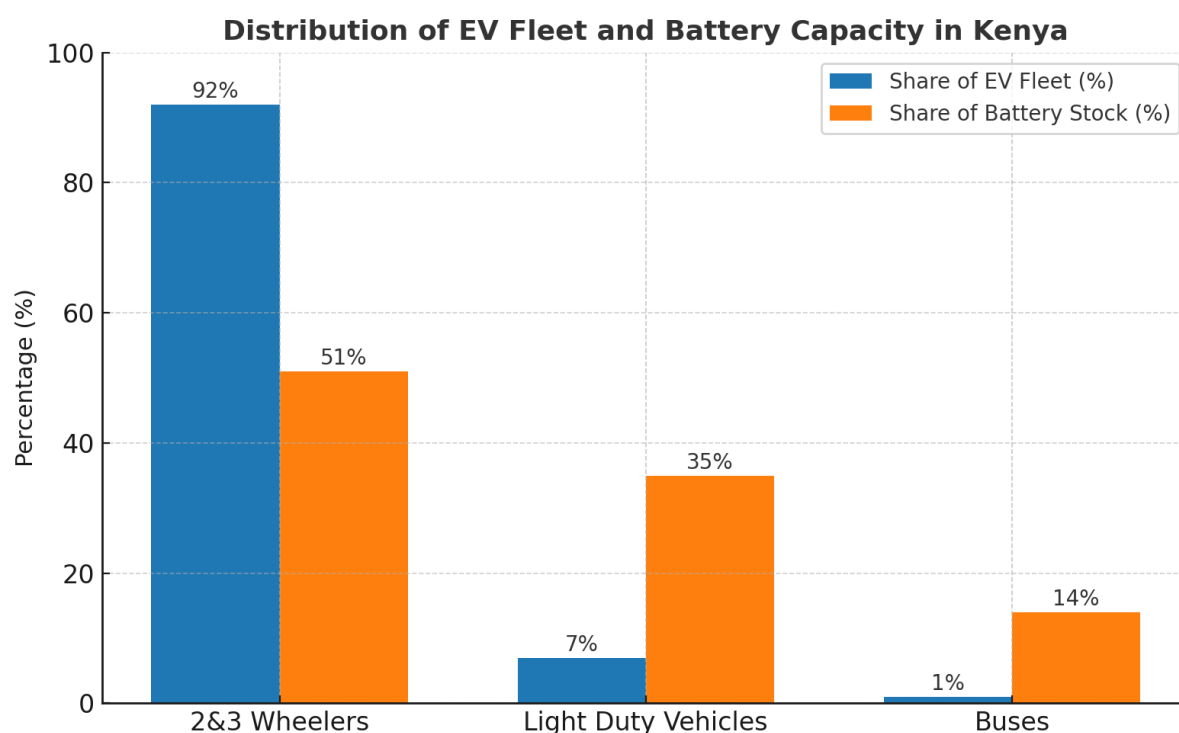


Figure 2: Kenya's EV fleet composition and battery capacity distribution:

Although two- and three-wheelers make up over 90% of the EV fleet, they account for only 51% of total battery capacity due to their smaller individual battery sizes compared to light-duty vehicles and buses

EV batteries are typically removed from road use when they have only 70 to 80% capacity, marking the end of their first life. At this point, there is an opportunity to put the EV batteries to use (or most likely be sold on to others for use) in second-life applications, most commonly stationary energy storage. The value of the EV battery at the end of its first life - either measured in its monetary or functional worth - is what is known as **residual value**.⁵

The residual value of a battery is directly linked to its state of health (SoH), which measures its current condition in relation to its original capacity and performance.

⁵ <https://www.sciencedirect.com/science/article/pii/S0301479718313124>

Within the context of residual value, Monetary and functional value have the following meanings:

- **Monetary Value:** A quantitative price a used battery can fetch in the resale, repurposing, or recycling market.
- **Functional Value:** A qualitative description of the battery's remaining usable capacity for alternative applications, such as stationary energy storage or grid regulation.

Defining and incorporating the residual value of electric vehicles (EVs) into financing models can help reduce the risks faced by lenders. By providing a clearer forecast of future asset value, financiers are better positioned to offer improved loan terms such as lower monthly payments thereby enhancing EV affordability for consumers and reducing default risk for lenders. For instance, assuming a landed battery cost of approximately \$250 per kWh, a standard 48 kWh battery would cost around \$12,000 at purchase. If the estimated residual value after five years is \$4,800 (40% of initial value), this projected depreciation provides financiers with a measurable benchmark for structuring loan terms and managing asset risk. Including such valuation estimates or visual comparisons (e.g., cost vs. residual value charts) would strengthen the financial modeling and improve confidence among lenders and insurers.

Battery Cost vs. Estimated Residual Value (48 kWh, 5-Year Projection)

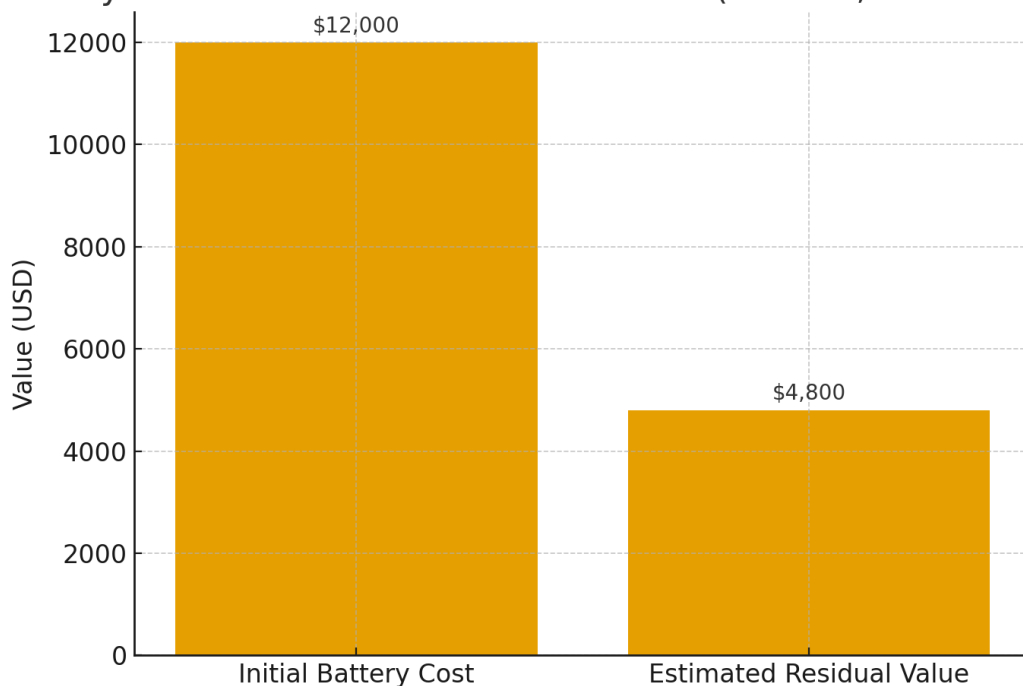


Fig 3: Comparison between Battery Purchase cost and estimated Residual Value

This approach improves financial confidence in asset-based lending by defining the long-term value of EVs. When supported by a strong second-hand market and reliable tools for assessing battery health, the market has the ability to grow. In Kenya, reducing the uncertainty around EV technology can be achieved by building local data on battery performance, training qualified assessors, encouraging standardised methodologies for battery assessment and developing resale value forecasts.

As a result, financing mechanisms will improve, EV ownership costs will decrease, and the country can promote a circular economy model by creating second-life markets for used EV batteries for use in areas such as backup power systems and decentralised microgrid systems. In China, NIO's battery-as-a-service model separates battery ownership from the vehicle, lowering upfront costs and enabling predictable resale value. This approach, backed by centralized battery health tracking and second-life use in energy storage, has boosted financing confidence and EV adoption.⁶ This brief outlines a practical strategy for using residual value to strengthen Kenya's EV ecosystem through improved financing, policy support, and technical capacity.

Importance of Residual Value in EV Financing

Stakeholders Recognizing the Importance of Residual Value in EV Battery Financing

Stakeholder	Local + Global actors	Role
Banks & Financiers	Lenders and lease providers <i>Kingdom Bank, NCBA</i>	Use residual value to reduce risk, offer better loan terms, and improve loan recoverability.
Vehicle Manufacturers (OEMs)	EV and battery producers <i>Renault, NIO, BasiGo, Roam</i>	Introduce battery leasing/BaaS models to separate battery cost, reduce depreciation risk, and ensure resale predictability.

⁶<https://ir.nio.com/news-events/news-releases/news-release-details/nio-inc-announces-launch-battery-service-and>

Insurance Companies	Develop residual value models to underwrite vehicle and battery risks <i>GA Insurance, Directline)</i>	Consider battery lifespan and residual value when setting premiums and assessing total risk.
Secondary Market Platforms	Resale and second-life battery networks (currently informal market in Kenya, they are unregulated and lack official recognition)	Depend on reliable battery health and value to price and purchase used batteries.
Governments & Regulators	National and regional policymakers <i>NEMA, KEBS, KRA</i>	Support battery traceability, SOH standards, and residual value tracking to promote circular economy.
Development Agencies	Funders and technical partners <i>GIZ, World Bank, UNEP)</i>	Engaging through research initiatives and pilot projects that apply residual value models to inform EV financing and adoption strategies
Battery Recyclers/Refiners	Globally Companies like Redwood Materials, ReCell	Rely on predictable end-of-life battery values to invest in recycling and material recovery.
Academia & Think Tanks	Research institutions (AfEMA, Strathmore University)	Provide data, modelling, and policy recommendations on residual value and financing frameworks.

Residual Value and Its Impact on EV Financing Dynamics

1. **Loan Approval and Lending Terms:** Lenders use residual value to assess the recoverable worth of an EV, which informs loan-to-value ratios, interest rates, and approval criteria. Higher residual value reduces perceived risk and enables more competitive financing.
2. **Lease Structuring:** Leasing firms depend on accurate residual value forecasts to calculate depreciation. Higher projected end-of-term value leads to lower monthly lease payments, improving affordability for end users.
3. **Insurance Pricing and Risk Management:** Insurers incorporate residual value into premium calculations and coverage decisions. Knowing the retained value of a battery helps ensure fair compensation in cases of loss or damage.
4. **Secondary Market Development:** Strong residual values enhance the resale potential of used EVs and make battery packs more attractive for second-life applications (e.g., stationary storage in), boosting market liquidity and overall asset value.

Calculating Residual Value

An EV battery's residual value (RV) refers to its remaining monetary or functional worth at the end of its first life in an electric vehicle. Accurately calculating the residual value of EV batteries is essential for integrating it into financing models. The residual value is determined by assessing the battery's remaining capacity(SOH), market demand for second-life applications, and repurposing costs. The following methodology, adapted from global studies, provides a structured approach⁷:

1. A general formula can be:

$$RV = (IC \times SOH \times MD) - PC$$

RV = Residual Value of the battery

IC = Initial Cost of the battery/ New or replacement cost (\$)

SOH = State of Health (percentage of original capacity remaining, expressed as a decimal)

MD = Market Demand Factor (a multiplier based on demand, typically between 0.5 and 1.5)

⁷ <https://iopscience.iop.org/article/10.1088/1755-1315/461/1/012027/pdf>

PC = Processing Costs (logistics, testing, repurposing, or recycling costs)

2. State of Health (SOH) Assessment:

State of Health measures the battery's current capacity relative to its original capacity, typically expressed as a percentage. For example, a battery with 80% SOH retains 80% of its initial energy storage capacity.

Many electric vehicles feature proprietary onboard systems that monitor battery performance, but a growing number of third-party IoT-based diagnostic tools now allow independent tracking of key indicators such as charge–discharge cycles, temperature exposure, and degradation patterns. These tools are essential for estimating the SoH of a battery. Common SoH estimation methods include voltage analysis, internal resistance measurement, coulomb counting, and machine-learning models that analyze historical usage and environmental data. Examples of such tools include LeafSpy (used for Nissan Leafs), Torque Pro, and Battery Monitor by Ewert Energy, which provide real-time dashboards and SoH readouts accessible through mobile devices or diagnostic interfaces. Including standardized SoH assessment tools can significantly enhance transparency and accuracy in residual value estimation.

In Kenya, the development and adoption of standardized and regulator-approved methodologies by the Kenya Bureau of Standards (KEBS) would enable consistent monitoring of battery performance and valuation. Establishing clear standards alongside the selection of preapproved and calibrated hardware, will ensure uniformity in data collection and improve the credibility of residual value assessments across the industry.

3. Market Valuation for Second-Life Applications:

Estimate the battery's value in secondary markets, such as stationary storage or microgrids. In Kenya, a KeEBI industry survey indicates second-life batteries can fetch **KES10,400 to KES15,600 (\$80 to \$120)⁸ per kWh** for microgrid applications, compared to KES 19,500 to KES 26,000 (\$150 to \$200) per kWh for new batteries.

Adjust for repurposing costs including testing, grading, and refurbishment, which industry stakeholders in Kenya estimate to range between **KES 1,300 and KES 2,600 (approximately USD 10 to 20) per kilowatt hour**.

⁸ Information from industry - QTron industries

Residual Value (RV) of an EV battery is typically estimated using a combination of depreciation models, market demand, and State of Health (SOH).

MD- Market demand in Kenya is still very low therefore a value of 0.5 can be used.

4. Depreciation and Technological Obsolescence:

Account for battery depreciation based on usage patterns (approximately 1- 3% capacity loss per year depending on usage, local conditions and chemistry) and technological advancements, such as the adoption of lithium iron phosphate (LFP) batteries, which have on average longer lifespans than nickel manganese cobalt (NMC) chemistries.

5. Regulatory and Environmental Adjustments:

Factor in compliance costs for Kenya's evolving Extended Producer Responsibility (EPR) regulations, such as recycling fees.⁹

In the absence of established battery recycling infrastructure, residual value estimates should incorporate environmental risk premiums to reflect potential end-of-life disposal liabilities. These premiums can reduce the residual value by an estimated 5 to 10 percent, as noted in global assessments of battery lifecycle risks and circular economy frameworks.¹⁰

6. Kenyan context scenario:

Example: A 60 kWh battery with 80% SOH

$$\text{Remaining Capacity} = 80\% \text{ of } 60\text{kWh} = 48\text{kWh}$$

$$\text{Initial Battery Cost} = \$12,500$$

$$\text{Market price for second life use} = \$75 \text{ per kWh}$$

$$\text{Repurposing costs} = \$15 \text{ per kWh}$$

$$\text{Regulatory fees} = \$5 \text{ per kWh}$$

Market demand: 0.5 as the second life market is still underdeveloped in Kenya

⁹ Not yet fully established in Kenya but in the USA, \$3- \$9 per kWh in 2024

¹⁰ IRENA, 2020; European Commission, 2020

Calculation:

$$RV = (12500 \times 0.8 \times 0.5) - (0.8 \times 60 \times 20) = \$4,040$$

Using the average market resale value of EV batteries at **\$75/kWh**

The same battery will retail on the open market (for example resale platforms, repurposing companies or recycling buyers) at:

$$(48\text{kWh} \times \$75/\text{kWh}) = \$3600$$

The *resale value* refers to the actual market price at which the battery can be sold on the open market, typically calculated as the prevailing price per kWh multiplied by the remaining usable capacity of the battery. However, in early stage markets such as Kenya and other African countries, resale prices are likely to be less consistent due to limited buyer knowledge and market immaturity, but are expected to stabilize as the ecosystem develops and more transactions occur.

In contrast, the *residual value* is a forecasted estimate intended to provide greater predictability for market actors. Enhancing the accuracy of this model through iterative refinements by incorporating more precise estimations of repurposing and processing costs, will strengthen its reliability and applicability across the value chain.

With residual value acknowledged, the battery is treated as a recoverable asset, reducing the financing risk.

This allows:

- Lower interest rates
- Longer loan terms
- Improved monthly affordability

Opportunities for Second-Life Applications

The residual value of electric vehicle (EV) batteries unlocks significant opportunities for second-life applications in Kenya. Some of the applications include:

1. Stationary Energy Storage Systems (ESS)

- Grid Stabilisation - Providing frequency regulation, peak shaving, and load balancing can all significantly assist the Kenyan grid, which suffers from instability.
- Renewable Energy Integration - Storing surplus solar or wind energy for use during peak demand and to decrease energy bills (e.g., in mini-grids or solar home systems). Kenya has an approximate power generation capacity of 3.3GW¹¹ with a record high demand of approximately 2.4GW¹², leaving up to 900 MWh of energy available for storage and deployment in applications such as e-mobility, grid balancing, and backup systems.
- Backup Power - Providing energy storage in homes, businesses, hospitals, or telecom towers for backup during outages.

2. Off-Grid and Rural Electrification

- Power rural microgrids or solar-powered systems in areas without grid access.
- Serve as storage solutions in humanitarian or disaster-relief settings.

3. EV Charging Infrastructure

- Buffer energy demand at fast-charging stations to reduce peak grid loads.
- Serve as intermediate storage for solar-powered charging stations.

4. Temporary or Mobile Power

- Power for temporary installations (festivals, events, construction sites).
- Portable energy banks for field operations, mobile clinics, or emergency response.

Some other uses include grid tie application for load shifting, and education to teach circular economy principles, and in Industries to provide short-term backup power.

¹¹ <https://energy.go.ke/kenya-increases-power-connection-consumers>

¹²

<https://newsroom.kplc.co.ke/articles/electricity-demand-hits-a-new-record-high-of-2316-mw-on-the-back-of-enhanced-connectivity>

EV Battery Lifecycle

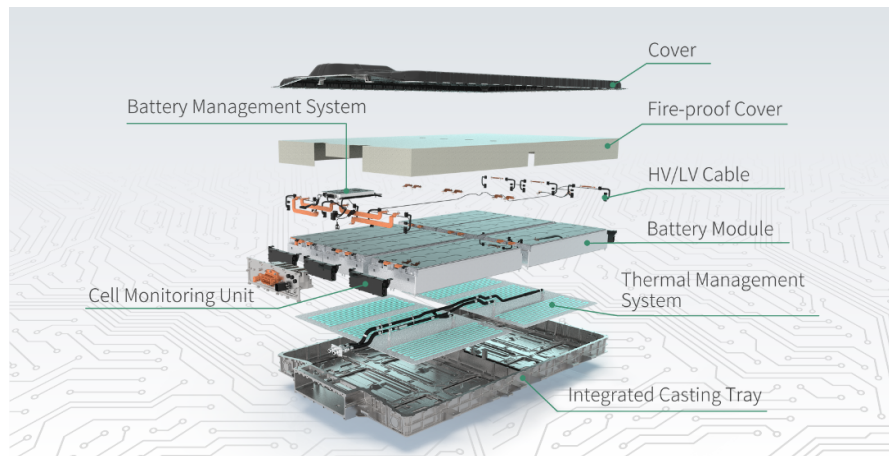


Fig 4: Internal parts of an E4W battery

A study by P3 Group examining over 7,000 electric vehicles found that batteries retain on average 80% or more of their original capacity after 200,000 kilometres of use.¹³ This finding is significant because it demonstrates that EV batteries degrade much more slowly than commonly perceived, reinforcing their long-term reliability and value. Integrating such empirical evidence into local valuation models can help financial institutions and insurers better estimate residual value and reduce perceived risk. For Kenya and other emerging markets, where financiers often cite battery degradation uncertainty as a barrier to offering affordable credit, evidence of this durability could underpin the development of standardized depreciation models and increase investor confidence in EV assets.

EV batteries follow a predictable lifecycle that determines their functional, economic, and environmental value over time. Understanding this trajectory is critical for stakeholders in transport, energy, and circular economy sectors.

Below is a comparison of State of Health (SoH) decline over cycle life for NMC and LFP battery chemistries. LFP batteries typically retain capacity over more cycles, making them better suited for commercial fleet applications where long life and safety are prioritized.

¹³ Hackmann, M., Knörzer, H., Pfeuffer, J., & Jeckel, P. (2024). Battery aging in practice: Analysis of over 7,000 vehicles provide deep insights into battery life and vehicle residual value. P3 group GmbH. https://www.p3-group.com/wp-content/uploads/2024/11/241125_Whitepaper_SOH_EN.pdf

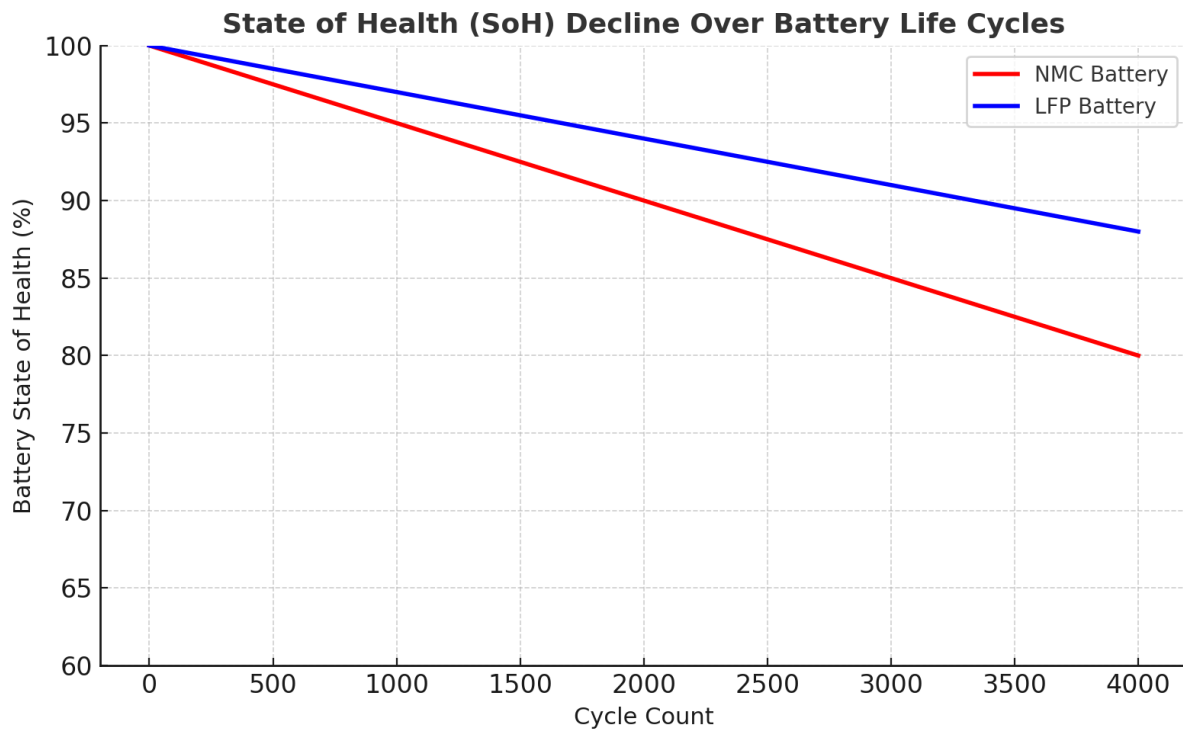


Figure 5: State of Health Decline over Battery Life Cycles

Phase 1: End-of-Warranty (EoW)

The end-of-warranty begins at the expiration of the standard OEM warranty (typically 8 years or 160,000 km for an electric four-wheeler; electric two-wheelers in Kenya are subjected to more arduous use, doing 3 - 5x the daily kilometres, which would reduce the years of service significantly). Most batteries retain $\geq 80\%$ of their original capacity.

Some manufacturers offer extended care programmes up to 10 years/1,000,000 km,¹⁴ subject to regular battery health checks, reflecting rising confidence in global battery durability. Local warranties by BYD Kenya run for 8 years or 150,000 km.¹⁵

Phase 2: End-of-First-Life (EoFL)

End-of-first-life (EoFL) is reached after **10–12 years or up to 300,000 km**, when the battery no longer meets automotive performance needs.

Remaining capacity: 60–80%.

Batteries at this stage are ideal for second-life applications.

¹⁴

<https://newsroom.lexus.eu/ux-300e-first-all-electric-lexus-offers-class-leading-quality-and-10-years-peace-of-mind-on-battery/>

¹⁵ <https://www.byd.com/ke/support/service-maintenance>

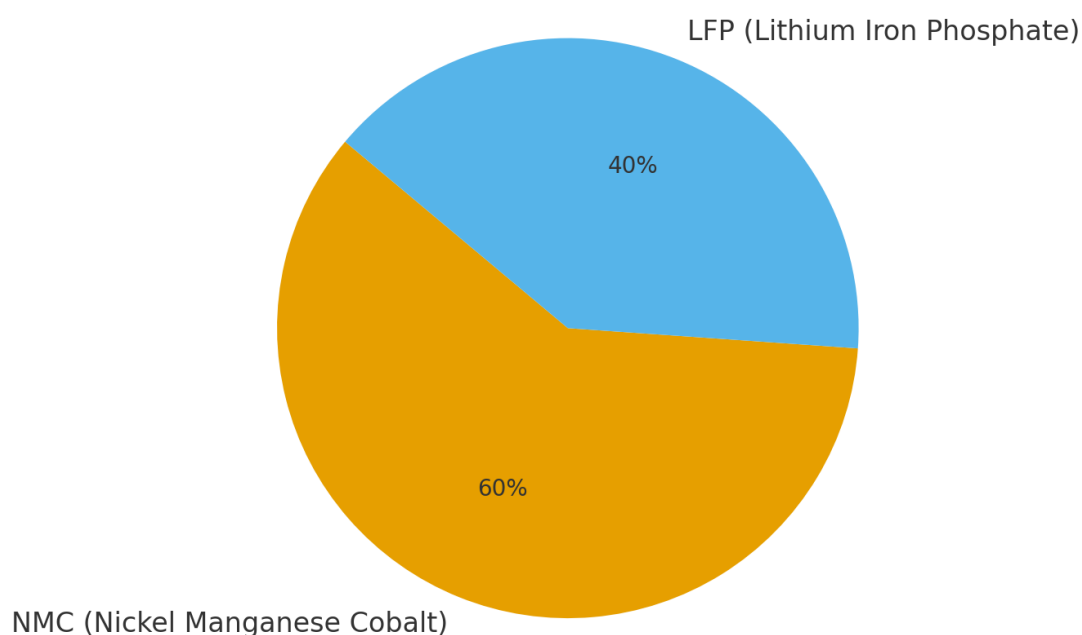
Second-life use can extend battery service life by 5–8 years, depending on conditions and usage.

Phase 3: End-of-Second-Life (EoSL)

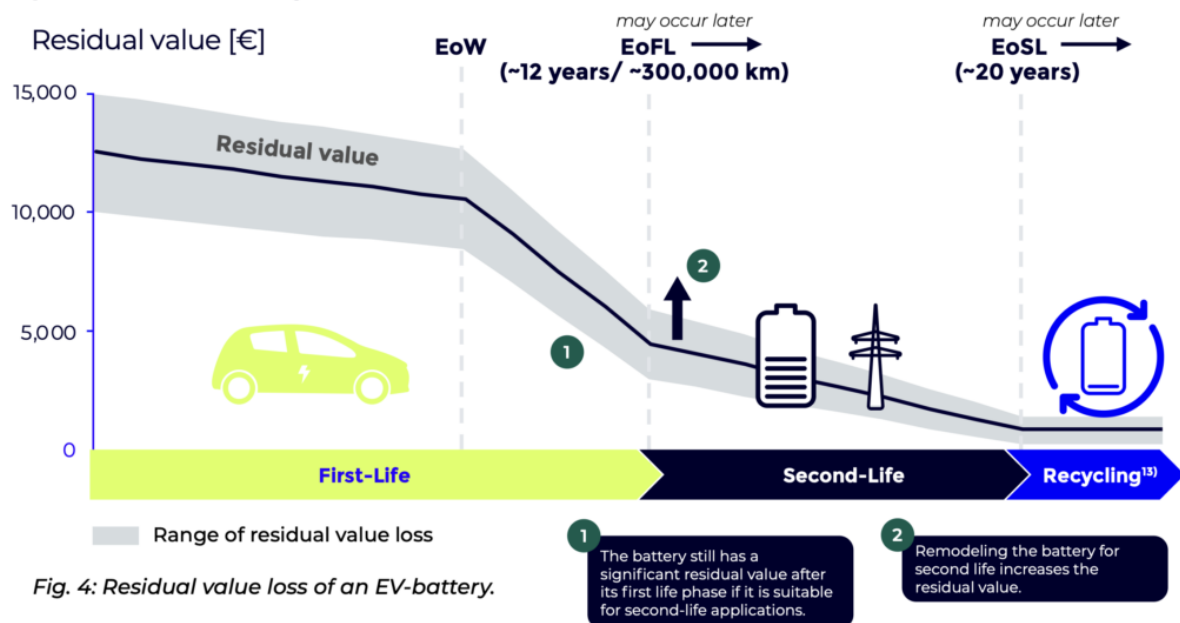
Battery end-of-life typically occurs at approximately 15–20 years of total service for personal-use vehicles. However, for commercial-use vehicles, which operate at much higher utilization rates, often driving two to four times more kilometers annually, battery lifespans are significantly shorter, typically lasting 50–75% less, or about 7–10 years on average. This distinction is critical when projecting replacement cycles and calculating residual values for electric fleets, particularly in high-mileage applications such as delivery, freight, and ride-hailing. The battery is no longer usable for energy storage or mobility but retains material value.

Recycling enables the recovery of key materials such as lithium, nickel, cobalt, manganese, iron, and copper supporting raw material circularity and sustainable battery production across both NMC (Nickel Manganese Cobalt) and LFP (Lithium Iron Phosphate) chemistries. In Kenya, the market currently leans toward NMC-based imports, though LFP batteries are gaining traction due to lower cost and improved safety. As these technologies mature and more batteries reach end-of-life, recycling will evolve from a nascent opportunity into a critical enabler of the region's circular energy economy.

Estimated Split of NMC vs LFP Batteries in Kenya (2025)



An exemplary progression of the residual value throughout the lifecycle phases of a battery¹²⁾



Battery Ageing Mechanisms

- **Cyclic Ageing:** Resulting from usage. **Frequent fast charging** and **deep discharges** accelerate wear. Optimal range: **20–80% SoC**.
- **Calendar Ageing:** Chemical degradation over time, accelerated by heat and high SoC which accelerated factors like electrochemical stress. Slowed by storing at **10–50% SoC** in cool conditions.

Feature	Calendar Ageing	Cyclic Ageing
What is it?	Chemical degradation that occurs over time, even when the battery isn't being used.	Wear and tear that results directly from charging and discharging the battery.
Accelerated By	• High temperatures • High state of charge (SoC) for long periods.	• Frequent fast charging • Deep discharge cycles (e.g., 100% to 0%).
Best Practices	• Store the battery in a cool place. • Keep the charge between 10–50% for long-term storage.	• Maintain a daily charge between 20–80%. • Avoid constant deep discharges.

Value Preservation and Circularity

EV batteries retain economic utility well beyond vehicle use. Second-life markets and mature recycling processes are unlocking residual value and closing the loop on resource use. These dynamics strengthen the case for EVs as long-life, circular assets, supporting investment, regulation, and sustainable infrastructure development.

Africa's Insurance Sector on EV Battery Residual Value

The development of electric vehicle (EV) insurance products is still at an early stage in Africa, with only a few insurers adapting their policies to cover EV-specific risks. A look at various firms across the continent, EV insurance is fragmented, and often excludes battery coverage, the most expensive component reflecting infrastructural and financial risks.

In Africa, the electric vehicle (EV) insurance landscape is still emerging, with South Africa and Nigeria leading in tailored products. The table below shows the different policies from the two countries.

EV Insurance Coverage in Africa (South Africa & Nigeria)

Country	Insurance Company	Policy Type	EV Specific Provisions	Notes/source
South Africa	Discovery Insure	Usage-Based Insurance (UBI)	Rewards safe driving with discounts; applies to EVs under standard motor policy	Discovery Insure
	Santam	Standard Motor Policy	Covers EVs but premiums adjusted for high-cost components (e.g., batteries)	Santam
	OUTsurance	Motor Insurance	Covers EVs, optional add-ons	OUTsurance

			for batteries and charging risks	
	King Price	Motor Insurance	Covers EVs, offers battery-related add-ons	King Price
	Naked Insurance	Digital Motor Insurance	EV coverage with optional add-ons for charging/battery risks	Naked Insurance
Nigeria	AXA Mansard	Tailored EV Coverage	Partnered with BYD to provide battery and liability coverage	AXA Mansard
	Leadway Assurance	Customizable Motor Policies	Includes high-cost EV components (e.g., batteries)	Leadway
	Cornerstone Insurance	Motor Policies with Add-ons	Covers battery replacement, charging risks, and cyber liability	Cornerstone Insurance
	AIICO Insurance	Motor Insurance	EV coverage offered, but batteries usually excluded	AIICO

	Custodian Insurance	Motor Insurance	Offers EV coverage, typically excludes batteries	Custodian Insurance
	Niger Insurance	Motor Insurance	EV coverage provided, with battery exclusions	Niger Insurance

In Rwanda and the wider East African region, EV insurance is gradually taking shape, with Radiant Yacu offering microinsurance for electric motorcycles that covers damage, fire, liability, and disability, while SONARWA General Insurance adapts standard comprehensive policies to include EVs.

In Kenya, insurers are mixed in their approaches, we have detailed these approaches in the table below:

Insurance Company	Policy Type / Approach	EV-Specific Provisions	Key Exclusions / Limitations	Notes & Sources
CIC Insurance	Comprehensive & Third-Party	EVs insured at the same rate as ICE vehicles; offers tailored battery cover if battery is unmodified (i.e., not tampered with or altered).	Battery coverage limited to manufacturer-approved units; no coverage if battery is modified.	CIC Insurance
Britam	EV Insurance (launched recently)	- Battery protection: covers repair/replacement of damaged batteries. - Out-of-charge recovery: roadside assistance if vehicle runs out of charge (similar to fuel rescue). - Comprehensive risk coverage including accidents, theft, and fire.	Coverage details are still new; terms may vary as Britam refines the product.	Britam

APA Insurance	Currently no EV cover	Reviewing possibility of comprehensive EV policies in future.	No current EV products due to lack of repair infrastructure and uncertainty around battery replacement costs.	APA Insurance
Directline	Motor Insurance	EVs covered at standard rates; "all risk" cover available for PSVs. All risk cover is a wider protection policy covering accidental loss/damage beyond limited categories.	Batteries excluded in most cases unless under "all risk" cover for public service vehicles (e.g., buses, taxis, boda bodas).	Directline
Heritage Insurance	Selective EV cover	Provides coverage depending on vehicle type.	Excludes PSVs (public service vehicles); battery coverage unclear.	Heritage Insurance
ICEA Insurance	EV Coverage under Motor Plans	Covers EVs and motorcycles under different plans.	Batteries are excluded across all plans; focus remains on vehicle body and liability.	ICEA Lion

Explanations of Insurance Terms

- **Battery protection:** Coverage for repair or replacement of the EVs battery if damaged in an accident, fire, or theft (terms vary by insurer).
- **Out-of-charge recovery:** A roadside assistance service that provides towing or mobile charging if the EV battery runs out of charge while on the road.
- **All risk cover:** A broad form of insurance that protects against accidental loss or damage from most causes (except those explicitly excluded), providing greater protection than standard or named-peril policies.
- **Usage-Based Insurance (UBI):** Refers to how much, how well, and under what conditions the vehicle is used, rather than just on static factors like age, model, or driver profile.

Unique African Considerations for EV Insurance

1. **High Premiums:** Insurers (in Kenya, and Africa at large) often charge higher premiums for EVs due to limited market knowledge, expensive imported parts, and a lack of

certified EV repair networks.

2. **Battery Coverage Gaps:** EV battery replacement is a critical concern, as batteries are the single most expensive component of an EV. For example, in South Africa, replacement costs can exceed R100,000 (\$5,766) for a mid-sized 40–50 kWh battery. Without clear residual value data and local recycling/repurposing systems, insurers are reluctant to underwrite these risks.
3. **Charging-Related Risks:** Many standard motor policies exclude risks linked to charging (e.g., fire while charging at home or damage from faulty public chargers). These risks can only be covered through insurance add-ons (these are optional extra coverage purchased in addition to the standard policy).
4. **Innovative Bundled Products:** Some products, such as LV's *"Electric X"* (South Africa), are experimenting with bundled offerings that combine insurance, vehicle leasing, and home charging solutions in a single package, lowering barriers for first-time EV adopters.

Challenges in Leveraging Residual Value

Leveraging the residual value of electric vehicle (EV) batteries to enhance financing in Kenya is hindered by several challenges. These barriers impede accurate valuation, increase financial risks, and limit the integration of residual value into lending, leasing, and insurance models. Below are the five most critical challenges:

1. **Lack of offtakers:** There is no established network of buyers or aggregators for second-life EV batteries. Without committed offtakers, secondary markets remain illiquid, making it difficult for financiers to assign residual value to EV batteries with confidence. Current second life operators such as Enviroserve, Acele Africa and Drivelectric are doing targeted B2B transactions or pilot projects.
2. **Limited Historical Data:** Kenya lacks extensive resale and battery history and health degradation data for EVs. This scarcity complicates risk assessments, leading financiers to adopt conservative loan terms and higher interest rates, stifling EV adoption.
3. **Inconsistent SOH Monitoring and Lack of Standardization:** The absence of standardized tools to track battery State of Health (SOH), coupled with diverse

battery chemistries (e.g., LFP, NMC) and designs being that this is a market where all assembler or importers are testing products for suitability and information is rarely shared across the industry due to IP protections, which increases valuation uncertainty. This inconsistency hinders accurate residual value estimation and increases costs for repurposing, deterring financiers and secondary market players. Financiers also rely on assessors to determine these values; therefore, having limited knowledge on the models used to calculate them limits business model innovation.

4. **Regulatory Gaps:** Kenya has an underdeveloped policy framework for battery recycling, second-life applications, and end-of-life management. While significant strides have been made, including the introduction of the Sustainable Waste Management (Extended Producer Responsibility) Regulations, 2024, we still have a long way to go before achieving a well-regulated battery management sector. This uncertainty deters investment, limits innovation, and undermines confidence in the long-term viability of battery residual value.
5. **Limited Infrastructure:** The limited availability of facilities for battery testing, grading, and repurposing continues to hinder the growth of a viable secondary market. In the absence of robust infrastructure, the cost of refurbishing batteries for second life applications such as mini grid energy storage remains prohibitively high, undermining their economic viability. While the current volume of retired batteries has not yet justified large-scale investment in such facilities, this gap presents an emerging challenge as battery stock accumulates in the near future.
6. **Environmental and Regulatory Risks:** Improper battery disposal poses significant ecological hazards, including soil and water contamination from heavy metals. The lack of a robust battery takeback exacerbates this risk by leaving batteries in the hands of the user who has little to no information on the right disposal techniques.

Global Best Practices

Recent international developments provide actionable insights for Kenya:

1. **Extended Producer Responsibility (EPR) Regulations:** The EU's 2023 Battery Regulation mandates recycling and second-life applications, ensuring batteries retain economic value. Compliance has driven a 15% increase in the use of repurposed batteries since 2023.
2. **Standardised SOH Monitoring:** The EU's battery passport, a digital record capturing battery health and lifecycle data, has increased financier confidence.¹⁶ Similarly, China's blockchain-based battery tracking systems offer enhanced transparency across the value chain.¹⁷ While establishing a universal monitoring standard may not be practical at this stage, providing a set of recommended and proven methods can introduce a level of consistency. This approach allows users to select from validated options, promoting greater data reliability and alignment across the industry.
3. **Secondary Market Innovation:** In the U.S., Redwood Materials processes over 20 GWh of end-of-life EV batteries annually, equivalent to approximately 250,000 vehicles. The company repurposes usable battery modules for stationary energy storage through its Redwood Energy division. This approach highlights the commercial viability of second-life battery applications and the broader revenue potential of recycling and reuse within the battery value chain.

Local Case Study

Drivelectric E-Mobility

Drivelectric, a Kenyan e-mobility company, is advancing the e-mobility landscape through innovative second-life applications of EV batteries, specifically from Nissan Leaf and Boma EVs, providing a compelling case study for leveraging the residual value of EV batteries.

Drivelectric has executed three proof-of-concept deployments to evaluate the commercial and technical viability of second-life EV batteries across diverse use cases. These include a 2.4 kWh residential backup system in Nairobi, a 7.7 kWh school energy solution in Mombasa, and a 24 kWh battery powering a solar-integrated fuel station in Lodwar. While detailed cost

¹⁶<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular>

¹⁷ Shen, D., Liu, Q., & Cudjoe, D. (2024). Competing Manufacturers Adopt Blockchain for Tracing Power Batteries: Is There a Win-Win Zone? *Energies*, 17(12), 2868.

data remains limited due to their pilot nature, these projects affirm the potential of repurposed batteries in residential, institutional, and mobility-linked applications.



a) 6.8kWh "Greencell" pilot repurposed battery using Gen 1 Nissan LEAF EV battery modules
b) 7.7kWh repurposed storage solution with original battery pack form factor with inverter

Field observations indicate lower degradation rates in privately used EV batteries compared to high-cycle fleet applications such as taxis. Leveraging this data, Drivelectric is developing predictive degradation algorithms to quantify residual battery value. This enables the design of performance-linked financing models, enhancing lender confidence and positioning second-life batteries as credible, lower-cost alternatives to new units. The approach directly supports the advancement of Kenya's circular economy agenda by extending battery life by an estimated 30–50% through second-life applications and reducing the overall cost of electric mobility by 10–20% through lower battery replacement and energy storage costs. These gains not only make EV ownership more affordable but also strengthen the economic case for local battery repurposing and recycling industries.



R&D Lab for EV battery testing and repurposing

Despite their progress, Drivelectric faces significant challenges in scaling second-life applications. Limited real-time data collection from vehicles, driven by restricted access to non-fleet battery data, hampers SOH tracking, while high repurposing costs and a lack of technical skills pose barriers. User perception of repurposed batteries as inferior to new ones further complicates market acceptance. Kenya's nascent regulatory framework, lacking standards for battery repurposing and large-scale recycling capacity, adds complexity, with environmental factors like high temperatures necessitating cooling systems to maintain performance.

Drivelectric advocates for innovative financing models, collaboration with manufacturers, and Extended Producer Responsibility (EPR) policies to foster a secondary battery market. Their work, supported by partnerships like GIZ, underscores the potential of second-life batteries to create jobs, expand energy access, and integrate residual value into EV financing, offering a scalable model for Kenya's e-mobility transition.

Recommendations

To effectively leverage the residual value of EV batteries in Kenya, the first priority is to support **the repurposing market**, creating immediate demand and laying the foundation for recycling in the longer term. Repurposing is the most appropriate near-term focus because it is less capital-intensive, can be implemented with today's limited end-of-life volumes, and delivers quick market value by extending battery use in applications such as stationary storage. It also builds the technical, regulatory, and financial capacity, as well as the data ecosystem, that will be critical for future recycling. Recycling, by contrast, requires high volumes and large-scale investment, making it more viable in the medium to long term once Kenya's EV adoption matures.

1. Formalisation of the Repurposing Market

- **Technical:** Standardize State of Health (SOH) measurement through IoT-enabled diagnostics and accredited testing centres, harmonize data collection, and invest in technician and facility capacity building. KEBS should develop standardized valuation frameworks aligned with international benchmarks to ensure comparability and enable future cross-border trade.
- **Regulatory:** Introduce licensing requirements for repurposing facilities and professionals, operationalize Extended Producer Responsibility (EPR), and establish local certification standards for repurposed batteries (drawing from international models such as UL 1974¹⁸) to ensure safety and credibility.
- **Financial:** Develop tailored financing and insurance products linked to residual value, and launch targeted capacity-building initiatives for banks, MFIs, and insurers. Pilot performance-based financing programs, such as low-interest loans pegged to verified residual value, to encourage adoption.

2. Structured Transition and Policy Alignment for Battery End-of-Life

Adopt a phased approach to end-of-life battery management, beginning with stockpiling and controlled export in the near term, then transitioning toward a regional recycling facility as

¹⁸ Le, R. (2024, May 21). *Overview of ANSI/CAN/UL 1974:2023 – The standard for evaluation for repurposing or remanufacturing batteries*. UL LLC.
<https://static1.squarespace.com/static/6548618de92db95798675b91/t/66500e8f662879613c2ce957/1716522643117/Overview+of+ANSI+UL+1974-2023+202405-V1.pdf>

volumes grow over the next decade. To support this pathway, embed policy incentives and regulatory measures that encourage environmentally responsible second-life and recycling practices. This includes:

- Government incentives and tax relief for companies investing in repurposing and recycling infrastructure.
- Full implementation of Extended Producer Responsibility (EPR) mandates by 2035, aligned with projected battery end-of-life timelines.
- Targeted tax incentives to offset compliance costs (e.g., SOH reporting) and de-risk private sector investment in recycling facilities.

This combined strategy reflects Kenya's 10-year EV battery end-of-life horizon while ensuring regulatory certainty, market confidence, and alignment between environmental goals and private sector participation.

3. Data and Valuation Infrastructure

Establish robust, Kenya-specific data repositories in collaboration with EV companies and e-waste handling companies. Standardized data reporting protocols will improve valuation accuracy, transparency, and investor confidence.

4. Financing and Market Development

Upskill financiers and insurers in battery analysis and valuation through dedicated training modules, leveraging both international benchmarks and Kenya's pilot projects. By integrating residual value into total cost of ownership models, lenders can provide lower interest rates, longer loan terms, and enhanced affordability.

6. Standardized Residual Value Calculator for Kenya's EV Market

Develop and implement a contextualized residual value calculator co-created with insurers, second-life battery actors, and regulatory bodies such as KEBS and IRA. The tool should integrate Kenya-specific variables, such as State of Health (SOH) data calibrated to local conditions, use-case segmentation, secondary market demand, and localized cost inputs, to provide consistent, evidence-based valuations across the EV value chain. This standardized approach will enhance technical confidence, reduce perceived risk, and enable

performance-linked financing and insurance products, ultimately accelerating EV adoption and circular battery market development.

7. Secondary Market Infrastructure

Prioritize the establishment of local facilities for testing, grading, and repurposing of batteries. KEBS should spearhead development of certification and quality standards to ensure repurposed batteries meet safety, reliability, and market credibility requirements.

8. Public Awareness and Demand Creation

Conduct nationwide awareness campaigns to sensitize businesses and EV consumers on the opportunities presented by second-life battery applications. Emphasize the safety, affordability, and environmental benefits of repurposed batteries—particularly for stationary storage and backup energy systems—while addressing public concerns about improper disposal or accumulation. Awareness-building is critical to stimulate demand, attract investment, and position battery repurposing as a complementary stage in the circular value chain, extending battery utility before final recycling and maximizing overall resource efficiency.

Conclusion

Kenya's burgeoning electric vehicle (EV) market presents a pivotal opportunity to accelerate sustainable mobility, yet financing barriers rooted in residual value uncertainties continue to impede progress. As evidenced by the exponential growth in EV registrations, and the concentration of battery capacity in two-wheelers, the integration of accurate residual value assessments into lending, leasing, and insurance models is essential. By leveraging State of Health (SOH) data tailored to the local market, market demand for second-life applications, and structured valuation frameworks, stakeholders can mitigate risks, enhance affordability, and foster a vibrant secondary market. Global examples from China, the EU, and the U.S., alongside local innovations by entities like Drivelectric and WEEE Center, demonstrate how embedding residual value drives EV adoption through innovative models such as Battery-as-a-Service and standardized SOH monitoring.

To capitalize on this, Kenya must prioritize the formalization of a repurposing market as the foundational step toward a comprehensive circular battery economy; a trajectory that many African countries, with similarly nascent EV sectors and limited end-of-life volumes, are likely to follow. Repurposing offers immediate, low-capital pathways to extend battery life in applications like stationary energy storage, microgrids, and backup systems, building technical capacity, data ecosystems, and investor confidence before scaling to recycling. Key recommendations include standardizing SOH assessments through KEBS-accredited tools, operationalizing Extended Producer Responsibility (EPR) regulations, developing performance-linked financing products, and investing in infrastructure for testing and grading. Collaborative efforts among insurers, regulators, EV firms, and development partners will be crucial to pilot and validate these initiatives.

Ultimately, by translating battery lifecycle data into tangible financial metrics, Kenya can improve e-mobility economics and position itself as a regional leader in circular economy practices and advanced energy industries. However, without structured end-of-life management, discarded lithium-ion batteries pose serious environmental and public health risks including toxic chemical leakage (such as lithium, cobalt, and nickel compounds) that can contaminate soil and groundwater, and fire hazards caused by thermal runaway reactions in unmanaged waste. Prolonged exposure to these pollutants has been linked to respiratory illnesses, neurological damage, and ecosystem degradation. Addressing these risks through robust collection, repurposing, and recycling frameworks not only enhances EV

accessibility but also strengthens energy security, supports job creation, and safeguards environmental sustainability paving the way for a resilient, low-carbon future.