Cleantech Group

June 2024

Factor E

The Rise of Two and Three-Wheelers in Africa: An Analysis of Six Countries

An Attractive Opportunity for Venture Investment

Purpose and methodology

Purpose of the report:

- Provide a high-level analysis of the rapidly growing electric two and three-wheeler (E2&3W) market in Africa, highlighting the attractive opportunity for investment across the continent
- Identify market trends, drivers, barriers, and key stakeholders in the E2&3W ecosystem to empower informed decision-making and contribute to the development of this transformative industry

Methodology:

- Conducted extensive primary and secondary research to gather comprehensive data and insights on the E2&3W market in Africa
- Primary research consisted of more than 15 interviews with innovators, investors, foundations, and other key ecosystem actors to obtain first-hand information and expert perspectives on the E2&3W landscape
- This report was drafted by Cleantech Group and sponsored by Factor[E] Ventures

About Cleantech Group

We are a research-driven company that helps catalyze opportunities for sustainable growth powered by innovation. We bring clients access to the trends, companies and people shaping the future and the customized advice and support businesses need to engage external innovation.

Our insights and expertise are delivered to clients all over the world through our Research, Consulting, and Events.

Industries are undergoing definitive transitions toward a more digitized, de-carbonized and resource-efficient industrial future. At every stage from initial strategy to final deals, our services bring corporate changemakers, investors, governments and stakeholders from across the ecosystem, the support they need to thrive in this fast-arriving and uncertain future.

We have been the leading authority on global cleantech innovation since 2002.

Factor E

We identify and invest in solutions to some of the world's toughest climate and development problems.

Working at the intersection of risk capital, technology, and emerging markets, we accelerate the pace at which innovation positively impacts economies, environments, and communities.

Disruptive innovation can shift the paradigm.

Through a process called technology brokering we bridge the gap between breakthrough innovations and the markets that desperately need them to drive climate and development impact in emerging markets

Deep Market Research

We immerse ourselves in understanding the most urgent energy, agriculture, mobility, and water challenges and develop science-driven investment strategies.

Early Stage Investing

We discover and source early-stage innovations to make products and services more affordable, accessible, and available.

Technical Hands on Support

We support ventures to scale and de-risk technologies by leveraging our technical expertise, market insights, and network of partners.

www.factore.com

info@factore.com

Contents

Cleantech Group

Electric two and three-wheeler (E2&3W) market is growing exponentially in Africa

Two and three-wheelers are expanding throughout Africa

- Number of all motorcycles in Sub-Saharan Africa grew from < 5 million in 2010 to > 27 million by 2022[1]
- Current estimated number of E2&3W in Africa in the low tens of thousands, expected to rise to ≥50% of all motorcycle sales by 2040[2]
- Demand for E2&3W driven by operational and fuelling cost for fleets and riders

Two and three-wheelers primarily used for commercial activity

- Up to 80-90% of motorcycles in Africa used for taxis, delivery, and other commercial applications[1,3]
- Percentage of individual ownership (B2C) versus fleet ownership (B2B) varies country to country
- Two main charging business models are (1) vehicle sale or lease and (2) vehicle sale or lease excluding battery with additional battery swapping services

E2&3W surge to create direct and indirect economic opportunities

- Commercial use of 2&3W create millions of jobs and is estimated to be one of the largest employment sources in several African countries[1]
- As many as 60% of riders are below 35 years old[4], tackling youth unemployment difficulties in Africa
- E2&3W also create auxiliary jobs for garages (repairs, parts), financiers (asset financing, green loans), sales, charging assets/infrastructure, etc.

[1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022)*.
[2] "Power to move: Accelerating the electric transport transition in sub-Saharan Africa." *McKinsey & Company (February 2022).*
[3] "Financing the transition to electric vehicles in sub-Saharan Africa." *Shell Foundation (2022).*
[4] "A Dozen Markets and Counting: The Opportunity for Two Wheel E-Mobility in Sub Saharan Africa" *Persistent Energy Capital (2022).*

Demand-side drivers and barriers for E2&3W in Africa

Demand Drivers

1. **Total cost of ownership of EVs reaching parity with ICE two and three-wheelers due to lower operation cost**
   - Innovators in Kenya, Nigeria, estimate a 50% cost reduction to operate E2W compared to ICE motorcycles
   - In other countries (i.e. Tanzania), some innovators have estimated cost savings as high as 80%

2. **Increased profits for riders and fleets due to lower operations, maintenance, and charging costs**
   - Profits for riders increase 30-50% according to innovators' estimates, depending on country
   - A study from Shell Foundation found commercial riders could increase profits 30% by switching to EVs[1]

3. **Imported E2&3W often inadequate for local conditions, creating demand for locally-suitable product**

Barriers to Growth

1. **Upfront cost of EVs a significant barrier for E2&3W adoption, especially for lower-income populations**
   - Electric motorcycles cost ~2x as much as ICE equivalent; asset financing required to make EVs accessible
   - Local currency financing exposes lenders, borrowers, to exchange rate risks as loans often US$ denominated
   - Battery swapping reduces upfront cost via battery lease

2. **Many countries lack buyer incentives for EV adoption;** subsidies, zero-rated tax, and removal of import tariffs are tools' governments can use to aid EV adoption

3. **Concerns like range of E2&3W cause adoption anxiety**
   - Commercial riders require well-developed charging infrastructure/battery swapping network
   - Some innovators addressing range concerns by equipping each vehicle with two batteries
   - Concerns regarding longer/intercity travel remain

4. **Limited charging infrastructure and unreliable electricity supply in many countries;** battery swapping networks/portable charging hubs sidestep these challenges

[1] *"Financing the transition to electric vehicles in sub-Saharan Africa." Shell Foundation (2022).*

Supply-side drivers and barriers for E2&3W in Africa

Supply Drivers

1. **Estimated +27 million motorcycle taxi and delivery riders in Africa[1] represent customer base to use E2&3W**
   - 2W used by taxi collectives, fleet operators (B2B), and individual commercial riders (B2C) via taxi, delivery apps
   - 3W used more frequently for cargo, last mile delivery

2. **Reduction of taxes for locally-assembled EVs and energy tariffs for electric mobility lower production and charging costs for innovators**
   - Incentives used in analyzed countries include:
     i. Reduction of corporate tax for local EV assembly
     ii. Zero-rated import tax for EV parts
     iii. Lower electricity rates for e-mobility retailers

3. **Local expertise in manufacturing parts like chassis leads to improved performance and cheaper cost**
   - Innovators engage with African distributors to supply parts and spares, reducing import dependence
   - Knowledge of local conditions and demand (e.g. cargo use) informs design decisions

Barriers to Growth

1. **Lack of financing, especially equity investors, limits how fast companies can scale E2&3W production**
   - Dearth of equity impedes debt lenders; banks willing to lend but cannot since start-ups must maintain D/E ratios
   - Several innovators stated production backlogs of +6 months; demand is present, but supply is constrained

2. **Skill gap around operations, maintenance, repair of EVs, as well as training of riders**
   - Innovators in Kenya, Ghana, Rwanda, are taking a leading role in educating garages to upskill mechanics with the knowledge they need to service E2&3W
   - Some innovators also engaging government to promote EV skills training in trades schools

3. **Policy bans around two-wheel taxis in some countries limit customer segments**
   - Many West African countries have partial or full bans on the use of two-wheelers for moto-taxis
   - East African countries generally have less restrictions on commercial use of E2&3W, although some apply

[1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022)*.

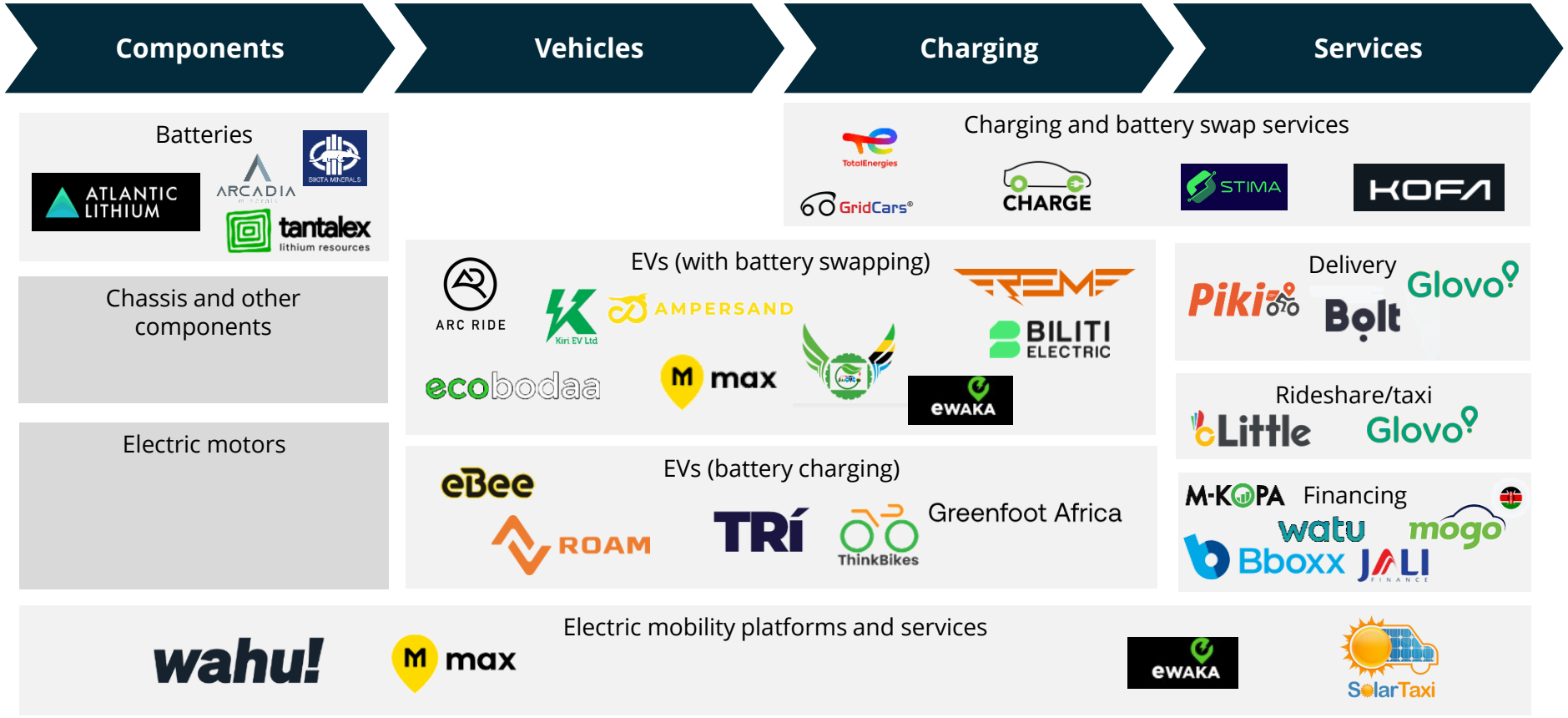
Contents

Cleantech Group

Value chain of E2&3W with example innovators

Observations:

- Batteries are currently imported from China; discovery of critical battery materials deposits (e.g. Ghana) present opportunity to engage in battery production value chain, though it will be challenging to compete with price-point of Chinese battery producers
- Innovators combine imports and local assembly/manufacturing depending on local incentives and expertise (e.g. Kenya's metal expertise)
- Local and international actors beginning to collaborate on battery recycling and establish critical materials circular economy initiatives



*Innovators placed in groups as representatives of primary activities and may engage in a wider scope of business activities

Most significant innovation is battery swapping, which addresses barriers around price and electricity access

Battery Swapping

Business Models:

- BaaS providers **sell E2&3W without battery**
- Battery rented to riders under various subscription plans, including payment per use, per swap or fixed daily price for unlimited swaps
- Innovators like **Kofa (Ghana) design batteries to power multiple applications beyond E2&3W** like off-grid power supplies, electronic appliances, back-up power in offices, etc.
- Economic analysis of battery swapping in Kenya, Rwanda done by BCG Green Ventures

Advantages:

- **Lower upfront cost for customers** as batteries can cost ~ US$ 1k
- **Creates forward-looking revenue opportunities** like energy storage/grid flexibility
- Can also generate revenue for local actors hosting swap stations

Disadvantages:

- **Battery swapping results in higher recharging cost**, as each swap can cost 2-3x more than charging vehicle at home
- **Higher cost for innovators** financing significant supply of batteries to create battery-swap network

Market Challenges:

- **Mitigates grid instability** and **addresses electricity access barriers**
- **Sustainability concerns regarding magnifying battery waste** and increased demand for critical materials, but asset centralization could facilitate e-waste collection/recycling

Image of Ampersand's SMART HM17 Swappable Battery. Retrieved from company website.

Other innovations include local vehicle design and ownership models, adapting requirements to African context

Local Vehicle Design

- Locally designed and assembled E2&3W circumvent problems with imported E2&3W, including **durability** (given tougher road conditions and more demanding usage in Africa compared to many European, Asian countries) and better **ability to carry heavy/large cargo**
- **Innovators design and assemble bikes based on feedback from customers** to ensure fit-for-purpose (e.g. REM developed their E2W with input from the Rwandan Motorcycle Federation, Ferwacotamo)

Image of Roam Air, designed for East African rider requirements like heavy cargo loads. Image retrieved from company website.

Ownership Models

- Variety of ownership models that address high upfront price of E2&3W and social well-being of riders, including **subscription-to-own models** where **innovators support rider ownership and safety** through microfinance, insurance packages, and driving trainings

Innovators like MAX in Nigeria provide health coverage, insurance schemes, and rider training as part of their lease-to-own subscription model. Image retrieved from company website.

Contents

Cleantech Group

Map of selected key stakeholders in examined countries

Senegal

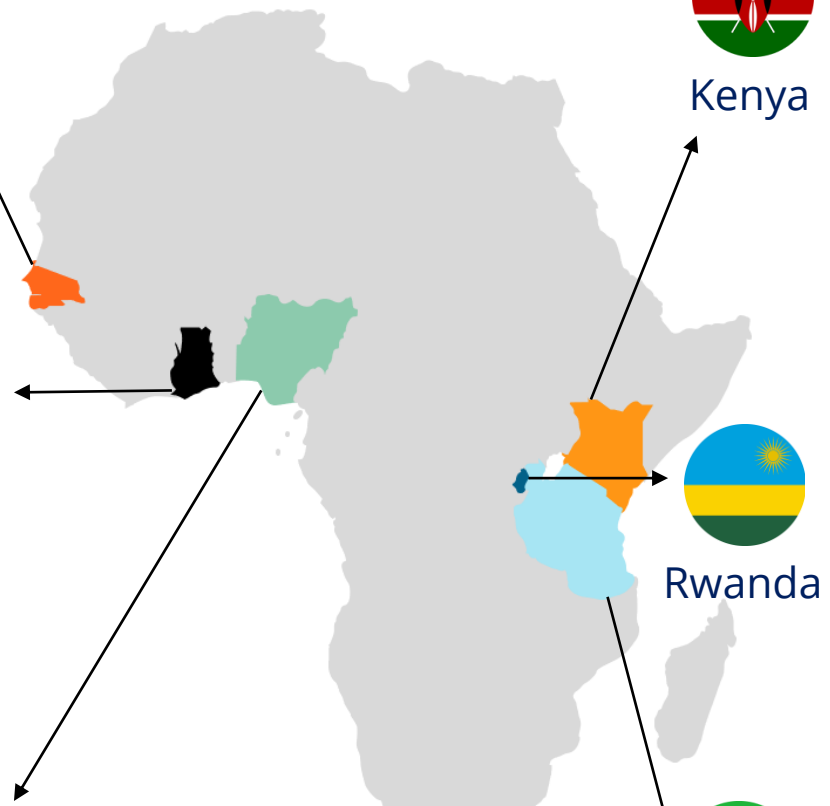
Innovators	Investors	DFIs and Foundations
solarbox		

Ghana

Innovators	Investors	DFIs and Foundations
wahu!, max, SolarTaxi, KOFA	BLUE LION, Wangara Green Ventures, PERSISTENT	Shell Foundation, SIEMENS | Stiftung, UKaid, MERCY CORPS, Foreign, Commonwealth & Development Office

Nigeria

Innovators	Investors	DFIs and Foundations
max, ThinkBikes	Breakthrough Energy, NOVASTAR VENTURES, lightrock, techstars_, YAMAHA, goodwell	Shell Foundation, SIEMENS | Stiftung, UKaid



Kenya

Innovators	Investors	DFIs and Foundations
ROAM, ARC RIDE, ecobodaa, Kiri EV Ltd, AMPERSAND, eBee, EWAKA, Little, BILITI ELECTRIC	Equator, At One Ventures, Factor E, watu, PERSISTENT, MUSASHI, mirova, NOVASTAR VENTURES, seedstars	Shell Foundation, SIEMENS | Stiftung, UKaid

Rwanda

Innovators	Investors	DFIs and Foundations
AMPERSAND, REMF	EIF ECOSYSTEM INTEGRITY, AGGFUND, Factor E, Equator, TotalEnergies	DFC U.S. International Development Finance Corporation, Shell Foundation, NEW ZEALAND FOREIGN AFFAIRS & TRADE Aid Programme, UKaid

Tanzania

Innovators	Investors	DFIs and Foundations
TRí, ekoglobe, Greenfoot Africa, E-MOTION	PERSISTENT	SIEMENS | Stiftung, UKaid

*Selected innovators produce, assemble, or sell E2&3W/E-Bikes; innovators working on other parts of the value chain not included in this map.

Cleantech Group

Investment Landscape: Challenges faced by VCs, DFIs, and Foundations participating in E2&3W market

Venture Capital

Innovators highlight lack of equity investment in African start-ups as key barrier to scale

- High risk premium on African market dissuasive to international investors
- Lack of track record and data on successful exits given infancy of e-mobility sector limits investor participation in African e-mobility market
- Impression that African VCs are software oriented and unfamiliar with hardware; global investors may be familiar with hardware but are often unfamiliar with investing in Africa
- Equity also plays a role in unlocking debt given debt providers are limited by debt-equity ratios

Development Finance Institutions

Large participation of DFIs from US, Europe, Africa investing in e-mobility, but many stakeholders believe they are too risk adverse

- DFIs have a unique potential to provide catalytic capital to incentivize investment, however, perception that they tend to prefer senior positions or debt instruments as opposed to first-loss capital, other catalytic tools
- Heavy due diligence process required by DFIs create risk for start-ups as it takes a lot of time to receive funds
- Rating agencies don't rate blended finance funds (funds that use a mix of development finance with public and/or private sector funds), preventing large private funds from investing and impeding scale

Foundations

Foundations have been amongst most active stakeholders in using catalytic capital, although some stakeholders think they can do even more

- Foundations like Shell Foundation, Siemens Stiftung, use junior equity positions, grants, and other tools to spur start-up growth and encourage follow-on investment
- Perception that some foundations are too risk-adverse; can do more to incentivize capital inflows
- Concern that start-ups may become dependent on grants and are not commercially viable; foundations can extend the lifeline of these business despite being uncompetitive, representing inefficient use of resources

Contents

Cleantech Group

Market attractiveness and challenges for E2&3W by country

	Market Attractiveness	Challenges
Kenya	Large, fast-growing market for E2&3W with strong asset financing and excellent policy incentives for EV assemblers and retailers	Competitive market with dozens of E2&3W innovators, making it harder for new entrants
Tanzania	Large motorcycle market and highest number of E2&3W in East Africa (10k); cheapest electricity prices in East Africa	New EV tax incentives do not apply to E2&3W; lowest electricity access of the six countries analyzed; limited asset financing
Rwanda	Among the most progressive EV policy in Africa, with developing asset financing ecosystem	Small market size with +10x less motorbikes than neighbouring Kenya, Tanzania (+110k in Rwanda vs +1.4m in Kenya/Tanzania)
Ghana	Highest number of EVs in West Africa (17k), promising innovation landscape, and first EV policy incentives declared in 2024 budget	Nation-wide ban on two-wheel taxis; challenges with asset financing given higher interest rates, less credit lenders
Nigeria	Highest number of two and three-wheelers of six countries (+5 million); removal of fuel subsidies in 2023 strengthens case for EVs	Grid stability; lack of policy incentives for EV uptake; lack of supply of EVs; bans in Lagos for two-wheel taxi commercial segment
Senegal	Nascent market with recently emerging start-up activity provides opportunity for first movers	Small market size compared to other analyzed countries; no EV policy incentives; ban on moto-taxis

Comparison of country-specific factors for E2&3W adoption

	Electricity Price (US$/kWh)[1]	% of urban/rural population with electricity[2]	Estimated # of E2&3W innovators[3]	Number of overall 2&3W[4]	Asset Financing Availability[5]	EV Policy Score[6] / E2&3W Policy Score[7]
Kenya	0.18	98% urban 68% rural	+10	+1.4m	High	83% / High
Tanzania	0.09	77% urban 23% rural	5 – 10	+1.5m	Low	16% / Low
Rwanda	0.22	98% urban 38% rural	<5	+110k	Medium	100% / High
Ghana	0.07	95% urban 74% rural	5 – 10	~800k	Low	50% / Medium
Nigeria	0.03	89% urban 26% rural	5 – 10	~5m – 8m	Medium	16% / Low
Senegal	0.18	94% urban 43% rural	<5	+150k	Low	0% / Low

[1] "Household electricity prices in Africa as of December 2022." *Statista.* <https://www.statista.com/statistics/1277594/household-electricity-prices-in-africa-by-country/>
[2] "Access to electricity (% of population), 2021." *The World Bank*. <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?most_recent_year_desc=false>
[3] Estimate from Cleantech Group primary and secondary research.
[4] Various sources. See Country Profiles section for details.
[5] Indicator that measures the number E2&3W asset financiers based on primary and secondary research. We do not review quality of individual finance providers.
[6] EV Policy Readiness Score, sourced from "Africa E-Mobility Readiness Tool, October 2023." *Africa E-Mobility Alliance.*
[7] *High* = Active policies explicitly include E2&3W; *Medium* = Announced policies explicitly include E2&3W but have not been implemented; Low= Policies explicitly exclude E2&3W or non-existent.

Contents

Cleantech Group

Kenya: leading Africa's electric two and three-wheeler revolution across the board – but competition is strong

Key Facts

- Population: **55 million**
- GDP/capita: **US$ 2.1k**
- Urban electricity: **98%**
- Rural electricity: **68%**
- Number of 2&3W: **+1.4m**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/ke.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=KE

Addressable Market

2nd highest number of 2&3W in East Africa and growing number of EVs

- 2&3W made up **majority (60%) of vehicle sales** in 2022 (+135k units)[2]
- Growing market with ≥1350 EVs, of which 1k are E2&3W [3]; some estimate up to 2k E2&3W[4]

Policy Incentives

E2&3W targets, tax policies, electricity tariffs incentivize EV adoption

- **Government objective of 200k E2W on road** by end of 2024[4]
- **Finance Act 2023 eliminated 16% VAT tax on E2&3W** and exempted 25% excise duty; cut corporate tax from 30% to 15% for local vehicle assemblers
- Kenya Power set **new e-mobility tariff** at Sh16 (~US$0.11) during peak periods and Sh 8 (~US$0.06) during off-peak[8]

Competitive Landscape

90% of 2W used for commercial purposes[5]

+10 E2&3W innovators; Kenyan e-mobility start-ups have received more than $50m in investment

- Competitive market and insufficient investment to meet demand = harder for new entrants
- Innovators use battery swap and residential charging models given high electricity access
- Most innovators assemble locally, although some import fully-made two and three-wheelers
- Kenya's e-mobility association (EMAK), with 28 member start-ups, advocates for EV adoption

Developed asset financing market with numerous microfinanciers, banks, supporting EV purchases

- ≥ 7 microfinanciers including Watu, Mogo, Tugende, M-Kopa,
- Some innovators estimate **+80% of Kenyan market financed via microfinance** lenders
- NCBA Bank to make Sh 2 billion (~US$ 14m) available for EV financing, including E2&3W[6]
- KCB Bank partnering with UNITAR to provide asset financing for 100k E2&3W[7]

Tanzania: Large market size with cheap electricity, but policy incentives and electricity access must improve

Key Facts

- Population: **61.5 million**
- GDP/capita: **US$ 1.2k**
- Urban electricity: **77%**
- Rural electricity: **23%**
- Number of 2&3W: **+1.5m**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/tz.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=TZ

Addressable Market

Highest number of 2&3W in East Africa; highest number of E2W in East Africa with an estimated 10k electric motorcycles[2]

- EV adoption due to cost savings, not incentives, as Tanzania has amongst the cheapest electricity prices in the region

Policy Incentives

Limited incentives to promote E2&3W adoption and assembly; behind regional peers like Rwanda, Kenya

- Tanzania recently introduced first set of tax incentives by exempting electric four wheelers and e-buses from excise duty, **although benefits do not apply to E2&3W despite their popularity**[2]
- Innovators mentioned some recent incentives (e.g. less tax on imported parts) as a step in the right direction, but government can do more to support EV transition

Competitive Landscape

E2&3W used for taxi, delivery, and logistics; no restrictions identified on motorcycle use

Estimated 5-10 E2&3W innovators, but less investment than neighbouring Kenya, Rwanda

- Tanzania e-mobility companies have received US$ 1m in investment[3]; perception that investment environment is improving under new presidency
- Innovators utilising both battery swapping and battery-included business models
  - Battery swapping may be more suitable in short term given low electricity access
- Tanzania Electric Mobility Association (TAEMA) is driving e-mobility adoption (similar to EMAK)

Some microfinanciers supporting EV adoption; banks hesitant to engage given EV unfamiliarity

- Microfinanciers like Watu are active in Tanzania
- Banks in Tanzania provide loans, other financial tools to ICE motorcycles, but are risk-adverse with EVs given lack of data, understanding of risk in the e-mobility sector

Rwanda: Advanced E2&3W policy incentives, however, small market size limits scale

Key Facts

- Population: **13 million**
- GDP/capita: **US$ 966**
- Urban electricity: **98%**
- Rural electricity: **38%**
- Number of 2&3W: **+110k**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/rw.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=RW

Addressable Market

Smallest market of six countries studied

- Motorcycles make up <40% of Rwanda's +260k registered vehicles[2]
- 200 EV charging stations in Kigali alone[3]

Policy Incentives

Leading policy incentives to boost EV purchases, production, and charging [4]

- **Government objective to have** 20% of buses, **30% of motorcycles** and 8% of cars **electrified by 2030**
- **Zero-rated VAT and import duties** for EVs, spare parts, batteries, and charging station equipment
- E-mobility retailers setting up **charging stations can access government's land rent-free**
- **Corporate tax rate cut in half to 15%** for companies manufacturing and assembling electric vehicles
- **Reduced tariffs for EV charging** (priced at the industrial tariff as opposed to residential tariff)

Competitive Landscape

2021 data estimated nearly **half of all motorcycles operating as taxis in Rwanda**[5]; number has since risen over the past 3 years

Innovator landscape dominated by a couple major players like Ampersand, Rwanda Electric Motors (REM); limited competition compared to neighbouring markets

- **Major innovators using battery-swapping business models** to ensure lower purchase price for customers
- REM working with United Nations Development Fund on 2W retrofit programme
- No e-mobility association to coordinate activities, although innovators admired progressive work done by Kenya's EMAK

Developing asset financing market with various microfinance institutions aiding in EV purchases

- ≥ 3 microfinance lenders supporting E2&3Ws, including Watu, Jali Finance, and Bboxx's partnership with Ampersand[6]

Ghana: High EV penetration and growing start-up activity, but high interest rates impede asset financing

Key Facts

- Population: **32 million**
- GDP/capita: **US$ 2.2k**
- Urban electricity: **95%**
- Rural electricity: **74%**
- Number of 2&3W: **~ 800k**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/gh.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=GH

Addressable Market

Estimated +17k EV in Ghana[2], amongst the highest number in West Africa

- ~3.2m registered vehicles (2022)[3]; **only 25% of vehicles are motorcycles**, less than East African countries analyzed

Policy Incentives

2024 budget speech offered promising incentives to accelerate EV adoption, but **implementation is yet to kick off**

- **Waive import duties on import of electric vehicles for public transportation** for 8 years; definition of public transport pending[4]
- **Waive import duties on semi-knocked down, knocked down EVs** imported by registered EV companies for 8 years[5]
- **Extend zero rate of VAT on locally assembled vehicles** for 2 years[5]
- However, **innovators report there is no implementation plan in place by government** for these new measures

Competitive Landscape

Moto-taxi ban since 2012, liming a major customer segment

- Illegal to use two-wheelers as taxis, therefore, main use of motorcycles are couriers (food delivery, parcels, etc.)

Growing innovator landscape with numerous emerging local and regional start-ups

- Local innovators include Solar Taxi, Wahu, Kofa
- Most innovators engage in local assembly, importing semi knocked-down parts
- 98% of batteries imported from China[6]

High interest rates (+30%) and microfinance irregularities makes asset financing difficult

- Innovators reported absence of microfinanciers in Ghana; Bank of Ghana has clamped down on MFIs in recent years
- Wahu partnered with Untapped Global to finance E2&3W via revenue-sharing model
- Some banks (e.g. Cal Bank) involved in financing

Nigeria: Largest motorcycle market offering great potential if policy incentives, grid reliability improved

Key Facts

- Population: **211 million**
- GDP/capita: **US$ 2.16k**
- Urban electricity: **89%**
- Rural electricity: **26%**
- Number of 2&3W: +**5m**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/ng.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=NG

Addressable Market

Highest number of 2W in Africa

- <400 EVs in Nigeria, representing 0.002% of +18m total vehicles[2]
- Removal of fuel subsidies expected to have large impact on EV adoption
- African E-Mobility Alliance estimates **subsidy removal will make ICE motorcycles 3x more expensive to drive**, incentivizing EV adoption[2]

Policy Incentives

Government proposed **first policy incentives for manufactures** in 2023, **but no incentives for buyers or imports**

- **10 years tax relief** for EV and components assemblers/manufacturers[3]
- Innovators using **imported E2&3W receive no benefits, tax incentives**
- **No demand-side incentives** (e.g. zero-rated VAT) to back EV adoption
- Nigerian senators rejected bill seeking to phase out ICE vehicles in 2035[4]

Competitive Landscape

Partial moto-taxi bans across the country, including in Lagos

- Several E2&3W innovators shut down post-ban
- Others had to reinvent business models to focus on delivery, logistics segments

Main EV adoption barrier is grid stability

- Many companies interested in EV transition, but adoption is slow due to unreliable power supply
- Most electricity powered by fossil fuels, creating additional concerns around carbon-intensive grid

Innovators using both battery-swapping and battery-included models despite grid concerns

- MAX, Nigeria's largest E2&3W platform, import fully-built E2W; other innovators assemble locally

Developing asset financing ecosystem with engagement from microfinance and banks

- Watu present in Nigeria
- Sterling Bank's *Qore* initiative provides asset financing for EV charging stations, engine retrofits, and battery swapping services[5]

Senegal: Lack of EV policies and moto-taxi ban impede growth despite reliance on 2&3W for employment

Key Facts

- Population: **17.2 million**
- GDP/capita: **US$ 1.6k**
- Urban electricity: **98%**
- Rural electricity: **68%**
- Number of 2&3W: **+150k**[1]

Population statistics from UN Data (2021)
https://data.un.org/en/iso/sn.html
GDP data from World Bank (2022)
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=SN

Addressable Market

2nd smallest market of analyzed countries
- Some sources estimate more than 300k moto-taxi riders in the country[2]

Policy Incentives

No policy incentives provided for EVs or E2&3W, although **government supports specific EV projects directly**
- **Bob Eco** (Hong Kong E2&3W innovator) **working with Government and state-owned microfinancier** (Anpej) **to deploy 50k E2&3W** to create 125k jobs[3]
- **EV innovators in talks with government to remove 70% import tax** on vehicles and to implement EV incentives[4]
- Ministry of Transport, World Bank, and investors collaborating to launch Bus Rapid Transit system, +140 battery operated buses for mass transit[5]

Competitive Landscape

Senegal's National Motorcycle Taxi Association estimates **nearly one in ten young people make living via moto-taxis**[2]

Moto-taxis are illegal throughout the country, but the ban goes unenforced by authorities[6]
- Other commercial use of 2&3W like delivery are legal
- Digital logistics platforms Little WIGO became official delivery platform for Bob Eco in 2022[7]

E2&3W innovator landscape is extremely nascent; only one local innovator (Solar Box) identified through this study
- Foreign innovators exporting E2&3W to Senegal include Bob Eco[3] and WIKA Industri Manufaktur (based in Indonesia)[8]
- Few pilot-stage local EV innovators like Mbay Mobility addressing sedan taxi market

Contents

Spotlight: Innovator Examples

ARC RIDE

Location: Nairobi, Kenya

Capital: $ undisclosed

Investors: Musashi Seimitsu, Watu, Car&General

Contact: Bede Hesmondhalgh, Director

Positioning: Developer of two-wheel electric vehicles supported by a battery swapping network and battery-as-a-service offering

Company insight

- Africa's largest EV charging/swapping network with 78 active stations throughout Nairobi
- Battery management systems and IoT-enabled data tracking to monitor vehicles and provide data on vehicle use in order to inform battery swap station locations
- Several hundred E2W and interoperable batteries across vehicle models
- Physically smaller, more manageable battery is easier for customers to interchange
- Partnerships with financing institutions allow for individual financing as well as battery leasing model – vehicle sold outright, battery leased on daily or monthly basis

ARC Ride's new Bidii Boda E2W. Image retrieved from company representative.

Cleantech Group

Spotlight: Innovator Examples

Location: Nairobi, Kenya (and Paris, France)

Capital: $ undisclsoed

Investors: DEG Impulse, On.Capital SAS

Contact: Emile Fucheri, CEO & Founder

Positioning: SaaS providing two-wheel EV companies with IOT-enabled battery data for battery swapping and vehicle management

Company insight

- SaaS enables EV and battery swapping companies to understand usage, enable predictive management
- Install IoT devices into individual vehicle batteries to provide real time data
- Software enables franchising of battery swap stations, generating revenue for local businesses to become a battery swapping site
- Can provide financial indicators of battery and share data with companies interested in financing batteries – reduces investment risk, provides insight on degradation and battery lifetime

Image retrieved from company's Twitter page.

Spotlight: Innovator Examples

Location: Nairobi, Kenya (and CA, USA)
Capital: US $400 million
Investors: Global Emerging Markets Group
Contact: Isaiah Omondi, Head of Operations

Positioning: Developer of 3-wheel EVs with swappable batteries for cargo and passenger transport

Company insight

- Cargo segment focused on last-mile delivery (for agriculture, commerce, pharmaceuticals)
- Engaging financial players to provide financing opportunities for vehicles and batteries, particularly trade unions, microfinance organizations
- E3W manufactured in India – similar road conditions to Kenya, so vehicles fit-for-purpose for Kenyan market
- Goal to produce 200k units in 2024 and open an assembly plant in Kenya

Max Power	7 kW
Peak Torque	70 Nm
Cargo Box Volume	~100 cu ft.
Warranty	3 Years or 50,000 miles (Conditional)
Charge Time	3-4 Hours
Seating Capacity	1 Driver

Biliti's "Taskman", one of three E3W models sold by the company. Image retrieved from company website.

Spotlight: Innovator Examples

Location: Nairobi, Kenya

Capital: US $24 million

Investors: At One Ventures, Equator, TES Ventures, Renew Capital, The World We Want, and One Small Planet, Factor[E] Ventures, others

Contact: Filip Lövström, Founder

Positioning: Developer of electric two-wheeler with removable battery and portable chargers; Roam also develops other EV vehicles like electric buses

Company insight

- Roam Air designed for African use case; driving range of 140km with two batteries
- E2W sold with battery, but adaptable to battery swapping
- Roam also provides auxiliary services like Roam Hub, a portable one-stop-shop for battery charging, rental, and after-sale services
- Roam Air assembled in-house in Nairobi factory; objective to produce 50k bikes a year
- Firm believers that demand for E2&3W is understated by industry estimates

Roam Air, Roam's E2W. Image retrieved from company website.

Spotlight: Innovator Examples

Location: Accra, Ghana

Capital: $ undisclosed

Investors: Persistent Energy, Untapped Ventures

Contact: Loving Asibey, Chief Investment Officer

Positioning: Producer of a locally-assembled electric motorcycle, battery pack, and manager of charging network in addition to an EV fleet management mobile application

Company insight

- Local assembly of vehicle, which is purchased by a financier, and the end user (courier driver) pays monthly payments to financier until they take complete ownership of vehicle
- Lease-to-own model significantly reduces upfront cost as barrier to adoption
- Goal to localize value chain – Ghanaian companies manufacturing some vehicle parts (e.g. chassis), batteries currently locally assembled
- Clear that EV operational cost are substantially lower than ICE vehicles, but data accessibility and accuracy makes it difficult to pinpoint the exact cost-savings for riders

SolarTaxi's ST-04 E2W, one of four different E2&3W sold by the company. Image retrieved from company website.

Spotlight: Innovator Examples

Location: Accra, Ghana
Capital: $ undisclosed
Investors: Blue Lion
Contact: Ian Mbote, Head of Technology

Positioning: End to end e-mobility solutions ecosystem. Provides services such as gig work for riders, subscribe to own payments for Wahu-developed electric bicycles, insurance, repair and maintenance

Company insight

- Fleet of hundreds of eBikes on the road
- Assemble and sell vehicles, import e-components and leverage local supply chains for frames, tires, breaks, etc.
- Rent-to-own scheme for customers on a weekly payment schedule which gives rider access to the vehicle, two batteries, a helmet, lock, and tracking system
- Batteries have 70km range (up to 140km with pedal assist), and are charged at home by riders
- Partnerships with delivery companies (e.g. Bolt, Glovo) and logistics companies as well as financing partner Untapped Global

Wahu!'s E2W and rider. Image retrieved from company website.

Spotlight: Innovator Examples

Location: Lagos, Nigeria
Capital: undisclosed
Investors: undisclosed
Contact: Tolulope Olukokun, Founder

Positioning: Producer of electric bicycle used mainly for last-mile transportation; plans to produce electric four-wheeler in near future

Company insight

- Last mile transportation using electric cargo bikes made available for ride-sharing and lease to individuals and businesses in urban and rural communities for affordable prices
- Offer pay-as-you-go option for bike sharing
- ThinkBikes has app that allows users to find nearby roads that are suitable for e-bikes, track journey and plan routes
- Local manufacturing of frame and chassis; import motors, controllers, and batteries from China
- Recycles batteries and repurposes batteries in house to reduce e-waste and import cost

ThinkBike's e-bike. Image retrieved from company website.

Spotlight: Innovator Examples

Location: Lagos, Nigeria

Capital: US $31 million

Investors: Lightrock, Novastar Ventures, Yamaha, Mastercard, Goodwell Investments, Alitheia Capital, Techstars and Breakthrough Energy Venture, others

Contact: Zino Orogu, Field Marketing Manager

Positioning: Vehicle subscription platform which provides E2W to riders on a subscription-to-own model

Company insight

- Integral model that supports riders purchase E2W through asset financing and provides riders insurance and training
- Developed all-in-one application to connect riders with enterprises for delivery services
- Initially focused on ride-hailing, but successfully pivoted to logistics after Lagos announced moto-taxi ban
- Import E2W from OEM; do not manufacture locally
- Work across 11 states in Nigeria and have recently expanded to Ghana

MAX's M3 E2W. Image retrieved from company website.

Spotlight: Innovator Examples

Greenfoot Africa

Location: Arusha, Tanzania

Capital: $ undisclosed

Investors: undisclosed

Contact: Johnson Jacka,
Founder & Managing Director

Positioning: Developer of electric three-wheel cargo vehicles and smart electric cargo bike platform

Company insight

- Focused on cargo transport market segment – three-wheelers are more capable of handling heavy cargo loads (60-200kg) required when transporting goods between distributors and stores
- Their 3-wheeler has parts that are built locally (ex. frame of the bike); other parts are sourced locally to assemble (ex. tires), and batteries and controllers are imported from China
- Plans to develop 2-wheeler for human transport in the near future
- Currently operate a vehicle rental model due to high price point for customers - partnerships with microfinance institutions will allow for an additional rent-to-own model

Greenfoot Africa's three-wheel cargo bike. Image retrieved from company website.

Championing Sustainable Innovation, Catalyzing Business Opportunities

Since 2002, our Research, Consulting and Events have propelled opportunities for sustainable growth powered by innovation to thrive in a more digitized, decarbonized, and resource-efficient future.

Contact Cleantech Group at info@cleantech.com

Contact Factor[E] Ventures at info@factore.com

Kenya Country Analysis - Citations

- [1]The National Transport and Safety Authority (NTSA) reported that there were 1,393,390 motorcycles registered in Kenya in 2018
- [2] "Economic Survey 2023." *Kenya National Bureau of Statistics*.<https://www.treasury.go.ke/wp-content/uploads/2023/05/KNBS-Popular-Version-BOOK-PRESS-%E2%88%9A.pdf>
- [3] "E-Mobility Conference Report, February 2023." *Kenya Power.* <https://www.kplc.co.ke/img/full/Final%20E-MOBILITY%20CONFERENCE%20REPORT%20(DRAFT%2010).pdf>;
- [4] "Kenya's push to make 'boda-boda' motorbike taxis go electric." *BBC.* January 2024 <https://www.bbc.com/news/world-africa-67781109>;
- [5] "Financing the transition to electric vehicles in sub-Saharan Africa, January 2022." *Shell Foundation.* <https://shellfoundation.org/app/uploads/2022/02/EV-Report-McKinsey.pdf>
- [6] "NCBA Launches Ksh 2 Billion Electric Car Loan Financing for Customers." *The Kenyan Wall Street*. August 2022. <https://kenyanwallstreet.com/ncba-launches-ksh-2-billion-electric-car-loan/>
- [7] "KCB, UNITAR Launch 100,000 Electric Motorbikes Project." *Business Today Kenya*. July 2023. <https://businesstoday.co.ke/kcb-unitar-launch-100000-electric-motorbikes-project/>
- [8] "Retail Electricity Tariff Review for the 2022/2023 – 2025/2026 Period." *Energy & Petroleum Regulatory Authority*. <https://www.kplc.co.ke/img/full/Osia.Mwanje_2023-03-24_21-00-19-1.pdf>

Tanzania Country Analysis - Citations

- [1] Tom Bishop and Tom Courtright, “The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa.” *Fia Foundation (2022*).
- [2] “East Africa Finance Acts 2023/24.” *African E-Mobility Alliance*. <https://africaema.org/resources/AfEMA_technical_brief_2023_EAC.pdf>
- [3] “Barriers to E-Mobility in Tanzania – March 2023.” *African E-Mobility Alliance*. <https://sun-connect.org/wpcont/uploads/TZEVBarrierReport.pdf?ver>

Rwanda Country Analysis - Citations

- [1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022*).
- [2] "Strategic Paper on Electric Mobility Adaptation in Rwanda." *Republic of Rwanda, Ministry of Infrastructure (2021).* <https://www.mininfra.gov.rw/fileadmin/user_upload/Mininfra/Publications/Laws_Orders_and_Instructions/Transport/16062021_Strategic_Paper_for_e-mobility_adaptation_in_Rwanda-Final.pdf>
- [3] "In face of rising air pollution, Rwanda turns to electric vehicles." *UN Environment Programme (31 October 2022*). <https://www.unep.org/news-and-stories/story/face-rising-air-pollution-rwanda-turns-electric-vehicles>
- [4] "Supercharging Rwanda's E-Mobility Transition." *Republic of Rwanda, Ministry of Environment.* <https://www.environment.gov.rw/index.php?eID=dumpFile&t=f&f=55460&token=6003242e29667513f33c128466ffc760c62d81d8>
- [5] "The Government of Rwanda and UNDP Rwanda launch a retrofit electric motorcycles project." *Rwanda Environment Management Authority (2021).* <https://www.rema.gov.rw/info/details?tx_news_pi1%5Baction%5D=detail&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Bnews%5D=126&cHash=ccc78aac4af706b07f2618f92abc2904#:~:text=According%20to%20the%20Ministry%20of,46%2C000%20operating%20as%20moto%2Dtaxis>
- [6] "Bboxx partners with Ampersand." *Bboxx – Group News (12 October 2022).* <https://www.bboxx.com/news/bboxx-partners-with-ampersand-to-provide-thousands-of-taxi-e-motos-for-drivers-in-rwanda/>

Ghana Country Analysis - Citations

- [1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022*).
- [2] "Electric vehicle policy in the offing, 17,000 EVs currently in Ghana – Energy Minister." *Citi Newsroom (11 November 2023).* <https://citinewsroom.com/2023/11/electric-vehicle-policy-in-the-offing-17000-evs-currently-in-ghana-energy-minister/>
- [3] "3.2 million vehicles registered in Ghana as of 2022 – Transport Minister." *Ghana News Agency (3 July 2023).* <https://gna.org.gh/2023/07/3-2-million-vehicles-registered-in-ghana-as-at-2022-transport-minister/>
- [4] "Ghana Electrical Vehicle Tariffs." *International Trade Administration – Department of Commerce*. <https://www.trade.gov/market-intelligence/ghana-electrical-vehicle-tariffs#:~:text=In%20early%20November%2C%20as%20a,a%20period%20of%20eight%20years>
- [5] "Ghana Waives Import Duties On Electric Vehicles For 8 Years Starting 2024." *CleanTechnica (November 2023).* <https://cleantechnica.com/2023/11/16/ghana-waives-import-duties-on-electric-vehicles-for-8-years-starting-2024/>
- [6] "Ghana Electric Vehicle Baseline Survey Report 2022." *Energy Commission of Ghana.* <https://www.energycom.gov.gh/files/DEI%20BASELINE%20REPORT.pdf>

Nigeria Country Analysis - Citations

- [1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022*).
- [2] "Nigeria Fuel Subsidy Removal – Time For Electric Mobility?" *African E-Mobility Alliance (July 2023).* <https://africaema.org/resources/AfEMA_technical_brief_2023_Nigeria.pdf>
- [3] "FG enables 10-year tax relief for electric vehicle manufacturers in Nigeria – DG, NADDC." *Nairametrics (May 2023).* <https://nairametrics.com/2023/05/27/fg-enables-10-year-tax-relief-for-electric-vehicle-manufacturers-in-nigeria-dg-naddc/>
- [4] "Nigerian senators reject bill seeking to phase out petrol cars in 2035." Premium Times (17 April 2019). <https://www.premiumtimesng.com/news/top-news/325811-nigerian-senators-reject-bill-seeking-to-phase-out-petrol-cars-in-2035.html?tztc=1>
- [5] "Sterling Bank Launches Qore to Accelerate Electric Vehicle Purchase, Financing in Nigeria." *Brand Times (26 June 2023).* <https://www.brandtimes.com.ng/sterling-bank-launches-qore-to-accelerate-electric-vehicle-purchase-financing-in-Nigeria>

Senegal Country Analysis - Citations

- [1] Tom Bishop and Tom Courtright, "The Wheels of Change: Safe and Sustainable Motorcycles in Sub-Saharan Africa." *Fia Foundation (2022*).
- [2] "Au Sénégal, Ziguinchor dans le rétroviseur des motos-taxis : « Le jakarta nous a sauvé la vie »." *Le Monde (15 June 2023).* https://www.lemonde.fr/afrique/article/2023/06/15/au-senegal-ziguinchor-dans-le-retroviseur-des-motos-taxis-le-jakarta-nous-a-sauve-la-vie_6177831_3212.html
- [3]"Bob Eco's Hilde Watty creates 125,000 jobs in Senegal!" *Bob Eco (2022).* https://www.bob.eco/blog/bobcoin-hilde-watty-bob-eco
- [4]"Mbay Mobility Is Launching An All-Electric Taxi Financing Platform In Senegal." Cleantechnica (June 2023). https://cleantechnica.com/2023/05/29/mbay-mobility-is-launching-an-all-electric-taxi-financing-platform-in-senegal/
- [5] "BRT Dakar." *Meridiam.* https://www.meridiam.com/assets/bus-rapid-transit-brt-dakar/
- [6] "I have no other choice': Senegal's illegal - and often deadly - moto-taxis." *France 24 (27 September 2023).* https://www.france24.com/en/video/20230927-i-have-no-other-choice-senegal-s-illegal-and-often-deadly-moto-taxis
- [7] "Bob Eco announces vehicle access partnership with Little WIGO." Bob Eco (2022). https://www.bob.eco/blog/bob-senegal
- [8] "Indonesia exports electric motorcycles to Senegal." Indonesia Window (20 October 2021). https://indonesiawindow.com/en/indonesia-exports-electric-motorcycles-to-senegal/