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Powering sub-Saharan Africa's two-wheeler transition: Policy, manufacturing and solar charging

Significance:

Sub-Saharan Africa, with its strong demand for affordable urban and peri-urban mobility, presents a major opportunity for electric two-wheelers. In October 2024, a team rode a Kenyan-designed Roam Air electric motorcycle over 6000 km from Nairobi to Stellenbosch using only solar power from a South African-designed battery and solar power plant, illustrating that electric motorcycles can already operate effectively under sub-Saharan African conditions. Adoption nonetheless remains constrained by high upfront costs, limited charging infrastructure, import dependence and fragmented policy environments. Greater regional policy coordination, local manufacturing capability and solar-integrated charging could reduce costs, improve energy access and enable the region to capture more of the economic value of the transition.

A 6000-kilometre proof of concept

In October 2024, a team from Stellenbosch University's Electric Mobility Laboratory rode a Kenyan-designed Roam Air electric motorcycle over 6000 km from Nairobi to Stellenbosch using only solar-generated power, completing the journey in 17 days through Kenya, Tanzania, Malawi, Zambia, Botswana and South Africa.¹ Across diverse terrain, international borders and variable climatic conditions, the bike, charged from a mobile solar array and battery energy system designed in South Africa and carried in a support vehicle, sustained an average of more than 350 km per day, including a 1000 km final day to Stellenbosch.^{2,3} The journey, documented in the seven-part docuseries *Recharging Hope*, was not intended as definitive proof of scalability but rather to demonstrate that the core engineering case for solar-charged, locally manufactured electric motorcycles is no longer speculative.

The expedition motivates the wider question this Commentary addresses: what is required to scale electric two-wheelers in sub-Saharan Africa while localising more of the value chain? We examine the emerging electric two-wheeler landscape, the constraints on scale, and the policy and industrial pathways that could accelerate local adoption and manufacturing.

Context

Cities across sub-Saharan Africa are experiencing rapid growth, and with this growth comes an increasing demand for transport. Motorcycles have become a widely used solution for last-mile transport across the region due to their affordability, agility in congested streets and ability to navigate poor road conditions. The number of motorcycles in sub-Saharan Africa rose from around 5 million in 2010 to more than 27 million by 2022, and in Kenya alone, motorcycle taxis (locally known as *boda bodas*) support an estimated 3 million riders.⁴⁻⁷ In Kenya, approximately 285 000 new motorcycles were registered in 2021 (about 71% of all newly registered motor vehicles that year), showing the dominance of two-wheelers in the country's motorisation pathway.⁸ South Africa is an exception to this regional pattern: motorcycle ride-hailing is far less established, and the country's policy environment has yet to anticipate two-wheeler electrification at the same scale. This widespread reliance on internal combustion engine (ICE) motorcycles brings significant drawbacks: fluctuating fuel prices, high maintenance costs, air pollution that poses serious health risks and substantial carbon emissions.

As governments and investors work to decarbonise transport in the region while fostering economic development, electric motorcycles have emerged as a promising solution. They produce zero tailpipe emissions, operate quietly and offer materially lower operating and maintenance costs.^{8,9} In Kenya, where about 90% of grid electricity is generated from geothermal, hydropower and other renewable sources, the well-to-wheel emissions case for electrification is particularly strong.^{8,10} Concerns nonetheless remain regarding affordability, local manufacturing capacity, charging infrastructure and rider safety regulation.

The two-wheeler landscape in sub-Saharan Africa

The shift to electric has only just begun. In Kenya, the most advanced market in the region, 4862 of 68 804 new motorcycle registrations in 2024 were electric (7.1%), highlighting the vast untapped opportunity.^{5,11,12} Continent-wide, electric two- and three-wheelers represented an estimated 0.2% of two- and three-wheeler stock in recent surveys, with most current models operating on lead-acid batteries with single-charge ranges below 50 km.⁹ Modern lithium-ion designs assembled for the African market, such as the Roam Air, substantially exceed this range, easing the operational case for urban duty cycles.⁸

Several pioneering companies are already operating at meaningful scale. Ampersand, founded in Rwanda in 2016, uses a battery-swap model in which riders pay for energy rather than owning the battery, and had deployed more than 5800 electric bikes across Rwanda and Kenya by May 2025.^{13,14} Spiro reported operating across seven countries (Togo, Benin, Rwanda, Kenya, Uganda, Nigeria and Tanzania), with 35 000 electric bikes in service and 500 million carbon-free kilometres driven, as of July 2025.¹⁵ Kenya-based Roam designs and manufactures electric motorcycles specifically for African roads and had approximately 4000 motorcycles in operation in Nairobi, having announced a supply agreement with Uber for 3000 units in 2023.^{16,17} These companies are not running pilots; they are building operating businesses at regional scale, and their models share a key insight: the business

of electric motorcycles in sub-Saharan Africa is not just about selling hardware, but about selling uptime, predictable energy and access to a network.

The economics are compelling at the rider level. A peer-reviewed life-cycle and total-cost-of-ownership study of an electric motorcycle assembled in Kenya for the African market reports an upfront price of USD2050, compared with USD1140 for a comparable 150 cc petrol motorcycle, an upfront premium of approximately 80%.⁸ At an assumed duty cycle of 90 km per day for 320 days per year over an 8-year lifetime, annual operating costs (fuel plus maintenance) fall from approximately USD1950 for the petrol bike to USD212 for the electric – an operating-cost reduction of close to 90%. The electric option becomes cheaper than the petrol option after about 7 months on a cash purchase and 2 months under a typical Kenyan asset-financing arrangement.⁸ For a commercial rider, a battery swap at a staffed depot also takes only a few minutes, preserving working hours that would otherwise be lost to charging and providing a predictable energy cost that contrasts sharply with the volatility of petrol prices. Whether these savings are ultimately passed through to passengers, or captured by riders, platforms or operators, is an open distributional question that warrants empirical study as fleets scale. Early qualitative work with mototaxi drivers in Lomé, Togo, indicates that rider uptake is also sensitive to whether the electric option matches or exceeds petrol-bike performance in everyday use.¹⁸

Africa's rapidly urbanising population, expected to roughly double by 2050, will intensify demand further, and ride-hailing and delivery platforms including Bolt, Uber, Jumia Food, Glovo and Mr D are actively electrifying their fleets, helping to de-risk the business case for manufacturers and operators.

Challenges to scale

Despite this momentum, several challenges constrain widespread adoption across the region.

Upfront affordability remains the most immediate barrier for riders. In Kenya, a new 150 cc petrol motorcycle typically costs around USD1100, while commercially available electric equivalents range from approximately USD1200 to over USD2000 depending on battery configuration – a premium that, without access to flexible asset financing, can be prohibitive for commercial riders operating on tight daily margins.⁸ Although the life-cycle economics favour electric models within a year of intensive use, the higher upfront cost is still a real burden for riders who often earn USD5 to USD10 per day. Access to affordable credit is limited across much of the region. Traditional banks are often hesitant to finance a new technology with a limited track record, and although battery-as-a-service and lease-to-own models are reducing the effective upfront cost, reaching the mass market requires broader financial inclusion and more accessible lending products.¹⁹ A clearer path forward is to translate the rapidly accumulating operational record (evidenced by Spiro's 500 million carbon-free kilometres and Ampersand's expanding swap network^{13,15}) into structured asset-finance products in which the daily fuel-cost saving can service the repayment. The Kenyan financing arrangements modelled by La Fleur et al. (in which a financing company holds title and the rider makes daily payments over an 18-month period) provide one template that could be standardised regionally.⁸

Charging infrastructure gaps present a related constraint. Outside cities where swap networks operate, riders have few reliable options for recharging. Grid reliability is inconsistent in many areas, and establishing a sufficient density of swap stations requires patient capital. Home charging, where available, tends to concentrate demand in evening hours when riders return from work, which can raise peak loads on already-stretched distribution networks. Modelling of full-fleet *boda boda* electrification in Nairobi indicates that uncontrolled overnight charging could raise national daily energy demand by up to 6.85 GWh and introduce peak loads as high as 2.4 GW, whereas managed daytime swapping aligned with solar output reduces both the peak grid burden and the system capacity required.¹⁰ Similar modelling for Cape Town's last-mile delivery motorcycle fleet finds that right-sizing the fleet and aligning charging with solar generation can reduce required system resources by more than 50%.²⁰ Range anxiety is therefore best

understood as partly legitimate (real grid and infrastructure gaps in non-urban contexts) and partly a legacy of earlier-generation vehicles: modern African-assembled designs achieve well over 100 km on a single charge under realistic conditions.⁸

Import dependency is a structural vulnerability. Historically, the vast majority of electric motorcycles in sub-Saharan Africa are imported, predominantly from China and India.²¹ This exposes the region to supply-chain disruptions and currency risk, and it means that sub-Saharan Africa remains a consumer rather than a producer of the technology underpinning its own mobility transition. Local manufacturers face a structural cost disadvantage against imported finished products, driven by limited economies of scale, high input costs, fragmented logistics and restricted access to finance – conditions that make it difficult for domestically assembled models to compete on price.^{21,22}

Policy fragmentation compounds the above. Divergent import duty regimes, inconsistent homologation standards and the absence of coordinated manufacturing incentives mean that companies face significant regulatory complexity when operating across borders, while local manufacturers cannot achieve the scale needed to compete on cost with imported products. A parallel and complementary challenge is rider safety: motorcycle ride-hailing is sometimes characterised as an urban nuisance, and a coherent industrialisation strategy will need to be coupled with credible safety, licensing and homologation rules so that two-wheelers are integrated into urban transport rather than restricted from it.²² Without a clear and predictable regulatory framework, companies face long-term risk and investors are reluctant to commit the patient capital that the industry requires.

Pathways to scale

These challenges are substantial but not insurmountable. Three interconnected pathways offer the greatest leverage for accelerating and localising the transition.

Local manufacturing

The case for local manufacturing is not merely aspirational; it is already being proven on the ground. Kenya-based Roam (formerly Opius) designs and manufactures electric motorcycles specifically engineered for African roads, load conditions and climatic environments. In 2025, the company reported that approximately 36% of its second-generation Roam Air was locally produced (including body panels, wire harnesses, connectors and the battery compartment, with more than 40 locally manufactured components in total), and set a public target of 70% in-house sourcing within 3–5 years.¹⁶ Reaching that target from the 2025 base will require continued investment in supplier development, electronics and battery assembly capability, and is ambitious rather than guaranteed. Collaborative research between Roam and Stellenbosch University's Electric Mobility Laboratory has produced peer-reviewed work on the grid and fleet implications of African-designed electric motorcycles.^{10,20} Ampersand has built battery-swap infrastructure locally in Rwanda and Kenya¹³, and Spiro has established operations across seven countries¹⁵, demonstrating that assembly, battery management and maintenance ecosystems can all be developed within the region.

The African Continental Free Trade Area provides a structural framework for lowering intra-African tariffs on locally manufactured electric motorcycles, potentially creating a continental market large enough to support efficient production at scale. The priority is to invest in specific supply-chain interventions (including battery assembly, motor controller manufacturing and skills development) that will build the regional industry from its current early stage. Local assembly plants and battery-recycling facilities create jobs, foster technical skills and lay the groundwork for a circular economy in which end-of-life batteries are managed responsibly and their residual value recovered, generating broader economic benefit that extends well beyond the transport sector itself.⁹

Regional policy coordination

Targeted policy is already shaping outcomes. Rwanda's April 2021 e-mobility package zero-rated import duties and VAT not only on imported electric vehicles but also on their components, spare parts,

batteries and charging equipment, alongside provisions for rent-free land for charging infrastructure and preferential electricity tariffs.²³ This is principally a demand-stimulus policy: it lowers prices for both imported finished electric vehicles and the parts used by local assemblers such as Ampersand and Rwanda Electric Motors. Its primary effect on these companies has therefore been to grow the overall Rwandan electric vehicle market within which they operate and to reduce the cost of imported cells and components that they integrate locally, rather than to provide a differential incentive against imported finished competitors.

A sharper example of a policy explicitly designed to incentivise local assembly is Kenya's Duty Remission Scheme for unassembled motorcycles (Legal Notice 112 of 2020), which waives import duties for manufacturers that localise a defined set of key parts; Roam's second-generation Roam Air qualifies under this scheme.^{16,24} South Africa has signalled intent to become a regional electric vehicle production hub through its Electric Vehicles White Paper (2023) and a 150% tax deduction for local electric vehicle manufacturing investment from 2026, although high import duties on finished electric vehicles persist.²⁵ The Electric Mobility Association of Kenya has proposed a more comprehensive package of fiscal incentives, including the removal of the 10% import duty on completely knocked-down electric two- and three-wheelers, the removal of the 25% import duty on lithium-ion batteries, VAT exemption on battery-as-a-service charging and leasing, and the introduction of a dedicated e-mobility electricity tariff.¹²

These national initiatives are encouraging, but they remain fragmented. The opportunity for sub-Saharan African countries is to move towards shared homologation standards, joint manufacturing-incentive zones and technology-transfer agreements that distribute the benefits of industrialisation across the region. A harmonised regulatory framework would also reduce the risk that deters private investment, encouraging the flow of the patient capital that early-stage local manufacturers need. The commercial logic for regional scale already exists: Roam's 2024 supply agreement with Uber for 3000 motorcycles and Spiro's reported seven-country footprint show that operators are already building at a regional level.¹⁷ What is required is the institutional framework to match that ambition.

Solar-powered charging infrastructure

The region's solar resource is one of its most significant competitive advantages for the mobility transition. The battery-swap model pairs particularly well with solar generation: swap stations distribute charging demand across daylight hours, aligning naturally with solar output and avoiding the evening peak loads that concentrated home charging creates.^{10,20} This system-level alignment means that solar-powered swap infrastructure reduces stress on the grid, can be deployed in areas without reliable grid access, and provides riders with a predictable and affordable energy cost. The 2024 E-Cross Africa expedition demonstrated this directly, using a mobile solar array to sustain more than 350 km per day without access to any fixed charging network.¹⁻³

Uganda-based Zembo reported operating 27 swap stations (7 with solar), with plans to expand to 60, as of 2023, providing a replicable commercial model for solar-integrated charging in peri-urban and rural contexts.²⁶ Investment in charging infrastructure should therefore be co-located and co-designed with solar generation capacity from the outset, and development finance institutions active in both sectors are well-positioned to support such integrated projects.

Conclusion

Electric two-wheelers represent one of the most significant low-carbon mobility opportunities available to sub-Saharan Africa. The market is growing rapidly, the technology has been validated under real-world conditions across the region, and the commercial models are already operating at scale. The 2024 E-Cross Africa expedition encapsulated what is already possible: over 6000 km on solar power, on a locally designed and partly locally manufactured motorcycle, without major modification and with minimal technical intervention.³

The principal challenges are clear: high upfront costs, limited charging infrastructure, import dependency, policy fragmentation and the need for safety regulation that integrates rather than restricts two-wheelers.

None is insurmountable. Local manufacturing capacity exists and is growing. Solar-powered charging is commercially deployable today. The African Continental Free Trade Area provides the framework for the regional coordination that can unlock manufacturing scale and reduce fragmentation across borders.

For researchers, the priority is to quantify the supply-chain investments and grid-integration strategies that offer the greatest leverage in building regional manufacturing capacity, and to study the distributional question of how operating-cost savings flow between riders, platforms and passengers. For policymakers, it is coordination: aligning national e-mobility frameworks with regional trade and manufacturing strategy, and learning from instruments such as Kenya's Duty Remission Scheme that explicitly reward local value addition. For investors, it is supporting the transition from import-dependent distribution to locally grounded production, with solar charging infrastructure as the enabling foundation. Electric motorcycles are no longer a distant prospect in sub-Saharan Africa; they are already part of a rapidly evolving mobility landscape. The question is whether the region will manufacture the vehicles its people depend on, charge them from its own abundant solar resource, and capture the full economic and social value of this transition.

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Declarations

We have no competing interests to declare. We have no AI or LLM use to declare. All authors read and approved the final manuscript.

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