



## Introduction

The electric mobility industry is nascent in sub-Saharan Africa but can significantly improve the livelihoods of millions of people and reduce the impact of the transport sector on the

environment.

This fact sheet focuses on two-wheel electric vehicles (“e-2W”) in East Africa, where motorcycles are a common mode of transport.

## Key Facts on Mobility in East Africa

Vehicle ownership rates in Africa are growing quickly at a rate of 10% per year but are presently low, with just 26 vehicles per 1000 people in sub-Saharan Africa compared to 182 vehicles per 1000 people in the rest of the world<sup>1,2</sup>.

Many of these motorcycles are often operated as taxi businesses that ferry both people and goods and employ numerous young people as drivers.

The penetration of electric vehicles is extremely low, with only 350 out of 3.2 million registered vehicles listed as using electricity in Kenya in 2019<sup>4</sup>.

Technology	Electric motorcycles (e-2W) and electric vehicles in general
Application	Motorcycles are often used as taxi businesses and provide jobs for millions of people in East Africa.
Technology Overview	Electric motorcycles use electric motors powered by rechargeable batteries and can typically travel between 40–150km on a single battery charge. Battery swap stations and charging hubs provide the energy for vehicles, and batteries usually take 1.5 - 4 hours to charge.
Economic and Financial Feasibility	Electric motorcycles have lower lifetime costs than petrol equivalents despite having roughly twice the CAPEX costs (\$2000 including batteries vs \$1000). Battery swap stations require \$1800 - \$2500 capital investment for batteries and chargers but can serve riders multiple times per day.
Start-up Models	Electric mobility start-ups in the region are exploring diverse models such as: electric motorcycle manufacturing and distribution, delivery services, ride hailing services, safari vehicle conversion and electrifying public transport. At least four e-mobility start-ups in East Africa have secured over \$1M in investment.
Benefits and Outcomes	Electric vehicles can reduce greenhouse gas emissions and local air pollution caused by fossil fuel vehicles. The industry can also create local jobs and increase earnings for vehicle operators.
Constraints and Risks	The EV market growth is constrained by prevalence of charging infrastructure. Ethical extraction of minerals and environmentally responsible disposal/recycling of batteries need to be addressed.



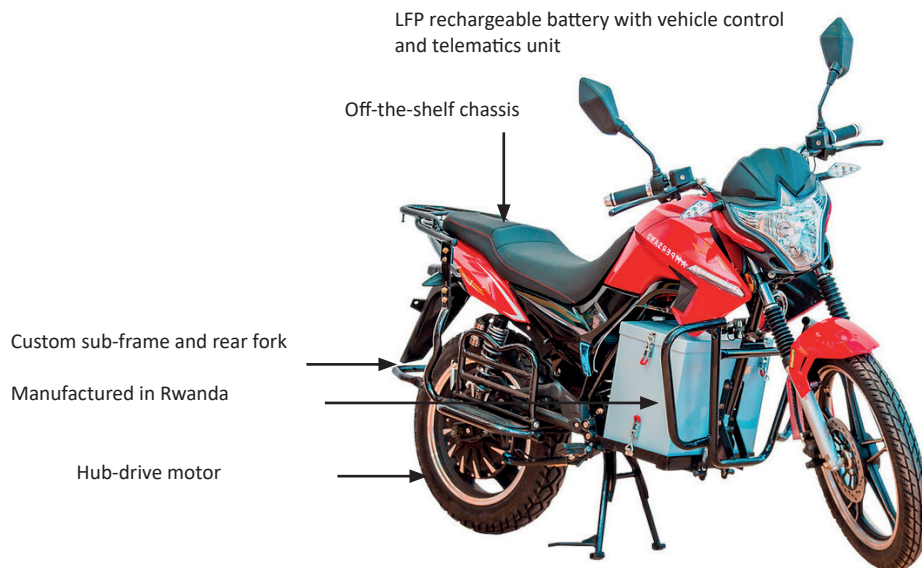
**10%**  
Growth of vehicle  
ownership rates in Africa  
per year

## Technical Information

Electric motorcycles use rechargeable battery packs to power a motor, which is either positioned in the centre (“mid-drive”) or integrated into the wheel hub (“hub-drive”). Battery packs often use LFP or another lithium-ion chemistry and deliver about 3–4 kWh, offering a range of 40–150km on a e-2W before needing to be recharged. The charging time for battery packs depends on the charging current, but typically ranges between 1.5–4 hours when using 1–4 kW chargers. To reduce waiting times, companies such as Ampersand in Rwanda have established battery-swap stations that swap their depleted battery pack for a fully charged one in less than five minutes.

Electric vehicles can be charged with solar power in off-grid areas and serve as anchor loads for mini-grids. Off-grid markets may require higher battery to vehicle ratios so that battery packs can be charged during the day when power is plentiful and cheap. Unused batteries could potentially be used to support mini-grid peak loads in the evening. Regulation of electric vehicle technology is still at the early stages in East Africa and there are no current standards for batteries, chargers, or EVs in general. Consequently, EVs in East Africa may not be subject to any safety or quality tests and EVs from different suppliers might require different charging infrastructure. Electric vehicles procured

from abroad are likely to be subject to standards of the country of origin and the standards of markets that the supplier exports to (e.g. US, EU). International regulations such as the UN Global Technical Regulations<sup>7</sup> Numbers 20-22 outline common standards for electric vehicles that often influence country’s national standards. EVs procured in East Africa should be vetted for compliance with international standards, but how they are being customised in local markets should also be considered. Many electric vehicle companies in East Africa customise the vehicle chassis or use proprietary battery technologies, and these modifications may be unregulated.



**25 – 80%**  
Estimated operational savings for riders of electric motorcycles compared to petrol motorcycles.

Graph 1: A hub-drive Ampersand electric motorcycle (Picture: Ampersand)

## Economic and Financial Feasibility

For riders, electric motorcycles offer operational savings estimated between 25-80% over petrol-fuelled motorcycles. Although the vehicle’s up-front price is typically double that of petrol motorcycles (\$2,000 including batteries vs. \$1,000), e-2W are less expensive over the vehicles’ lifetime. On-board sensors, such as those that track battery health, maintenance issues and geo-location offer riders and suppliers data that can maximise vehicle performance and enable easier access to finance. Companies operating a battery-swap model retain ownership of

the batteries and rent them out to customers to use and return. Under this model, motorcycle riders typically only lease or own the vehicle chassis, which is valued at less than \$1000.

Charging hubs or battery swap stations are essential infrastructure for electric vehicles and their availability can limit the market for EVs. An e-2W battery swap station requires an estimated \$1,800–\$2,550 in capital investment to purchase batteries (\$1000–\$1500) and chargers (\$300), with companies targeting a total presence

of 1.5 batteries for every vehicle on the road. In Rwanda, Ampersand riders pay \$1.17 for a fully charged battery swap and typically swap two to three times per day in order to ride 150km. Riders



increase their income by 41% over riders using petrol motorcycles, which would require 4L of fuel to cover the equivalent distance. The profitability of charging stations is largely dependent on the applied tariff.



## Case Study: E-mobility Start-ups in East Africa

One of East Africa's most mature e-mobility start-ups is Ampersand, which has 500 electric motorcycles on the road, ten battery swap stations in Kigali, and an average one million kilometers traveled by riders each month in 2022. Ampersand assembles their electric motorcycles that consist of an imported chassis, a customized battery pack with integrated electronics, and a chassis sub-frame that they manufac-

ture in Rwanda. Ampersand partners with asset financing companies to lease their motorcycles to riders who operate them as taxis.

Other start-ups are exploring the use of electric vehicles in other business models, such as using EVs for deliveries or converting safari vehicles to hybrid or electric models. In addition to lower operating costs, start-ups are highligh-

ting other EV features as value propositions to their customers, such as environmental friendliness, low noise, and improved handling.

Start-ups in this space are early stage, but some have secured significant early round investments, such as Zembo (\$3.4M, 2021), BasiGo (\$4.3M, 2022), Opibus (\$7.5M, 2021), and Ampersand (\$13M, 2021).

Company	Vehicles	Country	Core Business
Ampersand	E-2W	Rwanda, Kenya	Assembly and manufacturing of electric motorcycles for motorcycle taxis. Operates battery swap stations.
Greenfoot	E-2W, E-3W	Tanzania	Deliveries with electric scooters and electric three wheelers
eMo BodaBoda	E-2W	Tanzania	Sales and leasing of electric motorcycles
e-Motion	E-4W	Tanzania	Conversion of 4x4 vehicles to electricity
Bodawerk	E-2W, E-3W	Uganda	Manufacturing and sales of electric motorcycles for taxi and deliveries and three-wheel vehicles for cargo deliveries. Battery pack assembly and battery second-life recycling
Zembo	E-2W	Uganda	Sales of electric motorcycles and operations of solar-powered battery swap stations
Opibus (Roam Motors)	E-2W, E-4W	Kenya	Sales of electric motorcycles and conversions of buses and 4x4 vehicles
Kiri	E-4W	Kenya	Sales of electric motorcycles and three-wheelers for taxi and delivery businesses
BasiGo	E-4W	Kenya	Sales and local assembly of buses for mass transport
Asobo	E-OB	Kenya	Electric outboard motors for use on boats

### Benefits and Outcomes

Electric mobility has the potential to reduce greenhouse gas and other pollution emissions: in Kenya, transportation accounted for over 50% of national greenhouse gas emissions, and across Africa, air pollution causes about 176,000 annual deaths. Motorcycles are particularly harmful, emitting 10x more hydrocarbons and carbon monoxide per kilometre than passenger vehicles. Transitioning to e-2W would have an overall positive effect on air pollution, particularly locally, but may increase some emissions such as PM2.5 at power generation sites<sup>8</sup> depending on the primary energy used. Estimates for CO<sub>2</sub> reduction from e-2W transition range from 0.5–5 tons per vehicle per year. E-mobility can also have positive effects on jobs and the economy. Electric vehicle taxi drivers and riders can reduce their expenses due to fuel savings while also having easier access to asset financing due to on-board sensors. Local manufacturing, assembly, and servicing of electric vehicles can create new local jobs: Ampersand currently employs 150 people in Rwanda, with 60 staff working on vehicle production. Electric mobility can also reduce criminal activity by disrupting black markets for petrol, such as those in Nigeria<sup>9</sup>.

## Constraints and Risks

Electric mobility adoption can be limited by the lack of charging and battery-swap infrastructure. Developing this market will depend on access to affordable battery technologies, prices for which greatly declined from \$1191 per kWh in 2010 to \$132 per kWh in 2020 but have recently begun to rise due to a shortage of lithium.

E-mobility poses long-term environmental risks if not managed properly. Battery disposal and e-waste will be a growing concern. While some companies such as Enviroserve and Bodawerk repurpose lithium batteries for second-life purposes, there are no facilities for recycling lithium-ion batteries in East Africa and consequently, batteries not used for second-life purposes currently need to be exported to be recycled elsewhere. Ethical resource extraction is also an issue. The Democratic Republic of Congo produces over 70% of the world's cobalt, which is used in some lithium-ion batteries. Resource extraction in the DRC has historically fuelled regional conflict and instability and the cobalt mining industry has been heavily criticised for human rights violations<sup>10</sup>.

## Future Perspectives

Investors in electric mobility should consider the need for large-scale, long-term investments in infrastructure and the operating ecosystem: early-movers face a chicken and egg problem of having limited charging infrastructure or customers. Tech start-ups with models such as taxi services (e.g. "Uber for EVs in Tanzania") can help open the market, but governments and investors should consider how to support local motorcycle importers to transition to importing electric vehicles. Similarly, petrol station owners are ideal candidates to establish electric vehicle charging hubs and franchises.

Partnerships between stakeholders such as mini-grids, charging station owners, vehicle distributors, and asset financing companies can help spread the initial investment over different actors.

A strong and consistent regional policy framework will be important for the success of electric mobility. Amper-sand is leading e-mobility in East Africa partly due to the support of the Rwandan government, including VAT exemptions, import tax exemptions, and low energy tariffs, but the company has not received such support in expanding to

neighbouring countries. Product standards will benefit the market and consumers in the long-run, but need to be implemented with consideration for international standards and the ongoing,

## REFERENCES

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<sup>2</sup> E-Mobility Solutions for Rural Sub-Saharan Africa: Leveraging Economic, Social and Environmental Change; Siemens Stiftung

<sup>3</sup> Persistent.energy: [https://persistent.energy/wp-content/uploads/2022/02/Publication\\_The-opportunity-for-Two-Wheel-e-Mobility-in-Sub-Saharan-Africa.pdf](https://persistent.energy/wp-content/uploads/2022/02/Publication_The-opportunity-for-Two-Wheel-e-Mobility-in-Sub-Saharan-Africa.pdf)

<sup>4</sup> [www.siemens-stiftung.org/wp-content/uploads/medien/publikationen/publication-emobility-emobilitysolutionsforruralsubaharanafrika-siemensstiftung.pdf](http://www.siemens-stiftung.org/wp-content/uploads/medien/publikationen/publication-emobility-emobilitysolutionsforruralsubaharanafrika-siemensstiftung.pdf)

<sup>5</sup> 5M motorcycles on the road in Kenya by 2030 (UNEP); 1.46M registered electric motorcycles in Vietnam, Malaysia, Thailand, and the Philippines. Source: ASEAN Policy guideline: <https://www.unep.org/news-and-stories/press-release/e-boda-bodas-promising-day-electric-transportation-east-africa>;

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<sup>6</sup> [www.mckinsey.com/industries/automotive-and-assembly/our-insights/power-to-move-accelerating-the-electric-transport-transition-in-sub-saharan-africa](http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/power-to-move-accelerating-the-electric-transport-transition-in-sub-saharan-africa)

<sup>7</sup> <https://unece.org/transport/standards/transport/vehicle-regulations-wp29/global-technical-regulations-gtrs>

<sup>8</sup> [www.sciencedirect.com/science/article/abs/pii/S1361920922000244](http://www.sciencedirect.com/science/article/abs/pii/S1361920922000244)

<sup>9</sup> <https://kleinmanenergy.upenn.edu/research/publications/black-market-crude-organized-crime-and-environmental-externalities-in-nigerias-oil-sector/>

<sup>10</sup> [www.theverge.com/2022/2/15/22933022/cobalt-mining-ev-electric-vehicle-working-conditions-congo](http://www.theverge.com/2022/2/15/22933022/cobalt-mining-ev-electric-vehicle-working-conditions-congo); [www.newyorker.com/magazine/2021/05/31/the-dark-side-of-congos-cobalt-rush](http://www.newyorker.com/magazine/2021/05/31/the-dark-side-of-congos-cobalt-rush); <https://foreignpolicy.com/2022/06/30/africa-congo-drc-ev-electric-vehicles-batteries-green-energy-minerals-metals-mining-resources-colonialism-human-rights-development-china/>