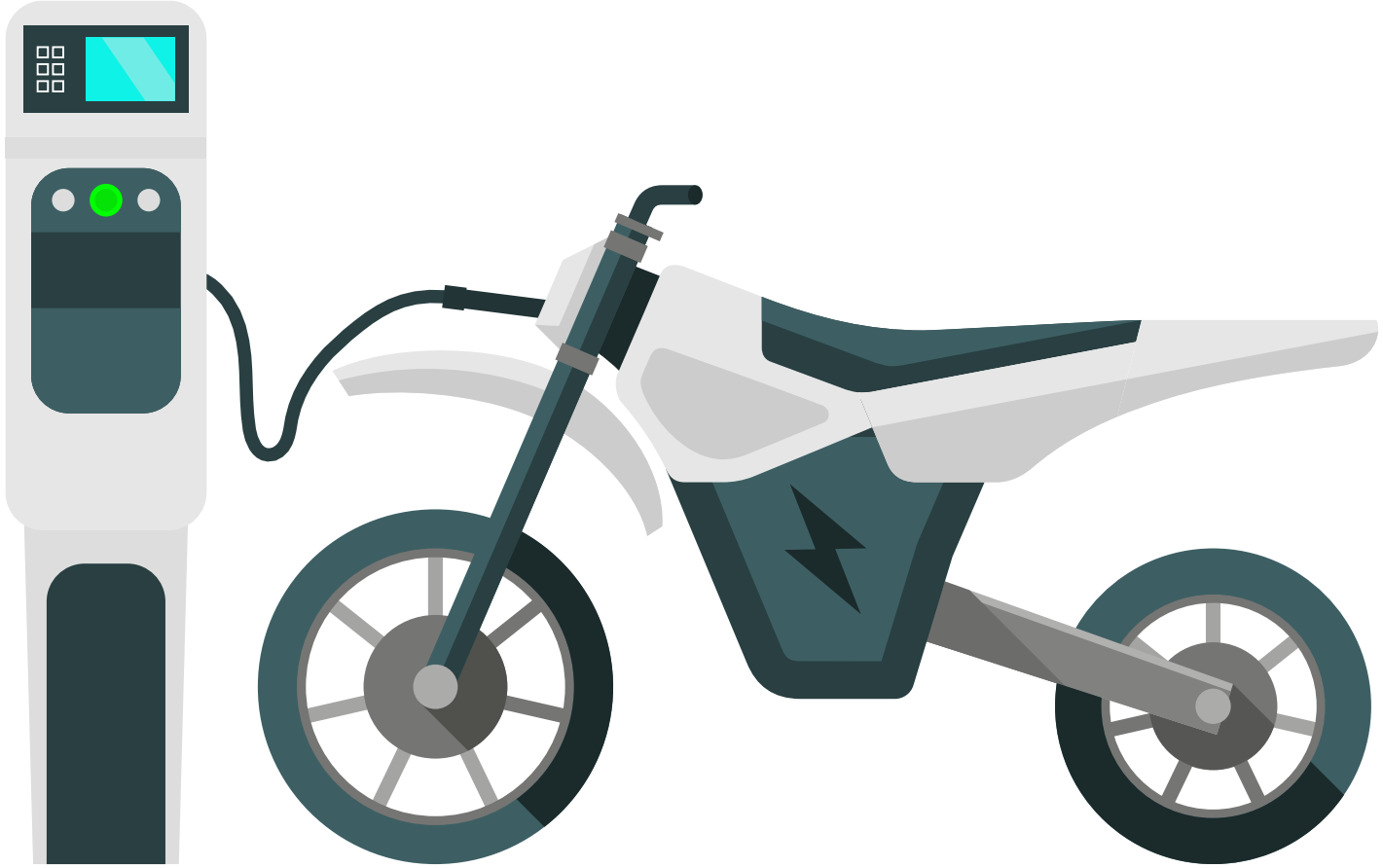
Opportunity and investment potential for electric vehicles in Kenya

Manufacturing Africa

October 2021



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We are in the process of syndicating this work with manufacturers, ministries, associations and development agencies

Stakeholders engaged in developing this document

8 private sector E2W assemblers

ARC Ride, Opibus, Powerhive, Mazi Mobility, Ampersand, Fika, Ecobodaa, Nopea

8 government entities

Ministries of Industrialization, Ministry of Environment and Forestry, National Treasury, State Department of Transport, KPLC, KenGen, KEBS, KEPSA

1 association

Kenya Association of Manufacturers

7 global McKinsey experts

Experts in e-mobility, batteries, automotive manufacturing, power

3 financiers

Coop Bank, Watu, Maris

4 development agencies

UNEP, P4G, Siemens Stiftung, GIZ

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

- **Making economics of locally-assembled E2Ws favourable**
- **Establishing accessible and reliable charging infrastructure**

Financing solutions

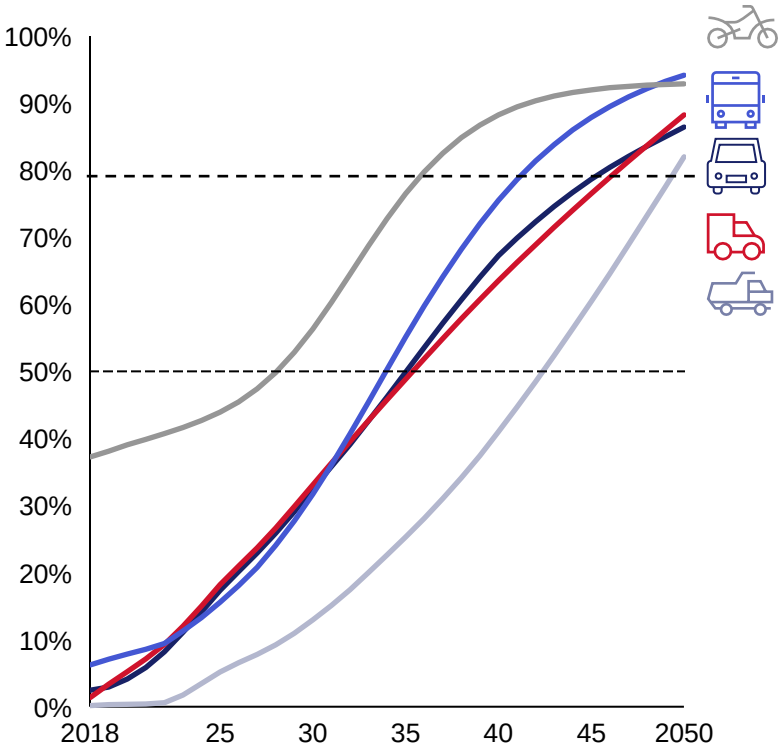
Electric motorbike pilot

Appendix

Global EV market is rapidly growing – 80% sales in all vehicle segments are expected to be electric by 2050

Electric Vehicle (EV) + Fuel Cell sales uptake by segment[1]

% of global vehicle sales



X% FC EV plug-in ICE

Global car parc,
Million vehicles

EV[1] sales as % of total in 2050

CAGR of EV 2018-35

Key insights

By 2050, **more than 80% of the sales** in all segments is expected to be electric

Excluding trucks, **all segments will reach >50% EV sales by 2035**, driven by

- Favourable regulations
- Improving economics
- Technology readiness

Electric two-wheelers (E2Ws) is the segment with the highest degree of electrification today, driven by the large number of E2Ws in China

1. EV = Battery Electric Vehicle (BEV) + Plug-In Hybrid Electric Vehicle (PHEV), EV = electric vehicle, FC = Fuel cell hydrogen

Source: McKinsey Energy Insights' Global Energy Perspective, June 2020

Kenya will need to adapt to accommodate EV as manufacturers are already making the shift

Car usage by brand in Kenya 2020, %

Year of stopping ICE production

	Car usage (%)	Year of stopping ICE production
Toyota	46	2040[1]
Nissan	10	2030
BMW	5	Will reduce ICE by 50% from 2021
Mazda	5	-
Subaru	5	-
Audi	3	2035
Chevrolet	3	-
Honda	3	2022 (in Europe)
Mercedes-Benz	3	2039[2]
Mitsubishi	3	-
Lexus	2	-
Volkswagen	2	2026
Datsun	1	-
Ford	1	2040
Land Rover	1	Around 2036
Suzuki	1	-

1. Target set prior to announcement that Japan plans to stop the sale of new gasoline-powered cars by the mid-2030s. No new target year has been stated by Toyota
2. Daimler has stated that it wants to achieve a CO_2-free fleet by 2039; however, Mercedes-Benz could offer 100% electric cars as early as 5 or 8 years earlier

Source: Statista, press search

Key insights

Kenya needs to make the shift to EV as manufacturers will be **reducing manufacturing of ICE vehicles** and increasingly shifting towards EV

As at March 2021, **manufacturers of ~70% of vehicles used in Kenya** have committed to **end production of ICE vehicles** within the next **2 decades**

Given **Kenya** has announced intentions to **eliminate imports** of all **second-hand cars** by **2026**, there is an **opportunity** to **support the influx** of **EVs** over ICE vehicles in the **near term**

SSA[1] presents a unique vehicle landscape which has implications for the transition to EVs

Market aspects	Insight
1 **Vehicle parc**	The 2020 vehicle parc in focus countries was **~12m vehicles** with **~55% 4Ws and ~30% 2Ws.** It is expected to grow to ~**34m** by 2040 with **~50-55% 4Ws and ~35-40% 2Ws.** 2W are a common mode of commercial transport (passenger and delivery) in these countries
2 **Vehicle ownership**	**Focus countries have low vehicle ownership compared to rest of the world** (<30 per 1000 people compared to ~80 for developing Asia and Middle East). Ownership is limited to **middle-to-high income earners** that also are more likely to have **access to electricity and a parking space**
3 **Used cars**	Majority of 4Ws and LCVs sold in Africa are **used** (80%+), and some are **up to 15 years old at date of purchase;** only 2Ws are dominantly sold new
4 **Road Infrastructure**	Many cities experience **heavy traffic and congestion**, although similar to other developing markets
5 **Electricity mix and reliability**	East African focus countries have a **large reliance on renewable electricity** (~70-90% of total energy mix, mostly hydro) while **Nigeria relies heavily on thermal energy** (~90% of total grid energy mix) and off-grid energy (assumed to be 5x higher than grid energy via diesel generators and off-grid solar). **Electricity access is low overall but generally high in urban areas; however, electricity systems are not always reliable** (e.g. Nigeria reliability index at 1.4 out of 7)

1. Excluding South Africa

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Stakeholder and expert interviews

Implications for e-mobility

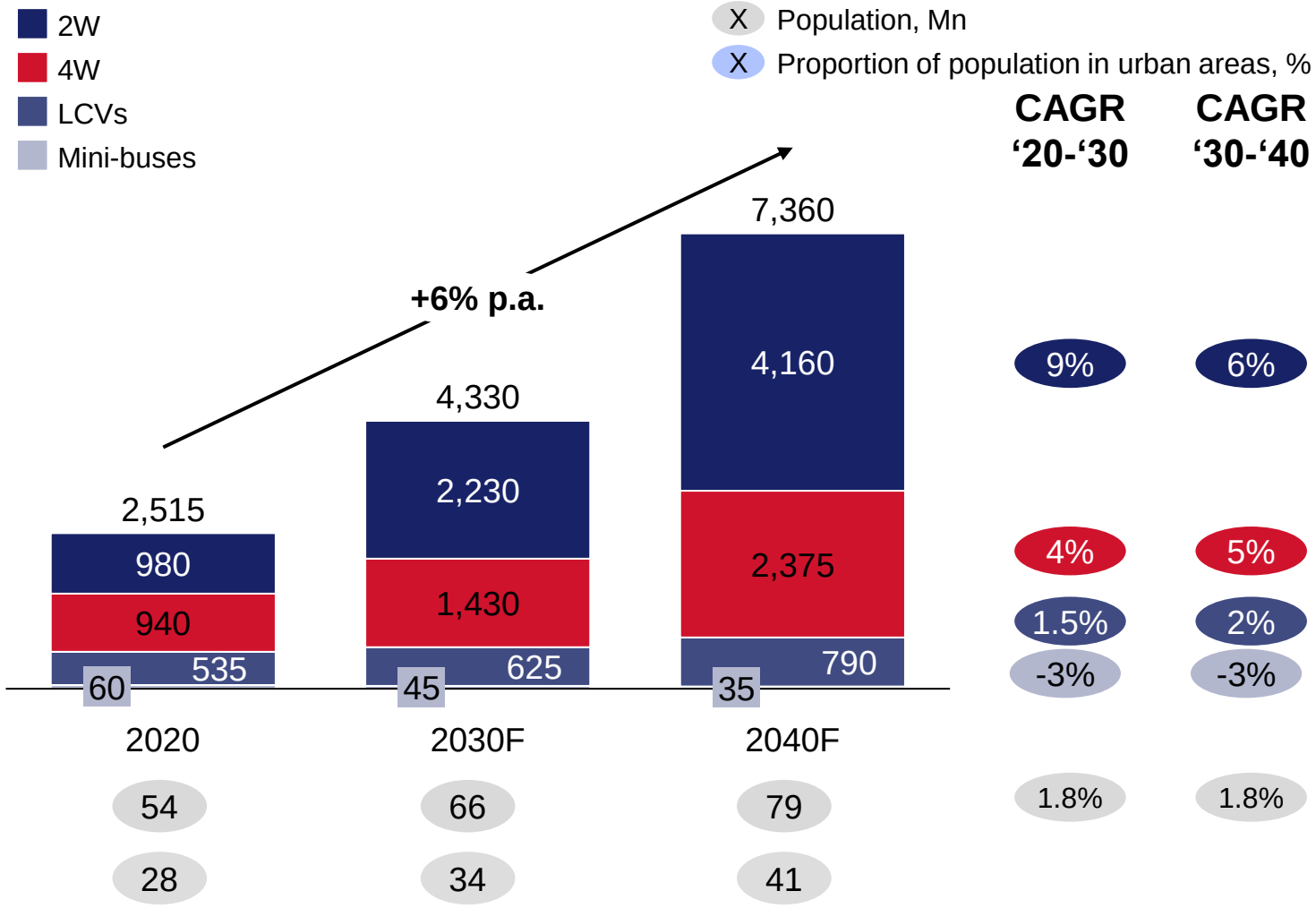
Current vehicle owners are mostly in **urban areas** and typically have **access to electricity**, which **supports EV adoption**

However, **adoption likely to be constrained** by two factors in the near-term:

- **Affordability of EVs** given current car market is dominated by older, low-priced used vehicles
- **Supply of used EVs** (that might match this price point), which is likely to be low until post-2035

Over the long term, **investment** will be required to **strengthen electricity reliability and supply**

The vehicle parc in Kenya is projected to reach ~7.4m in 2040



Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation; UN Population projections; World Bank, KNBS 2020 Economic Survey. McKinsey Centre for Future Mobility

Key insights

The largest and fastest growing vehicle segment is **two-wheelers**, which are commonly used as taxis ('boda bodas'). Growth is expected to be slower post 2030 due to reaching some level of saturation (particularly as 2Ws are primarily for commercial use)

Minibus segment is **expected to decline as government is actively trying to reduce use** and replace with larger buses

The majority of the **vehicle parc** are **used imports** (87%), predominantly from **Japan** (Toyota and Nissan)

Based on economics and behavioral analysis, feasibility of EV adoption for each segment can be assessed

	Degree of feasibility for EV adoption			
	High	**Medium**	**Low**	**Notes**
Primary use	Commercial use	Mix of commercial and personal use	Personal use	Commercial use usually translates to higher mileage which makes the TCO more favorable (faster recovery of upfront cost through operating expenditure savings)
Feasibility to charge	Have time to charge everyday	Sometimes have time to charge	Do not have time to charge everyday	Assuming that all riders have access to charging infrastructure, having blocks of time in the day to charge (e.g. while parked, over-night) is more feasible
Level of charging infrastructure required	Battery swap stations or Level 1 charging	Mix of Level 1 and Level 2 charging	Primarily level 2 or DC fast charging	Considering both the cost and power requirement of different charging infrastructure, battery swap stations are easier to implement relative to home charging and DC fast charging (most difficult)
Upfront cost of EV vs ICE	Same or lower upfront cost as ICE equivalent	<10% higher upfront cost relative to ICE equivalent	+10% higher upfront cost relative to ICE equivalent	The lower the upfront cost of the EV is relative to the ICE equivalent, the more feasible it is to adopt the EV
TCO of EV vs ICE	TCO shows advantages over ICE equivalent	TCO is the same as an ICE equivalent	TCO shows disadvantages over ICE equivalent	The lower the TCO of the EV is relative to the ICE equivalent, the more feasible it is to adopt the EV
Used vs new	New	Mix of new and used	Used	Purchasing a new EV is currently more feasible than purchasing a used EV given the limited supply of used EVs
Alternatives	No alternative sustainable fuel sources	Limited sustainable alterative fuel sources	Sustainable alternative fuel sources available	EV adoption is more feasible if there is no sustainable alternative

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Expert interviews, stakeholder interviews

These suggest 2Ws are most feasible for EV adoption, followed by LCVs

Based on TCO modelling, consumer surveys, and expert interviews

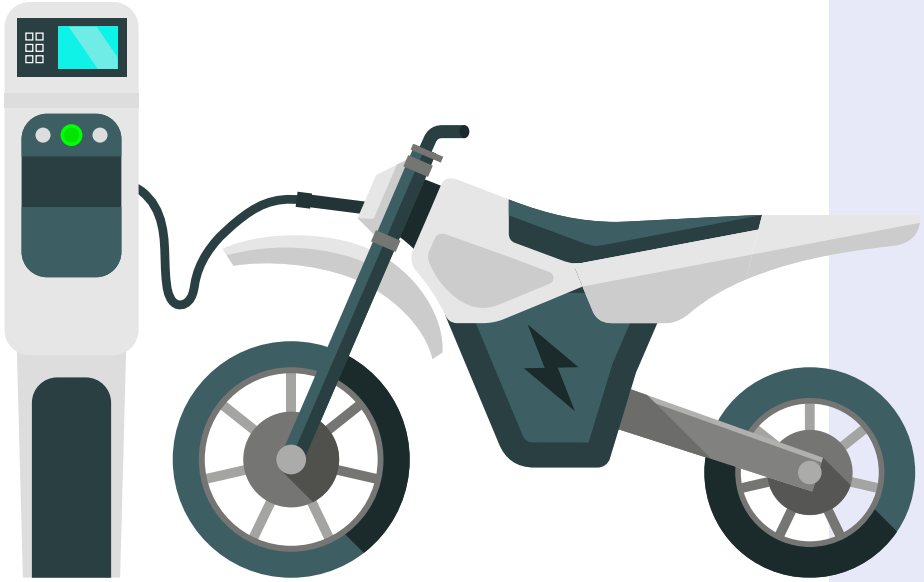
High | Medium | Low

	Primary use	Level of charging infrastructure required[3]	Feasibility to charge	Upfront cost of EV vs ICE	TCO of EV vs ICE	Used vs new	Alternatives
Two-wheelers	Commercial (bodas, moto-taxis or okadas): up to 90km per day	Battery swap stations currently the winning approach for 2Ws	Diders have time to make battery swaps, charge at home, or publicly charge	E2W can be equal to ICE 2W if incentives are applied	TCO always more favourable for EVs even in countries with high electricity costs	Likely new, potentially with some local assembly[1]	No clear alternates
Personal four-wheelers (used and new)	Personal: shorter distances (20-40km per day)	Level 1 charging at-home sufficient	Have access to electricity at home and able to charge overnight	~20% more expensive for new; used vehicles not yet available and might similarly be more expensive		Mostly used (~85% of all sales)	No clear alternates
Commercial four-wheelers	Commercial (taxis): up to 100km per day	For some riders (<150km per day) Level 1 charging sufficient, but some Level 2 might be required to cover all	Have access to electricity at home and able to charge overnight; have some time during the day to charge but limited	Same as above			In Kenya, Rwanda and potentially Uganda, Autogas adoption for 4Ws and LCVs might be an interim step before EV adoption[2]
LCVs	Commercial: travelling >100km per day	For some riders (<150km per day) Level 1 charging sufficient, but some Level 2 might be required to cover	Able to charge overnight at parking lot (for corporate vehicles); have some time during the day to charge	Likely to be 20-30% more expensive		Mix of new and used (used more common for privately-owned LCVs)	Same as for taxis and minibuses
Minibuses	Commercial: travelling >100km per day	80% drive <150km so Level 1 should be sufficient; however, L2/FC required for full coverage	Able to charge overnight at petrol stations; have some time during the day to charge	Likely to be 20-30% more expensive		Mostly used	In Kenya, Rwanda and potentially Uganda, autogas adoption for 4Ws and LCVs might be an interim step before EV adoption[2]

1. We are aware of a used market for 2W in Nigeria where bikes have a low holding period (~1 year); however, we anticipate that E2W will not follow this trend and instead be bought new as they have a longer average holding period
2. LPG infrastructure already exists in East Africa; some companies are already looking into this and the Rwandan government is also encouraging LPG use
3. See back-up for further detail

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Consumer survey, consumer interviews, stakeholder interviews

The potential of the EV market is driven by the underlying growth of the overall automobile market and expected EV uptake rates



Growth of overall automobile market

- Historical vehicle ownership rates (vehicles/capita)
- Historical sales per capita (vehicles/capita)
- New vehicle registration growth rates
- Projected GDP/capita
- Projected population growth

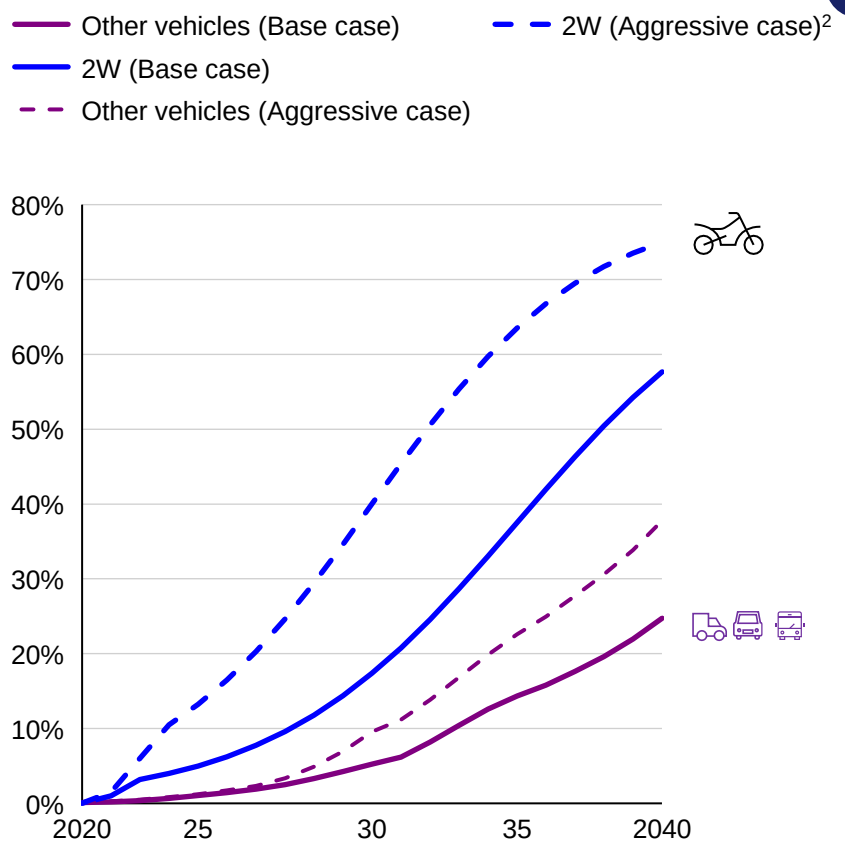
EV uptake rates

- Cost comparison between EV and ICE vehicle
- Operating costs
- Market maturity, considering:
  - Availability of charging infrastructure
  - Availability of appropriate EV models and spare parts

Source: Emerging market EV experts' input; OICA; Local sources (e.g., national statistics data); Industry reports

Kenya has the largest EV potential in East Africa, and could become a regional E2W assembly hub

Electric vehicle[1] sales uptake by segment, % of vehicle sales



Estimated electric vehicle sales (parc in parentheses)[3]

	2025		2030	
	Base	Aggressive	Base	Aggressive
Other vehicles	2k (5k)	<3k (21k)	10k (30k)	17k (64k)
E2W	21k (56k)	55k (141k)	85k (266k)	196k (633k)
Total	24k (61k)	58k (162k)	95k (296k)	213k (697k)

Key insights

In Kenya, the **revenue potential** for **E2W** in 2030 is **$190-360m[4]**, with 12-30% of the total 2W parc being electric by that time

The **motorbike** segment is **expected to transition** the **fastest**, in line with what has been seen in India and China

Other vehicles segments will transition slower due to the much **higher** relative purchase **price** of electric alternatives, particularly as **~85%** of these vehicles are **bought used** (versus 2Ws, which are dominantly bought new) and greater **range anxiety, particularly for larger vehicles** (e.g. buses, LCVs) which might travel >150km in a day

By 2030, Kenya can **save ~300,000 tonnes** of **petrol imports** in the aggressive E2W case – **currently** Kenya **imports ~6m tonnes** of petroleum

1. EV = BEV | 2. Aggressive case assumes incentives like VAT exemptions, restrictions on ICE vehicles, benefits (e.g. free parking), and building out of charging infrastructure | 3. Does not consider the electric car conversion market; this only considers market growth as a result of new electric vehicle sales I 4 Average selling price or $1500

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Emerging market EV experts' input, OICA, Local sources (e.g., national statistics data), Industry reports

Various business models are emerging for e-mobility players in Africa

Companies based in Kenya

Variation on business model

Business model	EV assembly	Sales and distribution	Sales and distribution	Charging infra-structure	Financial services	EV Rental	Examples
Importer – financer	Bodawerk locally assembles the battery	Imports CBUs			Offers vehicle financing on a lease model; some players offer unsecured lending		STIMA BODA, BODAWERK
Assembler – financer	Imports CKDs and assembles locally			Provides tailored charging infrastructure		REM sells E2Ws without batteries, and then rents out batteries only	Fika CLEAN MOBILITY, REM, Z
Pureplay importer or assembler	Either imports or assembles locally	Either imports or assembles locally		Provides tailored charging infrastructure			MOBIUS MOTORS, OPIBUS
Pureplay vehicle financier model (not EV-specific)					Offers vehicle financing; some players offer unsecured lending		moove, Uber, watu
Distribution – financer			Acts as a dealer by partnering with vehicle suppliers and showing no preference for any particular brand		Offers vehicle financing on a lease model; some players offer unsecured lending		TUGENDE

Key takeaways

Most **assembly or importing focused** e-mobility start-ups are focused on are still **small scale** (less than 20 vehicles) and focus on **E2W**

Business models are anticipated to evolve as the market grows - an additional business model Centred on pureplay charging infrastructure could emerge (e.g., from players such as TotalEnergies) while **other players may choose to specialise** in portions of the value chain

Pureplay finance and distribution-finance models today primarily consider ICE vehicles but are currently piloting financing electric vehicles

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Stakeholder interviews, press search

Kenya is already a hotbed for entrepreneurs in e-mobility that act across the value chain – but these players require support to scale up

- Opibus currently converts ICE vehicles to electric drive chain and is going to launch an E2W
- Opibus is hoping to sell its E2W at ~$1,300 with an advertised range of 150km
- Whilst Fika mobility is in pilot phase, they intend on manufacturing in country and are currently in R&D stage on manufacturing in Kenya
- Powerhive has ~30 bikes operating in Kisii as a pilot

- Kiri EV is piloting with 10 bikes, but planning to get 300 by end of year
- Driveelectric has partnered with Nissan to provide customers with Nissan Leaf vehicles
- Mazi has ~10 bikes currently and is building 2 swapping stations

- Financial services in this space are usually facilitated by 3rd-party finance providers
- Finance providers are starting to enter the e-mobility space as it allows them to access capital at lower rates from green capital providers
- Watu and Mogo are popular loan providers for boda boda riders, offering loans at ~50% interest rate annualized
- Maris, a PE fund is looking at investing in the e-mobility space in Kenya

- Uber, Bolt and NopeaRide have added electric vehicles as part of their fleets
- Users of these apps are given the opportunity to use electric vehicles as a mode of transport
- Jumia and GetBoda provide logistic services using E2W

E2W and car assembly → **Sales and distribution** → **Charging infrastructure** → **Financial services** → **Installation and maintenance** → **E-mobility ambassadors**

- Opibus has an ambition to build all the hardware and software infrastructure which other players can utilise
- All players except Opibus currently operate battery swapping stations or aim to do so
- Mazi has ~2 swap stations, ARC Ride has ~10 swap stations
- Kenya Power aims to run a pilot project with charging infrastructure in major cities with the aim of catalysing the industry; looking for development financing to fund the rollout
- ARC Ride announced plans to invest £4.5 million in growing its fleet of electric vehicles in Kenya.

- Maintenance includes both infrastructure and vehicle maintenance
- Opibus, Driveelectric and NopeaRide provide vehicles and infrastructure maintenance
- KenGen has a pilot location where it is testing the feasibility of electric vehicle charging

New entrants

- Ampersand is currently looking at entering the Kenyan market (already assembling E2W in Rwanda)
- They will look to play in sales and distribution and charging infrastructure through their battery swapping technology

Source: Press search, expert interviews, company websites, UNEP, Manufacturing Africa E-mobility workshop

Electric vehicles being assembled in Kenya include motorbikes, cars, tuk-tuks and scooters

Focus of this document

EV type	Current manufacturing capability: Assembly	Current manufacturing capability: Conversion	Example products	Example companies
Bus		✓		OPIBUS
Car		✓		OPIBUS
	✓			Nissan
Motorbike	✓			OPIBUS, Ecobodaa ecobodaa, Kiri EV
Tuk-tuk	✓			Kiri EV
Piktuk	✓			Kiri EV
Scooter	✓			Kiri EV
Handcart	✓			Auto-Truck Save Your Energy
Bicycle	✓			POWARD

Contents

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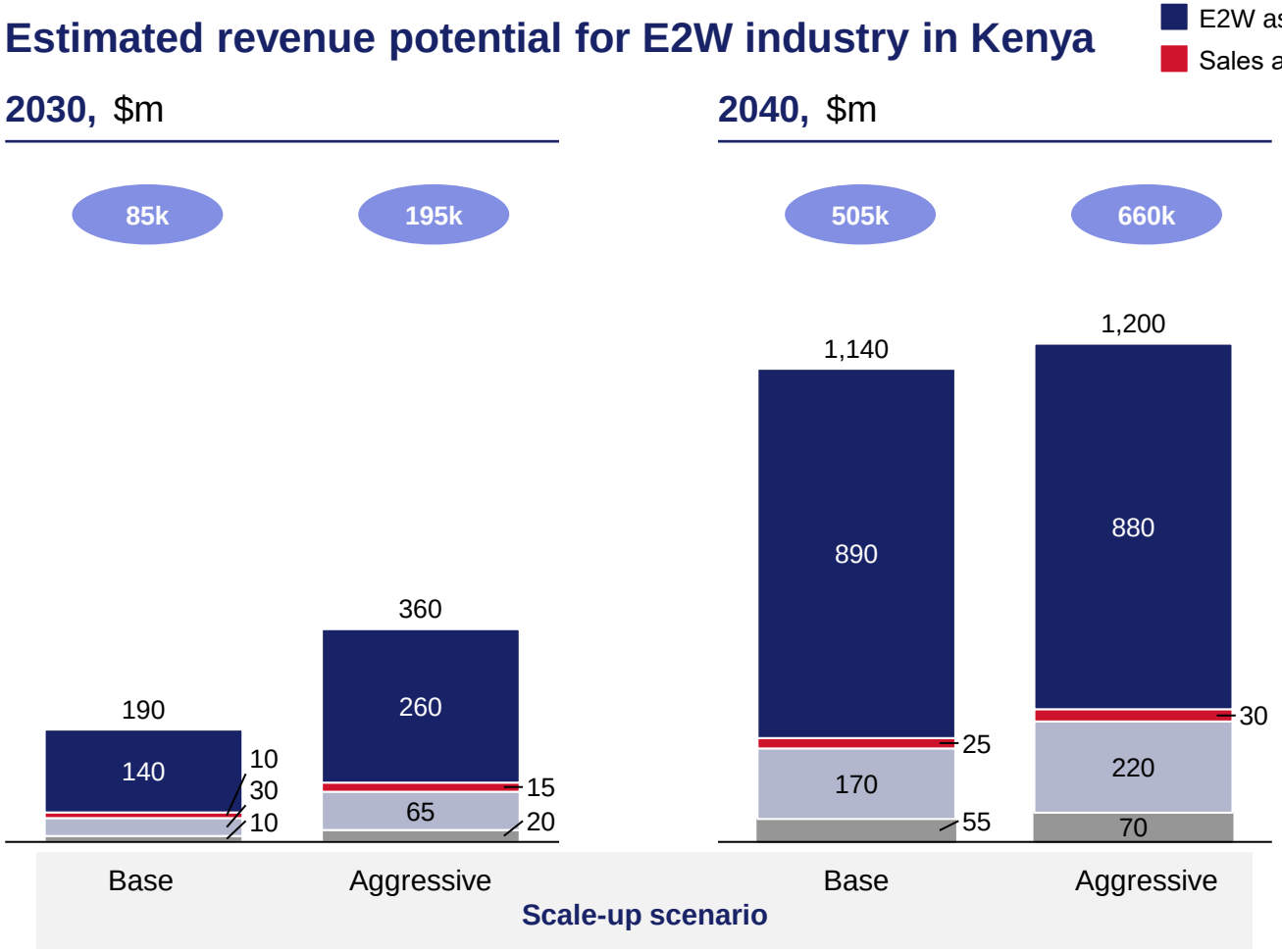
Electric motorbike pilot

Appendix

Revenue potential for the E2W industry in Kenya could be ~$350m per year by 2030, in the aggressive scenario where all incentives are applied

2030 chart not to scale with 2040 chart

Estimated revenue potential for E2W industry in Kenya



Key insights

In 2030, **revenues** for the **E2W industry** market **could range** from **$190-360m depending** on the scale-up **scenario**, i.e., whether sector-specific enablers are applied, including **Import** and **Sales VAT exemptions**

In 2040, **revenues** for the **E2W industry** market **could range** from **$1.14-1.20b depending** on the scale-up **scenario**

In both scenarios, **~75% of revenues** are generate by **E2W assembly**

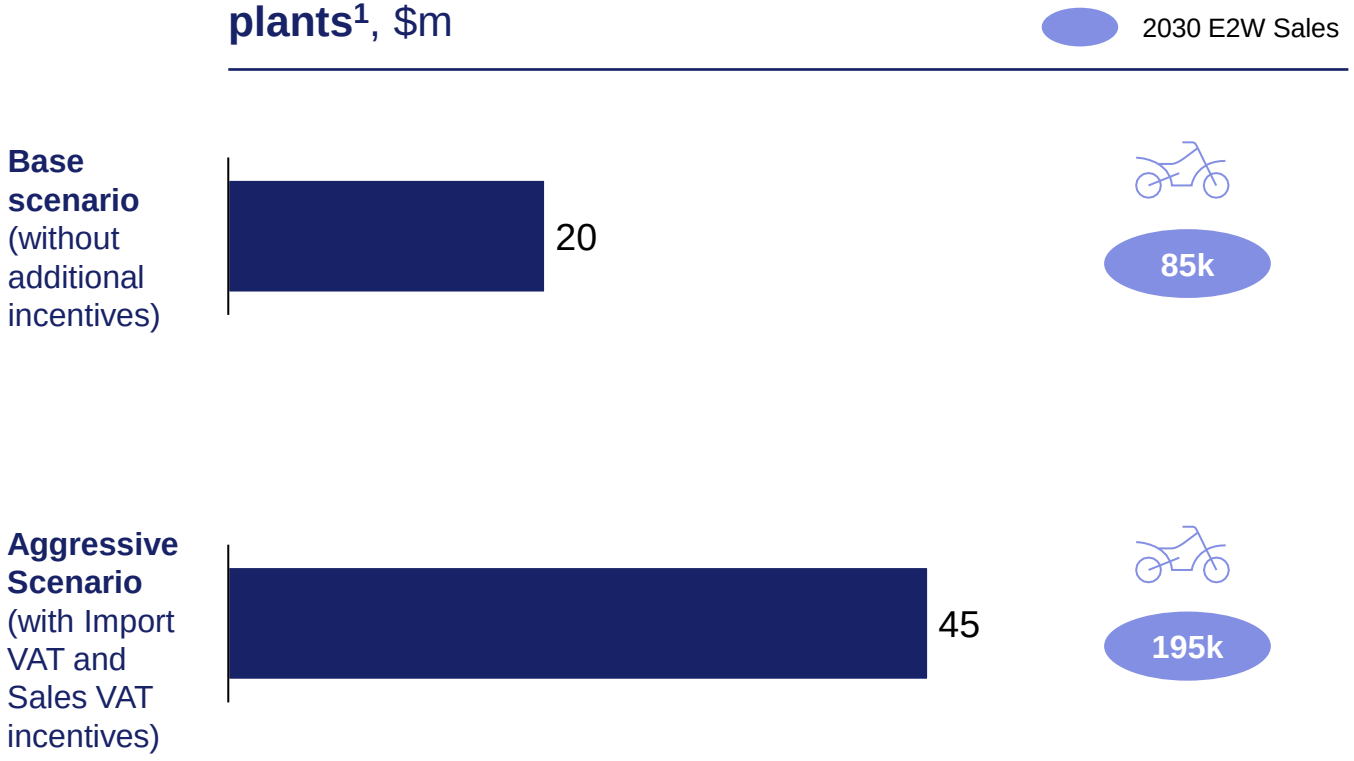
1.Import duty = 10%, Excise Duty = 0%, Import VAT = 0% and Sales VAT = 0% | 2.Import duty = 25%, Excise Duty = 15%, Import VAT = 16% and Sales VAT = 16% | 3. Assuming that the retail price of an E2W does not change between 2025 and 2030 – base case retail price is ~$1,770 and in the aggressive case retail price is ~$1,350 | 4. Assumes a 3% sales fee applied to the sales of an E2W | 5. Assumes that a E2W will swap a battery once a day at ~$1.5 per swap | 6. Assumes that a bike repairs on an E2W occur twice a month at ~$6.5 per incidence

Source: Expert interviews, Industry analysis

Investment opportunity for E2W assemblers could be valued between $20-45m by 2030

Investment required for E2Ws in 2030, with and without incentives

Projected 2030 investment potential for E2W assembly plants[1], $m



Key insights

In **2030**, investors will have the **opportunity** to **invest** between **$20-45m,** into **assembly facilities** depending on the scenario

In 2030, investors can also expect:

- **Start-up costs** to be **~$5m**
- **CAPEX** to range between **$5-10m** depending on the scenario
- **Working capital** to range between **$10-30m** depending on the scenario

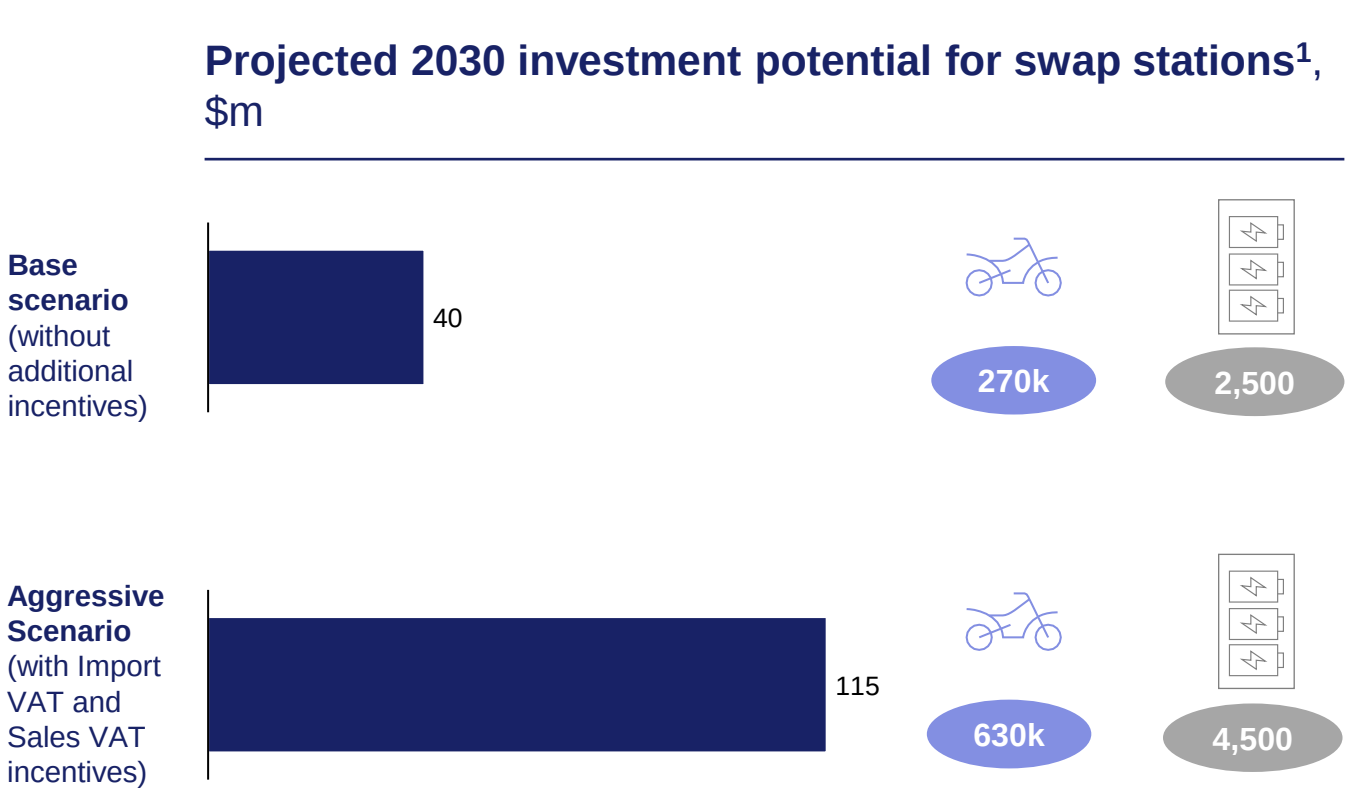
1. Based on forward looking cashflow modelling that considers working capital and inventory

Source: Emerging market EV experts' input, OICA, Local sources (e.g., national statistics data), Industry reports

Investment opportunity for E2W swap / charging stations could be valued between $40-115m by 2030

E2W swap / charging station investment required for 2030

Projected 2030 investment potential for swap stations[1], $m



Key insights

In **2030**, there will be between **2,500-4,500** swap stations, **requiring** an **investment** between **$40-115m, depending on** the scale-up scenario, or what extent of **incentives** GoK has put in place

The **battery cost is ~60%** of the **total investment for swap stations**, primarily because operators need to **buy buffer batteries**

Operators can start to **recover** this **cost over time** as they can **charge a fee per battery swap**

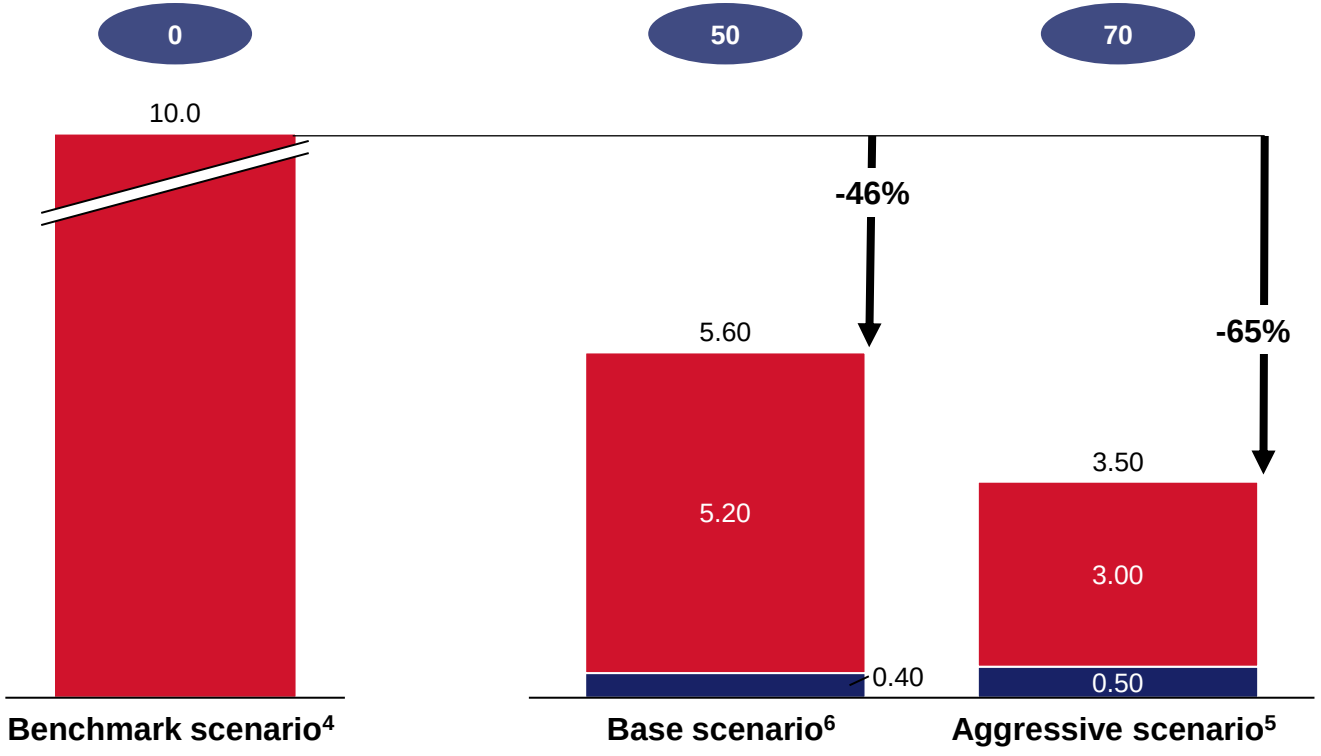
1. Includes investment for swap stations that also include 1-2 public L1 charging points

Source: Emerging market EV experts' input, OICA, Local sources (e.g., national statistics data), Industry reports

Increasing the E2W parc to ~50% of total 2W parc can decrease CO_2 emissions from motorbikes by ~46% in 2040, if all incentives are applied

ICE 2W emission intensity 2040[3], million tonnes CO_2

E2W and ICE 2W emission intensity 2040[3], million tonnes CO_2



Key insights

In the **base scenario**, increasing the **E2W sales to ~50%** can **decrease CO2 emissions from motorbikes** by **~46% by 2040**

In the **aggressive scenario**, increasing the **E2W sales to ~70%** can **decrease CO2 emissions** by **~65% by 2040, decreasing Kenya's transport emissions by ~28%[7]**

The **transport** sector is the **2nd largest contributor** to Kenya's emissions. **E2W uptake** will likely be **catalytic** to uptake across other **EV segments** as it will help increase awareness and improve perception of EVs, ultimately leading to **up to 10% of Kenya's total emissions or 30%** of the current **NDC target**

Tracking decreased emissions may open up **opportunities** for **new forms of financing,** e.g., Emtec in Kenya has developed a technology that links carbon offset markets to end users of carbon credits in the transport sector

Finally, the **dominant pollutant** type in Kenya is **PM2.5[8]**, most of which is **generated by combustion of petrol and diesel**. By **switching to EVs** Kenya can expect to significantly decrease the amount of PM2.5 released, thereby **improving air quality** and **reducing health issues** related to air pollution

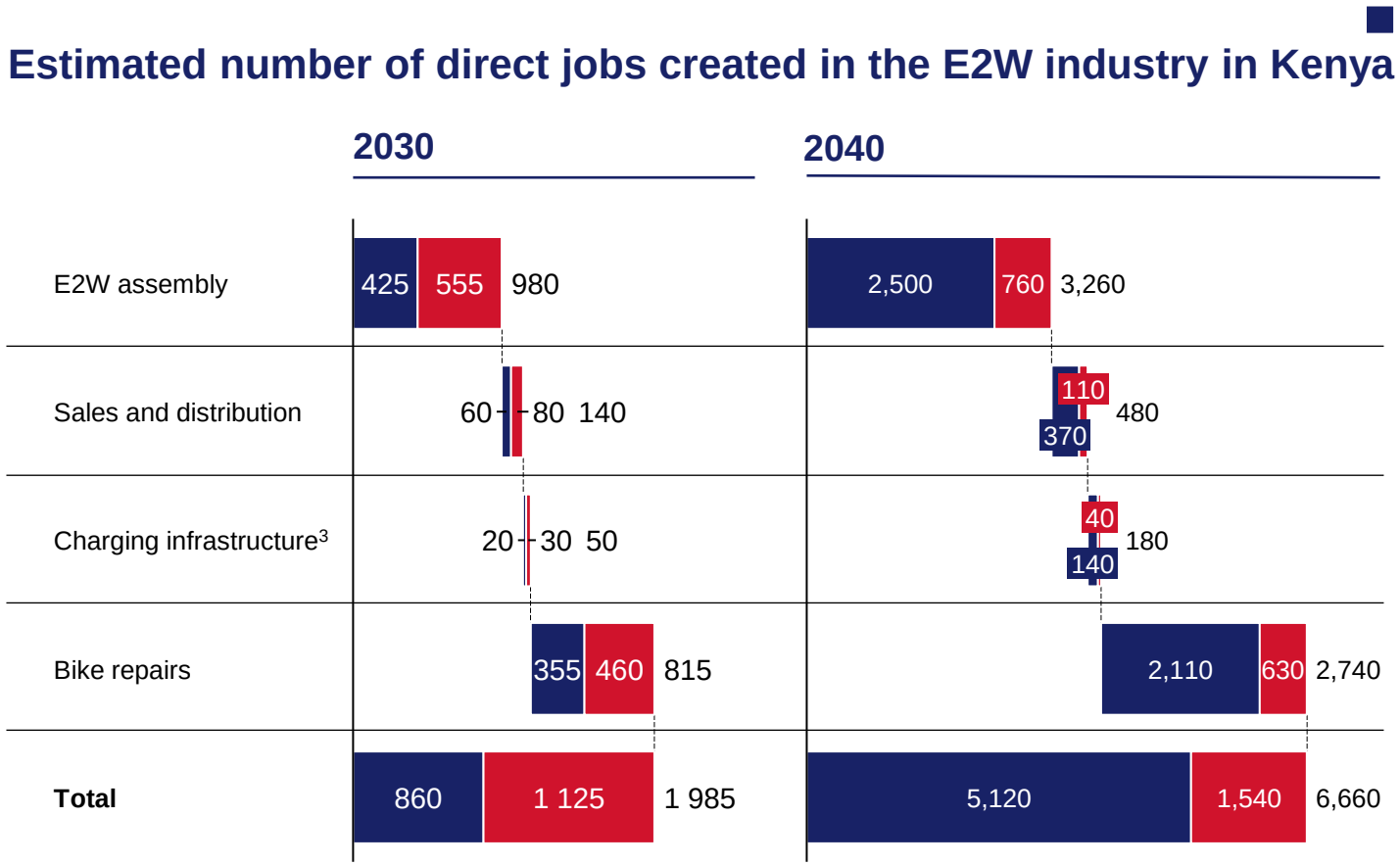
1. Assumes an ICE 2W CO2 emission intensity of 113 gCO2/km | 2. Assumes an ICE 2W CO2 emission intensity of 8 gCO2/km, grid emission intensity of 199 gCO2/kWh, E2W battery efficiency of 0.04kWh per km | 3. Assumes that both ICE 2W and E2W travel 90km per day | 4. This scenario assumes there are no E2Ws in 2030 | 5. Import duty = 10%, Excise Duty = 0%, Import VAT = 0% and Sales VAT = 0% | 6. Import duty = 25%, Excise Duty = 15%, Import VAT = 16% and Sales VAT = 16% | 7. Benchmarked to 2040 transport emissions of ~24 MtCO2e base line emissions (calculated based on GIZ TraCS analysis) | 8. PM2.5 is defined as fine inhalable particles, with diameters that are generally 2.5 micrometres and smaller

Source: Expert interviews, EPRA, EPA, Boda focus groups, 2019-2020 Transport Sector Climate Change Annual Report (GIZ), IQ Air, Greenhouse gas emissions from the transport sector (GIZ TraCS)

In 2030, ~2000 direct jobs can be created, which can increase to ~6,700 in 2040, if all incentives are applied

Jobs created across key parts of the E2W value chain

Estimated number of direct jobs created in the E2W industry in Kenya



Key insights

In 2030 and 2040, **~900** and **~5,000 jobs** can be **created** in the **E2W industry** respectively if **no incentives are applied**

If **all incentives** are **applied**, **jobs** created can **increase to ~2,000 in 2030** and **~6,700 in 2040,** representing a **3.4x increase** in **jobs**

In both scenarios, **E2W assembly** has the **biggest potential** to **create jobs**, accounting for **~50% in 2030** and **2040**

1. Aggressive scenario – Import duty = 10%, Excise Duty = 0%, Import VAT = 0% and Sales VAT = 0%. In 2025, E2W parc is 50k, in 2030 E2W parc is 355k
2. Base scenario – Import duty = 25%, Excise Duty = 15%, Import VAT = 16% and Sales VAT = 16%. In 2025, E2W parc is 11k, in 2030 E2W parc is 110k
3. Includes installation and maintenance

Source: Expert interviews, Industry analysis

Women have an opportunity in the EV sector – with a growing trend of women actively engaging in the motorcycle market in Africa

Case studies on women engaging in the motorcycle market in Africa

Kenya

Opibus in Kenya **actively hires females** in engineering, marketing and R&D

The **company's vision** not only aims to **reduce carbon emissions**, but also **change** the **culture** of the **motorcycle industry** to a more **gender-equal** one

"**Equality** between the **genders** means we will **design better products for everyone**, having in mind the masses and their various needs. That makes us **more effective in business**." – Albin Wilson, Opibus marketing manager

Rwanda

Women in **Rwanda** are starting to **break** into the **Moto business**

The Rwandan **government encouraged women** to **enter** into the **transport business** and **generate income**

"We have been **encouraged by** our **government** which puts **rights** of women at the core and inspired by **courageous Rwandan women**, who have **served** in **high government positions**." – Marie Louise Karegeya, Moto Dider

Liberia

Pink Panthers All-Girls Motorcycle Club, is **challenging** the **cultural norm** of motorcycle taxis in Liberia and doing a so-called **"man's job"**

UNDP and **Angie Brooks International Centre** are working together to help **Liberia's first all-women fleet** of motorcycle taxis get **financing** for their bikes and **protection** from harassment

"The **women picked** the name **Pink Panthers** because **pink** referred to **femininity** and **panther** to **strength** in an effort to reflect their ability to **work in a male-dominant environment**" – Esha Chhabra, ONE.org Journalist

Image credits: Francis Nderitu, Cyril Ndegeya, UNDP

Source: Press search, allAfrica, The Nation, Breaking News Kenya, Daily Monitor, Anadolu Agency, One.org

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

- Making economics of locally-assembled E2Ws favourable
- Establishing accessible and reliable charging infrastructure

Financing solutions

Electric motorbike pilot

Appendix

Compared with 4 other countries with high potential on the continent, Kenya is well positioned for EV adoption

2020 data

Beneficial for EV adoption

	Gasoline pump price $	World Bank Electricity reliability score Out of 7	Electricity price (household) $/kWh	Population access to electricity Percent	GDP per capita $	Urban population Percent	Age restriction for used imports Years	Presence of automotive assembly/ manufactu-ring	Driving side[1]	Degree of EV market activity	Electrification target
Kenya	$0.95	4.1	0,216	70%	$1,817	28%	8	Yes	Left	High	9% of vehicles to be electric with 20% being buses by 2030
Rwanda	$1.17	4.4	0,257	38%	$820	17%	None	Yes	Right	Medium	Aim for 5% of all imported vehicles to be electric annually by 2025
Uganda	$0.94	3.4	0,191	41%	$794	25%	15	No	Left	Medium	NA
Nigeria	$0.46	1.4	0,059	55%	$2,230	52%	15	Yes	Right	Medium	NA
Ethiopia	$0.75	3.2	0,257	48%	$856	22%	None	Yes	Right	Low	12% of all vehicles to be hybrid & electric by 2050

Nuance on vehicle segments

2W:

- Much higher presence of E2W starts-ups in Kenya and Rwanda compared to other countries, and indication that government may support the transition to electric (especially in Rwanda)
- Nigeria and Ethiopia both have regulatory push-back against 2Ws for commercial transport in urban areas (e.g. okada bans in Nigeria)

Minibuses:

- Some indication that Kenyan and Nigerian governments may disincentivize use of minibuses in favor of larger buses

1. Countries with left-hand side driving more likely to import from countries where EV adoption is faster meaning greater likelihood of used EVs over time

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, World Bank, ICCT, UNECE, consumer survey, consumer interviews, stakeholder interviews

Kenya is likely to scale E2Ws rapidly, but adoption of other EVs may be slower compared with countries already applying incentives

	E2W		All other vehicle segments	
	Rank	**Rationale for ranking**	**Rank**	**Rationale**
Kenya	1	Large 2W parc with significant presence of E2W start-ups starting to drive adoption Fintech and ride-hailing companies supporting innovations in leasing models to facilitate uptake	2	Relatively good availability of leasing models to facilitate affordability of vehicles, good electricity access, and strong presence of corporates who may want to drive a sustainability agenda for transport Age restrictions on used vehicle imports facilitate faster adoption Government actively speaking about encouraging EV adoption (although no incentives as yet). Minibuses might have some adoption constraint over time (relative to Rwanda) because government trying to push away from minibuses to larger buses
Rwanda	2	E2W start-ups driving adoption, combined with government incentives Relative to Kenya, fewer fintech and ride-hailing company innovations	1	Government actively trying to incentivize EV adoption Greater percentage of parc expected to be new over time which will encourage EV adoption as new ICE vehicles cease being available
Uganda	3	Likely to lag Kenya based on similar technology adoption waves seen (e.g. start-ups will start with Kenya and then expand into Uganda)	3	Likely to lag Kenya based on similar technology adoption waves seen (e.g. start-ups will start with Kenya and then expand into Uganda)
Nigeria	4	Large 2W parc, a few E2W start-ups starting to drive adoption, and large presence of fintech / ride-hailing companies driving innovations around leasing However, government regulation against okadas might stimy growth (e.g. already caused one company to have to revise business model)	5	Fairly similar conditions to Kenya; however, unstable and unreliable electricity supply likely to be a major barrier to adoption for larger vehicles (particularly as charging large vehicles on solar mini-grids unproven and likely very expensive; and charging on diesel generators defeats the value of EVs)
Ethiopia	5	Much smaller 2W parc relative to other countries with limited government incentives or presence of start-ups driving adoption Government trying to disincentivize use of 2Ws in city centers	4	Low vehicle ownership (although growing and likely to be more new vehicles than Kenya which might facilitate adoption); but lack of financing models make adoption challenging for more expensive vehicles

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Rwanda and Kenya lead on introducing enablers for 5 countries across SSA (1/2)

	Kenya	Rwanda	Uganda	Ethiopia	Nigeria
Charging Infra-structure	In 2020, Ministry of Environment required **new buildings** to **incorporate charging stations** In **2021, Kenya Power** announced plans for **nationwide network** of **public charging points** In **2020, KenGen** announced plans to roll out an **EV charging network** **Nopea** set up **charging stations** for **electric cars** at Two Rivers Mall, Hub Mall, Thika Road Mall, Sarit Centre	**Provisions made for EV charging stations** in the building code and city planning rule **Introduced technical standards and environmental standards** (e.g., recycling of batteries), **Safi Universal link** launched the first public multipurpose EV charging station which will allow all e-vehicles owners to access the charging service	The **Energy and Environment Partnership Trust Fund** in collaboration with **Zembo** financed **solar charging stations** with the aim of introducing **700 stations** in next 5 years	N/A	The federal government commissioned the **first solar-powered electric vehicle charging station** in July 2021
Electricity tariffs	Currently ongoing **negotiations** with Kenyan govt. stakeholders for **tariff reductions for e-mobility charging**	Electricity **tariffs for charging stations** to be **capped** at the **industrial tariff** Electric vehicles to benefit from a **reduced tariff during the off-peak time**	N/A	Electricity tariffs are favourable, with **residential tariffs at around $0.06/kWh**	N/A
Purchase/ demand incentives	N/A	Introduce **preferential parking** and **free entry** for green vehicles into any **future congestion zones and restricted zones**	N/A	N/A	N/A
Tax exemp-tions	Locally assembled E2W are **exempt from excise duty** and **import duty** is **decreased to 10%**	**Charging station equipment** will be **exempted from import, excise duties and withholding tax** Electric vehicles, spare parts, batteries and charging station equipment be treated as **VAT-zero rated products**	N/A	N/A	N/A

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Press search, CNBC, Bloomberg, WEF, Government strategies and policies

Rwanda and Kenya lead on introducing enablers for 5 countries across SSA (2/2)

	Kenya	Rwanda	Uganda	Ethiopia	Nigeria
ICE bans and restrictions	The National Automotive Policy will **regulate the age limit of imported vehicles progressively** This will be implemented from 8 years to 5 years in 2022; from 5 years to 3 years in 2024 and; from 3 years to zero in 2026	Government of Rwanda aims to rapidly transition to electric motorbikes and eventually to electric vehicles more broadly President Kagame announced in August 2019 his intention to **replace ICE motorbikes with electric motorbikes**	N/A	N/A	N/A
Fuel efficiency and CO2 emission targets	Kenya commits to **32% reduction in CO2 emissions by 2030**	Aim to **cut carbon emissions** from ~ 55.1g CO2/km for ICE motorbikes to ~13.3g CO2/km for electric motorbikes by 2025	**2030 emissions reduction potential set at 24%-34%** of business as usual projections for road transport	Aim to **reduce per capita GHG emissions** from domestic transport, relative to 2010 levels, by 64% by 2030	N/A
Official Electric Vehicle penetration targets	National Energy Efficiency and Conservation Strategy 2020 aims to **increase uptake of electric vehicles to 5% of all imported vehicles annually by 2025**	**9% of vehicles to be electric with 20% being buses by 2030**	N/A	Aim for **12% of all vehicles to be hybrid and electric by 2050**	N/A

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, Press search, CNBC, Bloomberg, WEF, government strategies and policies

Providing incentives and developing an enabling ecosystem could help Kenya to become a leader in EV scale-up vs. a laggard

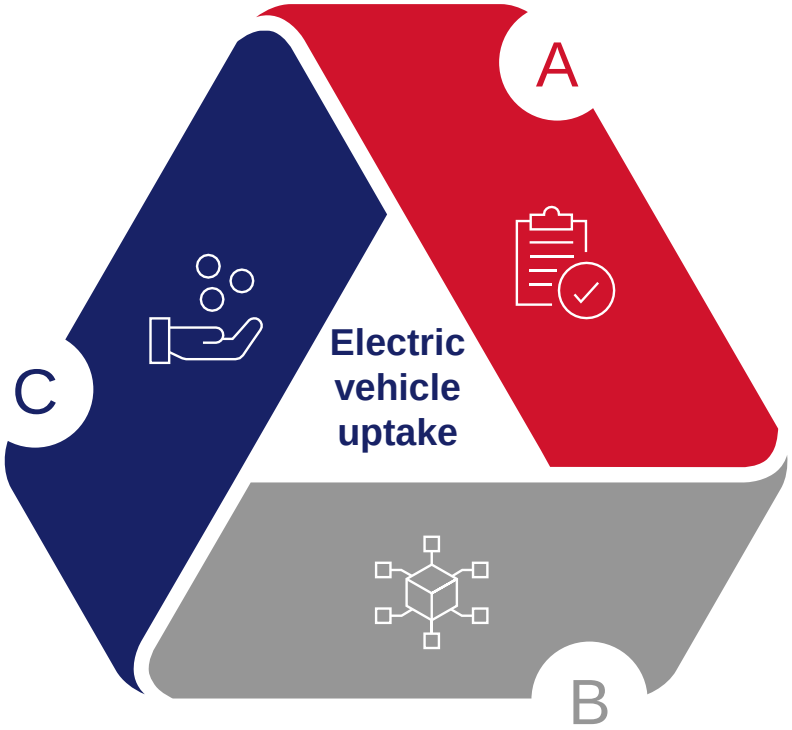
Potential dimensions that could determine Kenya's local and regional position as an EV scale-up leader/laggard

PRELIMINARY DRAFT

	A. Developed EV ecosystem and favourable conditions to scale locally assembled E2Ws vs. imported alternatives	B. Leading E2W assembly hub in East Africa
Leader in EV scale-up	• E2W **retail price** is **competitive** with Internal Combustion Engine (ICE) **alternatives before 2025** • E2Ws are **assembled locally** • Consumer behaviour (beyond price sensitivity) in **Kenya follows behaviour of markets with high penetration today** (i.e., Taiwan in 2020) • **EV ecosystem is developed** (e.g., availability of suitable EV models and charging infrastructure)	• Local manufacturing facilities **developed sufficient capacity** (driven by regulatory incentives and partnerships) and **technology capabilities** (with partnerships) able to serve EAC regional demand • **Price and technology competitiveness** with regards to other regional countries with local assembly • **Export tax incentives** to make regional exports profitable for Kenyan manufacturers • **Access to cost-competitive components** imported from major global manufacturing hubs
Laggard in EV scale-up	• **E2W parc dominated by imports,** as local production is not made competitive**,** pushing TCO parity post 2025 for E2W • **EV ecosystem is not developed** – public charging infrastructure lagging, preventing fast penetration	• **Insufficient assembly capacity** to serve regional demand • **Insufficient regulatory and tax incentives** to support local manufacturing

There are 3 factors which drive EV uptake and have led to e-mobility's disruption of the global transport sector

Factors driving e-mobility's disruption



A — Regulatory push

- Subsidies and incentives
- ICE bans and restrictions
- Fuel efficiency and CO_2 emission targets

B — Decline in battery cost

- Raw materials (cobalt, lithium, graphite and nickel)
- Battery production
- Applications (e.g., stationary storage)
- Used batteries recycling

C — Technology and infrastructure readiness

- Availability of model
- EV production ramp-up
- Charging station deployment (public and home/office charging)
- Power demand and load curve

Source: McKinsey Centre for Future Mobility

To enable scale-up of EVs, regulatory and infrastructure enablers are within Kenya's sphere of influence

PRELIMINARY DRAFT

Enablers within Kenya's sphere of influence

Enabling ecosystem for EV adoption High Medium Low

Enabling environment in various regions

Key Enablers		Chinese Mainland	Taiwan	India	Norway	Rwanda	Kenya
1 **Regulatory push**	Subsidies and incentives	High	High	High	High	High	Medium
	ICE bans and restrictions	High	High	Low	High	Medium	Low
	Fuel efficiency and CO_2 emission targets	High	Low	High	High	High	Medium
	Official Electric Vehicle penetration targets (e.g., X% of new vehicle sales by 2030)	High	Low	High	High	Medium	Medium
2 **Decline in battery cost**	Raw materials (Cobalt, lithium, graphite and nickel)	High	Low	Medium	Low	Low	Low
	Battery production	High	High	High	Medium	Low	Low
	Used batteries recycling	Medium	Medium	Medium	Medium	Low	Low
3 **Infrastructure and technology**	Availability of models	High	High	Medium	High	Medium	Medium
	EV production ramp-up	High	High	Medium	Low	Low	Low
	Charging station deployment (public and home/office charging)	High	High	Medium	High	Low	Low

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

2 key factors are critical for scale-up of local EV assembly in Kenya: economics and infrastructure

PRELIMINARY DRAFT

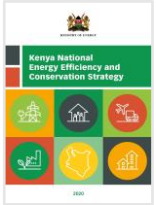
Category	Rationale
Regulatory push: incentives	Economics is the ultimate driver of EV adoption; locally assembled E2Ws **need to be cost- competitive with ICEs**, and have a **cost advantage over imported E2W alternatives**, whilst meeting consumer performance requirements Local assemblers could achieve this if they **reach production scale of ~25,000 bikes per year**, and have access to additional incentives, such as lower electricity tariffs for EV charging, as well as import VAT and sales VAT exemptions. If **Kenya** is to become a **regional hub for EV assembly**, it may help to have **incentives on par with regional neighbours**, and **following suit of countries across the world** that have demonstrated significant success in supporting scale-up of EV manufacturing. Non-fiscal incentives could also help, including free parking or access to specific “green zones”. Putting such a **suite of incentives** in place could **catalyse an aggressive scale-up scenario** for **locally assembled E2Ws**, and the **EV ecosystem** as a whole.
Infrastructure and technology: charging station deployment	Local assemblers will only be able to scale up if **range anxiety is mitigated** by establishment of a **network of charging infrastructure**, including **battery swap stations** for E2Ws, and a broader **plug-in network** for EVs, especially across **long distances** interconnecting Kenya’s major cities and towns. **Standardizing infrastructure** may be important in terms of **safety** standards, but standardizing **charging protocols** and **specifications** may be **premature**, as it could **inhibit innovation**.

Kenya has developed, and is in the process of implementing, multiple green economy and electrical vehicle-related regulations

Kenya's strategies and policies relating to green and electric vehicles

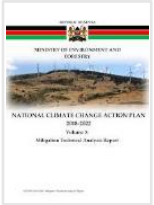
NOT EXHAUSTIVE

Green economy-related strategies:



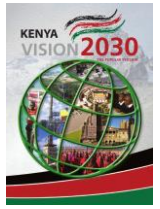
National Energy Efficiency and Conservation Strategy 2020: aims to increase uptake of electric vehicles to 5% of all imported vehicles annually by 2025

Green Economy Strategy and Implementation Plan (GESIP) 2016-30: increase resource efficiency in manufacturing



2018-22 Climate Action Plan: increase resource efficiency, optimise manufacturing and production processes and promote industrial symbiosis

Updated Nationally Determined Contribution, 2022: commits to 32% reduction in CO_2 emissions by 2030 relative to business-as-usual scenario



Kenya Vision 2030: Environmental projects include forest and river rehabilitation, wildlife conservation and water management

Policies in place that support local EV assembly:

2018

Increased excise duty on petrol- and diesel-powered engine motor vehicles

2019

Reduced excise duty for 100% electric vehicles, *Kenya Finance Bill*

2020

Locally-assembled motor vehicles are excluded from excise duty

Tax exemptions for import of components for general manufacturing/ assembly in Kenya

Ministry of Energy in Kenya announced plans to require all new buildings to incorporate charging stations

KenGen announced plans to roll out an electric charging network

2021

Kenya Power announced plans to build a nationwide network of public EV charging points

Source: GoK strategies and policies

Initiative options to improve investment attractiveness in scale-up of E2Ws, and support development of the EV ecosystem

Tuk-tuks Car Bus

PRELIMINARY DRAFT

Industry stakeholder assessment on relative benefit: High Medium Low

X Relevant for Green Fiscal Incentives Policy Framework

Category		Enabling initiative options	Impact	Relevance to other EVs
Incentives: Making economics of locally-assembled E2Ws favourable compared with alternatives	1	**Reduced electricity tariff** at charging stations for electric vehicles below the business price of KES 13/kWh	Medium	Tuk-tuks, Car, Bus
	2	**Free parking** for all electric vehicles in Kenya's main towns and cities, and **Green Zone** access for E2Ws into Nairobi's **Central Business District** and any other areas with motorbike access restrictions	Low	Tuk-tuks, Car
	3	**Government procurement policy** includes EVs and preferential procurement of locally-assembled E2Ws for urban-based police, military and KPLC where they meet the performance requirements *(solve KRA registration issue first)*	Medium	Car, Bus
	X 4	**Import VAT exemption or reduction** (16% to 0% or 5%) on **Completely Knocked Down (CKD) E2W kits, including all batteries,** and all **imported EVs,** with removal of the clause citing eligibility for tax breaks for motorbikes less than 1500cc	High	Tuk-tuks
	X 5	**Sales VAT exemption or reduction** (16% to 0% or 5%) on all **EVs**	High	Tuk-tuks, Car, Bus
	6	**Define KRA registration parameters**[1] to allow correct application of **excise duty** for imported EV products (knock-down kits, full vehicles or parts)	High	Tuk-tuks, Car
Charging station deployment: Establishing accessible and reliable charging infrastructure	7	**Public plug-in charging points for E2Ws and cars** along major highways every 50 km by 2025 and every 25 km by 2030 to enable distance travel, and in inner-city parking zones (for E2W) so owners have more options for daytime charging within the city	High	Tuk-tuks, Car
	8	**Avoid regulation of E2W battery standards** but **adopt** charging station **health and safety standards** already well developed in countries such as China	Medium	Tuk-tuks

Military, police and KPLC only procure approx. 100-200 motorbikes per year, so impact on order numbers will be low but powerful optics of these public entities using locally-assembled E2W would send a strong message to the public that could influence uptake

1. Analysis done by GIZ; see report: "Assessment of Electric Vehicle Classification in Kenya"

Source: Interviews with manufacturers, government and private sector stakeholders

E4Ws will cater to a different market segment but could benefit from similar initiatives and enablers as E2Ws

Implications of market segment, policy, and enablers and initiatives for E4Ws in Kenya

PRELIMINARY DRAFT

NON-EXHAUSTIVE

	Detail	Implications for E4Ws
E4W market segment	The market for E4Ws is, at first, likely to be **wealthy individuals** or **environmentally-conscious families**	This is currently a **small market compared** to the **E2W market** and is **expected** to **grow much slower** than **E2Ws;** in **2030**, the E4W parc is likely to reach **only ~31,000[1] cars**, whilst the E2W parc could reach ~355,000[1] motorbikes, if all incentives are implemented **Access** to a **range of EV models** will be **critical**, given wealthy demographic's preferences for large cars/SUVs
Existing 4W policies	The **2021 Budget Policy Statement** sets to **phase out** imports of **2nd-hand cars** by **2026**	Overall **prices** for both **E4Ws** and **ICE** vehicle will **increase** as **new vehicles** will need to be **imported** Unless **incentives** are put in place (e.g., enablers 4 and 5 below), **overall vehicle parc** will **age** as **new vehicle prices** will be **high** (per historical Ethiopian and Cuban situation)
Potential enablers and incentives[2]	1 **Define KRA registration parameters** for imported EV products (knock-down kits, full vehicles or parts)	Ensure that **E4W** and **spare parts** are **charged** the **correct Excise duty decreasing** the overall **price of the E4W**
	2 **Demand incentives** such as **free parking** for all electric vehicles and **Green Zone access**	**Drive uptake** of **E4Ws** by **providing** consumers **E4W-specific benefits**
	3 **Government procurement policy** includes EVs	Send a **powerful positive message** to the public that E4Ws are a **choice means** of **transport**
	4 **Import VAT exemption**	**Bring** the **price** of E4Ws **close to parity with ICE,** encouraging consumers to purchase E4Ws
	5 **Sales VAT exemption**	**Bring** the **price** of E4Ws **close to parity with ICE,** encouraging consumers to purchase E4Ws
	6 **Reduced electricity tariff** for electric vehicles below the business price at **charging stations**	**Reduce** E4W **charging cost**, which can be the **largest cost component** for an E4W owner
	7 **Extensive, fast and reliable charging infrastructure** for E4Ws	**Alleviate** E4W **range anxiety** for consumers who travel **within cities** and across **large distances**
	8 **Defined safety standards for charging stations**	Ensure that E4W **charging stations** are **safe** for **consumers** to use and are not a hazard to **neighbouring businesses** and **residences**

1. Aggressive scenario
2. Refer to initiative slide for impact and further detail

Source: Interviews with manufacturers, government and private sector stakeholders

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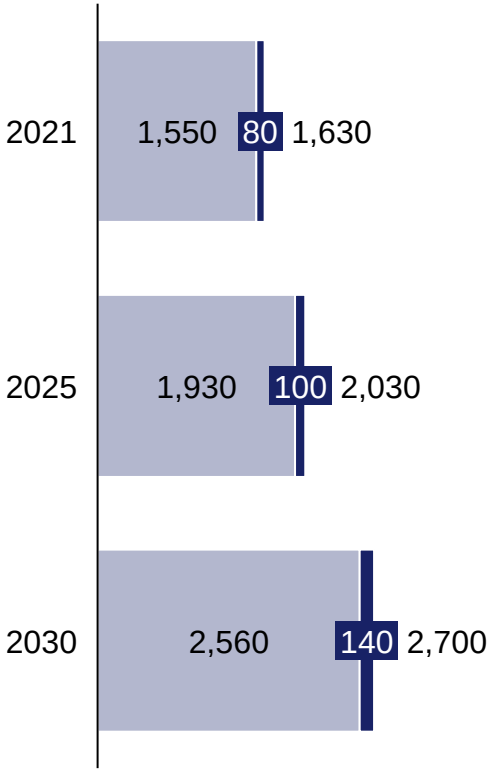
Appendix

The B2B segment of "boda bodas" and corporate fleets comprises the vast majority (~95%) of 2W demand in Kenya

B2B boda bodas[3] | B2C motorbikes | Torque output (N.m) | Payload capacity[2] (kg)

Projected number of 2W by segment per year[1], '000 units



Top players	Market share for B2B 2Ws, % of 2W unit sales	Example motorcycle and Kenya retail price	Torque output (N.m)	Payload capacity[2] (kg)
BAJAJ MOTORCYCLES	15%	Bajaj Boxer 2020 Red ~$1,300	12.3	252
YAMAHA	6%	Yamaha Crux-Rev-A ~$1,100	8.5	-
Hero	5%	Hero Achiever 150 ~$1,300	12.8	139

Demand drivers for conversion from ICE 2W to E2W

- (+) Increasing availability of high-quality electric motorbikes that suit Kenyan roads
- (+) Government programmes and incentives designed to encourage the use of electric models
- (−) Availability of charging and swap stations in the country
- (−) Less powerful engines with limited speed and range, lower performance than ICE models

Key insights

The Business to Business (B2B) segment comprises the **vast majority (~95%) of motorbike demand** in Kenya

"Boda bodas" (cargo and passenger bikes) **currently rely on locally-assembled ICE vehicles**; market leaders Bajaj, Yamaha, Hero have combined 26% market share

E2Ws will have to **compete** with these brands in terms of **performance, payload, ruggedness and cost** (upfront and running)

1. Assumes a 6% growth rate p.a. for both B2B and B2C segments
2. Illustrated as Gross Vehicle Weight Rating (GVWR)
3. ~95% of total ICE 2W sales are B2B boda bodas (estimate from local ICE assembler)

Source: Press search, Expert interviews, Statistica, Company estimates, OICA, Local sources (e.g., national statistics data), Industry reports

Boda boda riders are likely to buy new every 2-5 years and have electricity access for charging

Consumer persona for a commercial boda boda rider

Consumer profile

David Otieno

Lives and works in the city as a **two-wheel taxi rider**, occasionally doing trips for a **third-party**

Bought two-wheeler new and **plan to sell within a year**

Weekly earnings total ~$100

Driving patterns

- **Fuel spend**: ~$25 per week
- **Maintenance spend**: ~$160 per year
- **Insurance spend**: ~$880 per month
- **Weekly distance**: ~350-400km
- Typically drive **different routes but stay in the city**
- Spend **1-2 hours per day idle waiting** for customers
- **Time spent driving per week**: 70-80 hours

Charging access

- Park in a parking space next to my house
- Have an **electricity connection**

Financing

Typically finance 2W through lease-to-own model from microfinance institution:

- $20-40 monthly payment
- Simple interest rate of 52%
- 1-2 year lease

Implications for E2W adoption:

E2W are **likely to be bought new** in Kenya

E2W must be **designed and offered** in such a way that **meets the needs of a commercial rider**:

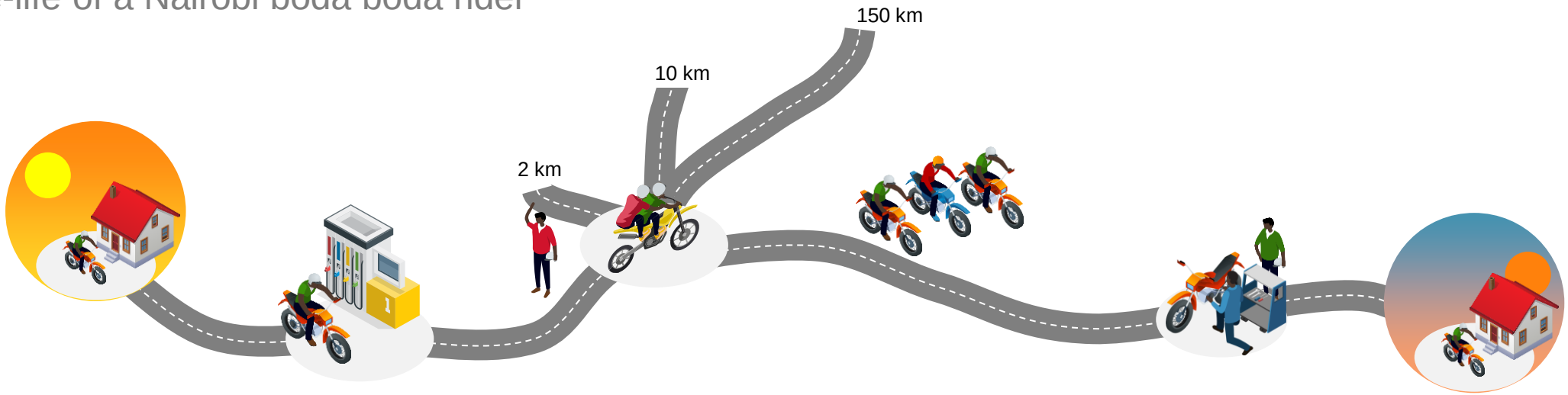
- Strong **powertrain** to carry heavier load
- **Long-lasting battery** with conveniently located **battery swap stations** to ensure that work is not disrupted
- Accessible through **leasing model** to ensure upfront cost does not act as a barrier to adoption

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, 2021 consumer survey of 674 4W owners and 217 commercial drivers; focus group with 2W riders, consumer interviews (e.g. with corporates, matatu associations, delivery companies, ride-hailing companies)

Boda riders often travel a range of distances throughout the day, with sufficient idle time to swap batteries or charge their bikes

A day-in-the-life of a Nairobi boda boda rider

Boda rider journey



Activity description	Rider **parks** the Boda **outside the house overnight**	Rider **typically fills** up first thing in the **morning**, albeit some fill up **2 or more times during the day**	Boda riders mostly **travel short distances** but **1-2x per week** travel a **long way** normally for **private business or ride hails**	On average, Boda riders **spend 1-2 hours per day idle waiting** for customers, often chatting amongst themselves	Boda riders often **repair** their bikes **~2x per month**, with the **same mechanic**	Riders get back home after a **10-12-hour day**
E2W implications	Boda riders can **charge** their **bikes over night** but this **may require long cables** and can be a **safety hazard** A **single battery** can **charge** in **~4 hours** and can be **removed** to **charge inside** the **house**	If they have **charged their bikes** at home they can **quickly start their day** If they need to **swap a battery**, it is **quicker than filling up** but **swap station** needs to be **located close to their homes**	**Range anxiety** is a concern for Boda riders; **swap stations need to be prolific** across the **city** and on **highways** to **other towns** as riders do not stay local If they **run low** on battery power but there are **no nearby swap stations**, they would have to **call someone** to **deliver** a **new battery**	During this time, riders **can charge** their bikes or **swap batteries** This could be done at a **shop** or **petrol station near** the **bike stages**	Even though **maintenance costs are generally lower** for **E2W**, there is some **concern** that their **mechanics will not have skills to repair E2W**	Riders come home having **travelled 45-125 km per day** **Range for E2Ws** on the market are between **70 km and 140 km** and so riders can get home **without charging midway through the day**

Source: Boda rider focus groups

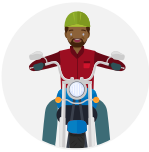
Boda boda riders like the idea of E2Ws and are keen to do a test drive

Boda boda riders like their current bikes

We like the Boxer because it is **robust and reliable**

We drive a lot during the day and **these bikes are comfortable and easy to handle**

They don't know much about E2W, and have some concerns …



I **don't** really **know** much **about electric motorcycles**

Where will I get **another battery** if I **run out** or **travel long distances**?

Will the **electric motorcycle** be able to **handle heavy loads**?

Before I **buy one** I'd like to **test it**

… but were quickly excited by the E2Ws and potential benefits …

Wow, this bike **looks** exactly **like a Boxer**

It seems that I can **save on fuel** and **maintenance costs**… **spare parts** for my **current bike** can be **expensive and difficult to find**

Free parking in the **CBD** will be a **great benefit**

Using an **electric motorbike** will **create less noise** and **pollution for Kenya**

… and were able to see how charging can fit into their daily routines

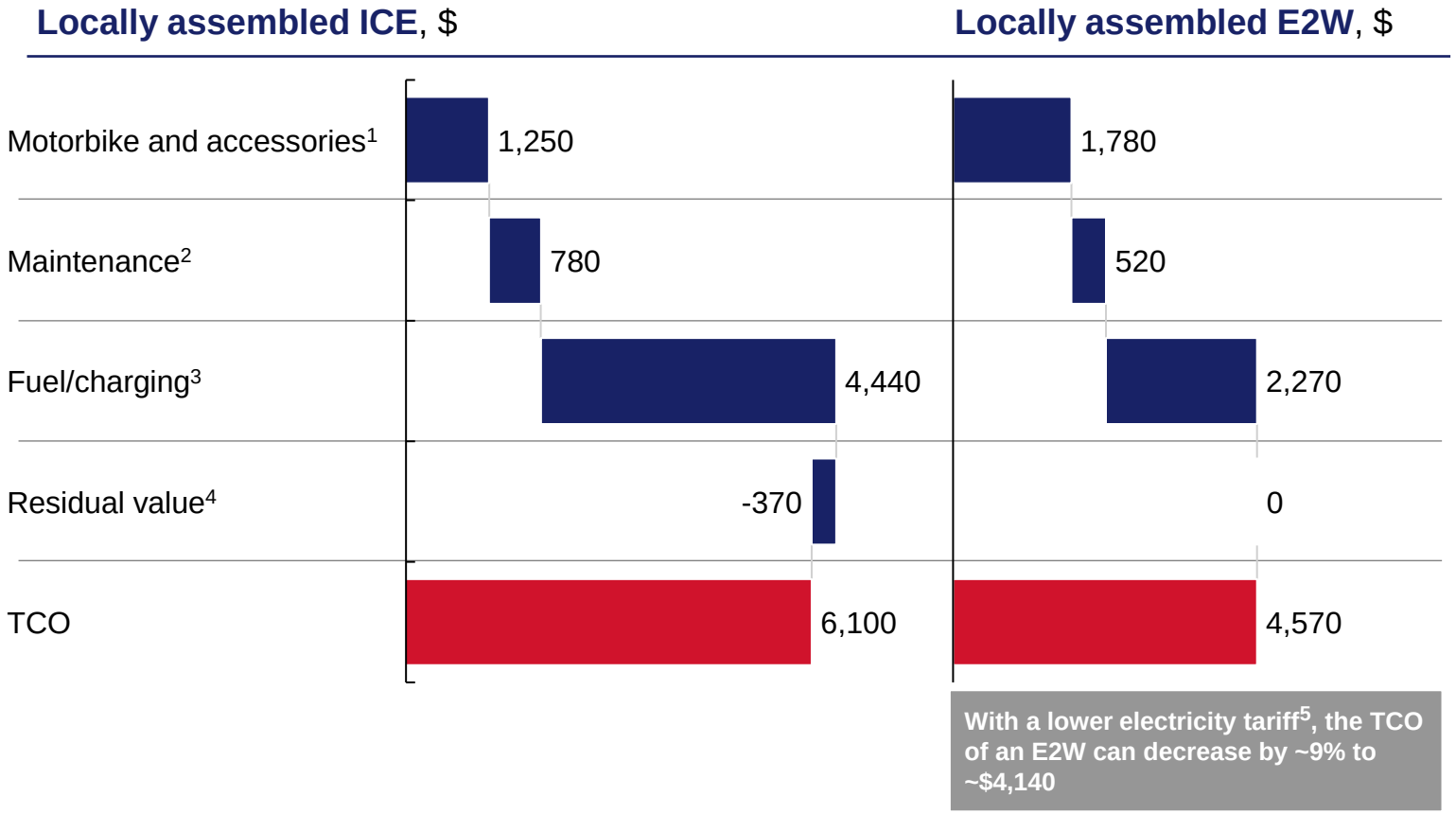
Charging at home will be **good** so I can **start my day immediately**

I usually spend between **1-2 hours** per day **idle waiting** for customers, so could **charge during this time**, especially if **swap stations** are **placed at stages** and **petrol stations**

Source: Boda Boda rider focus groups

In Kenya, the Total Cost of Ownership for an E2W is ~25% lower than an ICE 2W …

Total Cost of Ownership (TCO) over 5 years



1. Assumes 25,000 ICE 2Ws and E2Ws are assembled and includes the retail price as well as additional accessories as per GoK regulation: Retail price of ICE (~$1240 – from average new bike price for Boda focus group), E2W (~$1760 from retail cost analysis) and additional accessories ~$14
2. Assumes that rider spend ~$13 per month in maintenance and repairs over the lifetime of an ICE 2W with ~33% of maintenance costs saved with E2W
3. Assumes that a rider travels ~90 km conservatively per day for an ICE 2W and E2W, spend ~$4 per day in petrol costs over the lifetime of an ICE 2W and ~$1.50 per day charging a battery of an E2W and assumes 80% battery efficiency over the lifetime of an E2W)
4. Residual value of an ICE 2W is ~30% of retail price and for E2Ws the residual value is ~0%
5. Assumes that electricity tariff decreases to at least street lamp rate of KES7.50

Source: Expert interviews, Boda focus groups

… but the higher leasing fee could be a barrier

Key insights

TCO is a measure of the total cost of an asset over its lifetime, therefore considering both the purchasing price and the costs required to use the asset over its lifetime

At scale, (25,000 units assembled per year) and under the current policy environment the **TCO is already ~25% lower for locally-assembled E2W** than an ICE equivalent and with a **lower electricity tariff[5]**, the **TCO** can **decrease** by a **further ~7%**

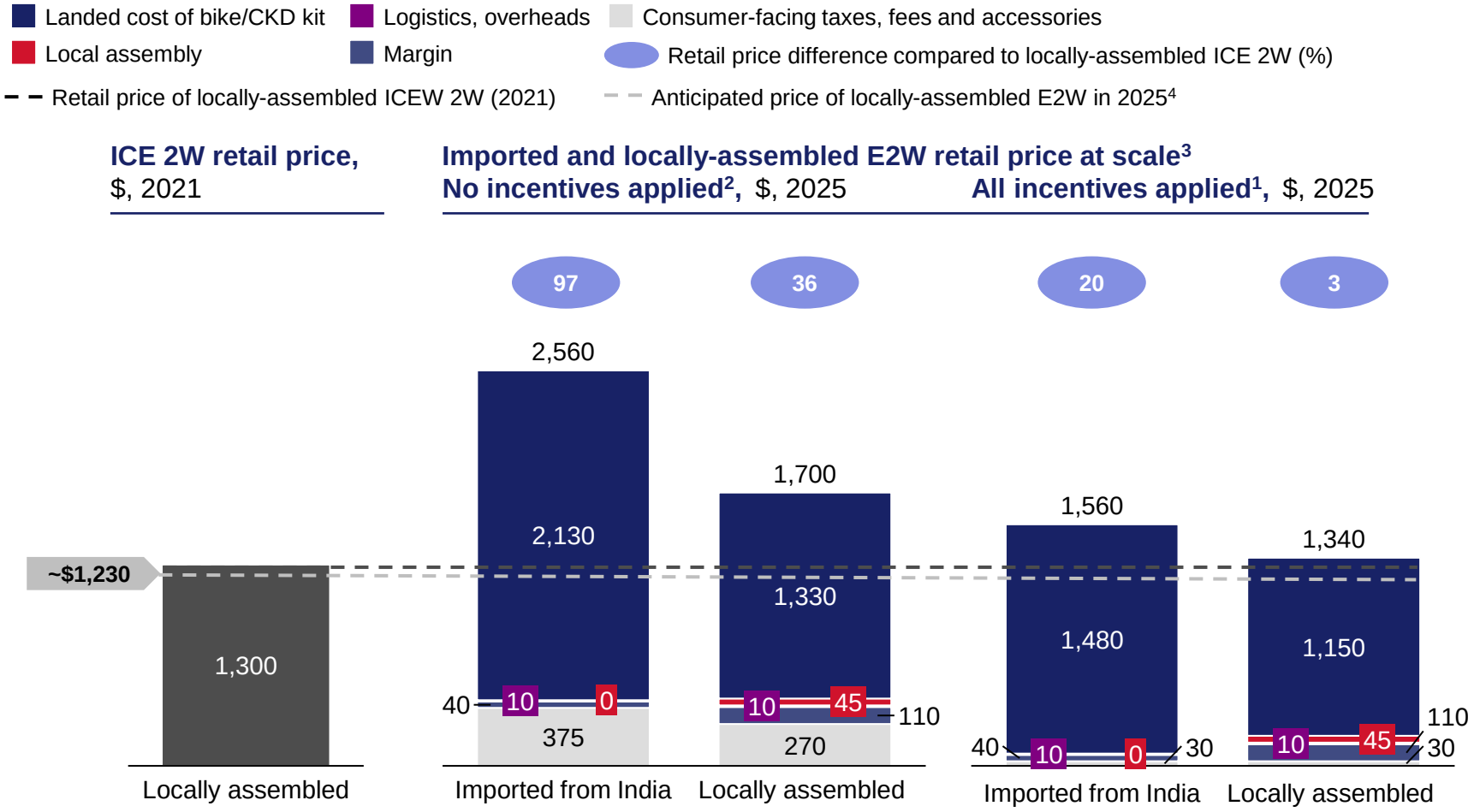
This is driven by **lower maintenance** and **fuel/charging costs** (~33% and ~50% lower, respectively) of an E2W compared to an ICE 2W and with a **lower electricity tariff[5],** Boda riders can **save up to ~58%** on **fuel costs**

TCO parity over 5 years for an E2W and an ICE 2W is **reached at ~20 km,** meaning that boda boda riders will start realising cost savings compared to an ICE 2W once they surpass ~20 km/day – well below their ~90 km/day average

However, the ~$465 **higher average upfront cost** for an **E2W** would mean **monthly leasing fees** could be up to **~$35 higher,** and this could still be a **barrier** to **uptake** amongst boda boda riders **for the first few years** (as they mostly buy on hire purchase agreements), despite the overall monthly savings

If incentives are applied, locally-assembled E2Ws could be cost competitive with locally-assembled ICE 2W and imported E2W

PRELIMINARY DRAFT



Key insights

Locally-assembled E2Ws can **already** be retailed at **lower prices** than **imported E2Ws**, thanks to existing incentives

However, they are **not cost competitive** with locally-assembled **ICE 2Ws** under the current policy environment

They **could be cost competitive** with **ICE 2Ws** with two additional incentives: **import VAT exemption** on E2W CKDs and **Sales VAT exemption**

The **battery** of an E2W is the **largest cost component** of the **retail price** of an E2W (~25%). **Battery cost** is expected to **drop by ~20% by 2025,** which would bring **locally-assembled E2Ws below price parity** (~$1,230) with a **locally-assembled ICE 2W** (~$1,300), assuming the above incentives are applied

1. Import duty = 10%, Excise Duty = 0%, Import VAT = 0% and Sales VAT = 0%
2. Import duty = 25%, Excise Duty = 15%, Import VAT = 16% and Sales VAT = 16%
3. Assumes 25,000 units assembled or imported per year
4. Assumes 20% battery cost decline

Source: Expert interviews, Industry analysis, Press search

Boda boda riders could increase profits by ~35% with an E2W at retail cost parity with an ICE, based on monthly fuel and maintenance savings

Monthly P&L of an "offline"[4] boda boda rider on a hire to purchase model over 18 months

Monthly P&L components, KES		KES	USD	Details	Implications for E2W
Revenue[1]		40,000	370	Assumes total revenue of KES 2,000 ($18.5) per day	Revenue likely to be **equivalent for E2W**
Costs	Loan repayment[2]	-10,000	93	Loan repayment at ~**52% simple interest[2]**	Opportunity to make E2W more attractive through **better loan terms** via green financing and bank-dealership partnerships
	Fuel	-8,000	74	Average fuel cost ~KES 400 ($3.7) per day[3]	Estimated **50% cost savings** for charging E2W (~58% with lower electricity tariff[5])
	Maintanance	-1,400	13	Maintenance cost is ~KES 700 ($6.5) twice per month	Estimated **33% cost savings** for E2W
	Insurance	-7,900	73	Comprehensive insurance is ~KES 95,000 ($880) per year	Insurance likely to be **equivalent for E2W**
Profit		12,700	118		**Profit could increase by ~35% or ~$40** from savings on fuel/charging and maintenance alone if the **retail price** of the **E2W is similar** to the ICE

If the retail price of the E2W is up to **$720 higher**, it can still be competitive with an ICE, **as additional monthly costs** (i.e., loan instalment amounts due to higher retail price) **do not exceed ~$40**

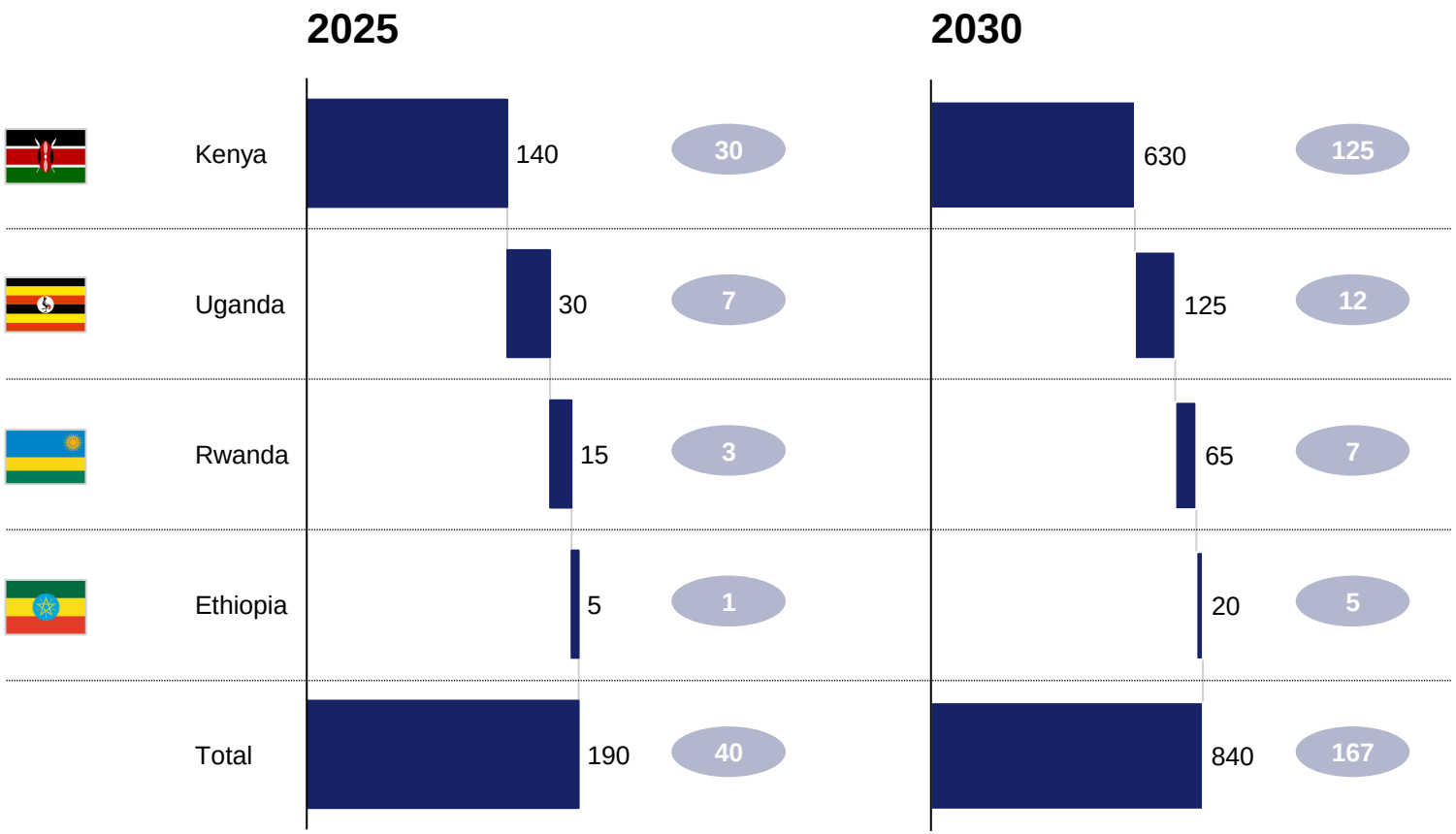
1. Revenue target of KES 1,500 per day plus KES 500-1,500 potential extra
2. Assumes monthly loan repayment cost of KES 2,308 per week
3. Assumes rider works 5 days a week
4. Motorbike taxis that do not use online ride-hailing apps
5. Assumes that electricity tariff decreases to at least street lamp rate of KES7.50

Source: Industry expert, Boda rider focus groups

In the aggressive scenario, sales demand for E2W in East Africa from 2025 to 2030 is projected to be ~167,000 p.a.

Projected E2W parc[1] in East Africa, ‘000

Average annual sales (‘000 units) over 5 years



1. Estimations under the aggressive scenario

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Key insights

In the aggressive scenario, cumulative **E2W domestic demand** is projected to reach **140,000 by 2025** and **630,000 by 2030** – with sales **going over 25,000 p.a. in 2023**

As scale required to achieve cost competitiveness is ~25,000 bikes per year, **local assemblers** will need a **sizeable market share in Kenya *and* neighbouring countries** to achieve sales targets for an E2W that can **compete with alternative ICE and E2W imports**

Kenya is **unlikely to be cost-competitive** for exports **beyond East Africa** to other African countries - **North Africa** is likely to be served by **Egypt,** and **West Africa** by **Nigeria,** where E2W assembly plants have already been set up

The **South African market is likely to be small**, as **motorbikes** are **not** extensively **used as taxis** (main market is recreational), thus demand E2W manufactured in Kenya will be low,

Other countries in **Southern Africa** either also have **low E2W densities** or **unstable power supply** with **charging infrastructure** likely to be **deployed slowly**

Finally, Kenyan exports will be **unlikely to be cost competitive** compared with other E2W directly imported into South Africa

Enablers for EAC export for an E2W assembler operating at scale

PRELIMINARY DRAFT

Near-term enablers Long-term enablers

Current process

Producers of E2W can export vehicles to EAC regions under two scenarios

1 Export under preferential treatment

- Exporters are **granted preferential tariffs** when they export products to an EAC country, if they have a **rules of origin[1] certification** for the export product
- The **preferential tariff[3]** is a **zero-rated Import Duty** from the country that the E2W is being exported to
- To **qualify** for **preferential treatment**, the exporter needs to show that **at least 35%** of the **exported E2W[2]** comes from **local value addition**
  - This can include additional parts (seats, cabling, etc.)
  - Hiring specialist labour for assembly
  - Consumption of energy that aids in local assembly

2 Export under non-preferential treatment

- Exporters are **not granted preferential** tariffs when they **export products** to an EAC country
- The **exporter** will be **charged an Import Duty** between **10% and 25%** depending on the country that the E2W is exported to and delivery terms
- This will mainly apply to **E2W that are imported** to Kenya as **fully built bikes**

Potential enablers to improve current process

There are 4 potential enablers that can make export to EAC easier

1 Seamless rules of origin certification across the region

- Some countries in the EAC will contest rules of origin and require clarification, making the process costly and time consuming
- This can hamper Kenyan E2W assemblers' ability to scale and service regional markets

2 Fast-tracked application for export under preferential treatment

- The process for ensuring that products are certified under the rules of origin can be time consuming and costly
- Ensure that E2W assemblers can access some aspects of preferential treatment whilst their applications for certification under rules of origin is being processed
- If the assemblers are not certified under rules of origin then they will need to pay back the benefits they were subject to whilst their application was being processed

3 Fast-tracked application for the Export Processing Zone (EPZ) programme

- Allow E2W assemblers to benefit from some of the EPZ programme while their application is being assessed
- If the assemblers EPZ application is declined, then they will need to pay back the benefits they were subject to whilst their application was being processed

4 Export duties on imported fully built E2Ws form outside EAC

- Applying an export duty to imported E2Ws can assist E2W assemblers to grow and service regional by preventing local export of fully built E2Ws from outside the region
- This enabler is a long-term enabler once the E2W industry is more established

1. Rules of origin are criteria to determine the local value addition of a product to be exported
2. Rules of Origin will not apply to E2W spare parts as there is no local value addition for these parts but as the industry grows this could change
3. Whilst The Africa Continental Free Trade Area Agreement is looking at developing a process and tariff structure for Africa, E2W tariffs for EAC export needs to be looked as specifically

Source: Expert interviews, EAC rules of origin manual

Other initiatives being implemented around the world to promote scale-up of EVs

NON-EXHAUSTIVE

Initiative	Description	Regions currently applying initiatives
Free public charging	Offer EV owners free public charging facilities or have a percentage of all public charging stations open to the public	China Singapore California
Permit exemptions	Exempt EV owners from paying for: • Operation permits • Registration certificates • License plate fees Allowing holders of a passenger drivers permit to drive electric vans class or hold other permits for EVs	China India Norway
Decreased vehicle registration processing time	Decrease the processing time for license plates and registration of EVs	China
Road and national/local toll benefits	Provide EV owners discounts on national and local road tolls Access to High Occupancy Vehicle (HOV), High Occupancy Toll (HOT) Lane and bus lanes	Norway California
Vehicle swapping schemes	Turnover schemes to encourage ICE owners to trade in their vehicles in exchange for a discount on EVs	Singapore California
Direct financing schemes	Provide loan guarantees to accelerate the deployment of EVs	California

Source: Press search, International Council on Clean Transportation, Natural Resources Defense Council, Norway Electric Car Association, US DoE

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

- Making economics of locally-assembled E2Ws favourable
- Establishing accessible and reliable charging infrastructure

Financing solutions

Electric motorbike pilot

Appendix

Globally, E2Ws have yet to have standardized batteries

Battery standards for various regional E2W players

Degree of standards overlap: Medium Low

Battery specifications	E2W company and main location: NIU, Chinese Mainland	gogoro, Taiwan	SUN MOBILITY, India	PIAGGIO, Italy	Standards overlap
Power	60 V 35 Ah	1.3 kWh	1.5 kWh	2.3 kWh	Low
Charging protocol	Home charging ~7 hours to charge	Home charging Battery swap	Battery swaps (stations charge 14 batteries in ~1 hour)	Home charging ~6 hours to charge	Medium
Communication protocol	N/A	App to monitor battery health, charging progress and battery location	Cloud-connected app that monitors battery performance	N/A	Low
Weight and dimensions	~10 kg (W) 18cm x (L) 30cm x (H)14cm	~9 kg	~12 kg	~15 kg	Low
Other specifications/ comments	Battery Pack harnesses 170 cells of lithium-ion technology	Batteries are encased in a durable, waterproof, aluminium case	N/A	N/A	Low

Source: Press search, company websites

Key insights

Regional players have a **varying set** of battery **specifications** that suit the product and markets where they are present

There is a **similar trend** with **electric cars** – OEMs globally are **building batteries into chassis**, meaning owners cannot swap or remove the batteries, for quality control and **safety reasons**

Piaggio, KTM, Honda and Yamaha are part of a **worldwide consortium** to agree on a **standard for swappable E2W** batteries – the consortium has not released any defined standards yet

With this in mind, **avoidance of regulating** battery standards would **allow innovation to continue**, but **defined safety standards** could be important for the industry

Avoiding regulation currently has **no downside**, as the **technology** that players adopt will adapt and **change over time**

Given there is no global standard, Kenyan assemblers have varying battery specifications

Battery standards for various Kenyan E2W assemblers

Battery specifications	Spectrum of specifications for assemblers in Kenya			Standards overlap
Power	**Voltage** 84-51	**Ampere hours** 30-60		Medium
Charging protocols	**Interface** Wall socket charging Swap stations Additional voltage transformers for home charging	**Connectors** Anderson XD CAN DIN80	**Charge times** 4-6 hours	Low
Communication protocols	**Common protocols** State of charge Temperature Current Number of battery cycles	**Uncommon protocols** Battery ID IOT connected device Various assembler specific apps Assembler proprietary telemetry		Medium
Battery dimensions	**Height** 22-35 cm	**Length** 18-34 cm	**Width** 17-35 cm	Low
Other specifications/ comments	**Cell type** 21700 NMC cell type Li-on cells	**Casing** Waterproof Explosion proof	**Protection** Current limiters Surge protection	Low

Degree of standards overlap: Medium Low

Key insights

There is **no unifying standards** for **E2W batteries**

Local players in Kenya are following global patterns – each player is **defining their own specifications** and not prioritising inter-operability, and many are **avoiding batteries being charged by other companies** to maintain quality control

There is **some overlap** on the **power** specification and **communication** protocols with **little overlap** on **other specifications**

Players in the country are still **evolving the design** of their **E2Ws** and so these **specifications** may **change** as they get **closer** to a **finalised product**

Enforcing standards on the industry at an early stage **could hamper innovation**

Despite this, **GoK** can take a **lead** in **developing safety standards** for the **industry**

Source Expert interviews

Keeping E4W charging standards unregulated for now will allow the sector to grow, leveraging relevant models from around the world

PRELIMINARY DRAFT

Electric Vehicles	Chinese Mainland	Taiwan	India	Norway	Kenya
Charging standards	**Two technical standards** for fast charging: 1. GB (DC) 2. GB (AC) 	As of 2019, Taiwan does **not yet have a set standard** for electric car charging stations and most charging stations in Taiwan are equipped **with multiple charging adapters**	**Two technical standards** for AC charging: 1. Slow 5 amp (type D) or 15 amp (type M) wall outlet without communication function to the on-board charger of the EV 2. Fast AC Bharat AC-001 1. Fast DC Bharat DC-001 	**Four technical standards** for fast charging: 1. CHAdeMo (DC) 2. Combo 2 CCS (DC) 3. Tesla Supercharger (DC) 4. CCS Type 2 43 kW AC (with the charger is in the vehicle) The CCS Type 2 and Combo 2 standards are the primary standards adopted throughout the EU Other standards are then applied on top of this primary (e.g., CHAdeMo and Tesla in Norway)	The **two standards** that are currently being used in **Keny**a are the **CHAdeMo and Type 2 connector** These standards are **based** on **standards** that are accepted by the **Nissan Leaf** car **imported** by **Nopea** **Nopea** currently has ~**60 Nissan Leaf cars** and operates **~5 charging stations** • Hub Mall • Sarit Centre • Two Rivers Mall • Thika Road • JKIA

Source: Press search, Bloomberg, Columbia University, EEC Taiwan, WEF, Automotive Component Manufacturers India, EV Norway,

For E4W, variety of charging types have been established across the world and are relevant to Kenya, given the sources of vehicle imports

PRELIMINARY DRAFT

	Level	Mode	CCS[1]		Bharat	GB[2]	CHAdeMO[3]	Tesla Super Charger
			US and Japan	EU	India	China	US and Japan	Tesla exclusive in global countries
Slow, Interface	Level 1, AC	Mode 2	Type 1	*Not included. In EU and China, household voltage starts from 220V.*				
	Level 2, AC	Mode 2, Mode 3		Type 2	AC-001	GB AC	*Not applicable. This standard is for fast-charging only.*	*Not applicable. This standard is for fast-charging only.*
Fast	DC	Mode 4	Combo 1	Combo 2	DC-001	GB DC	CHAdeMo	Super-charger
	Protocol		PLC		CAN			

Key insights

Leaving **charging standards unregulated** would mean the sector can continue to scale **without limitations on EV models**

The **current EV fleet** in Kenya already has a number of **different specifications and needs**

- **Nissan Leaf** uses a **CHAdeMO** type
- Some **assemblers** in-country are **adopting CCS type** connectors

Leaving the market unregulated will also **allow local players** to **innovate**

Despite this, **developing safety standards** for the industry could help avoid accidents (e.g., fires) seen in other regions

1. Combined Charging System
2. Guobiao standard
3. CHAdeMO is the trade name of a fast-charging method for battery electric vehicles; CHAdeMO is an abbreviation of "CHArge de MOve", equivalent to "move using charge"

Note: Photos showing vehicle inlet

Source: Literature research

Safety standards for EVs could be developed, leveraging global examples on infrastructure and batteries

PRELIMINARY DRAFT

Infrastructure safety standards

Kenya's National Building Code could incorporate **safety** standards for battery **swap and charging stations**

China has developed **building codes** that define the **safety** specifications for **swap stations and charging stations**:

- GB 50016 - code for **fire** protection design of buildings
- DL 5027 - typical **extinguishing** and protection regulation of **electrical equipment**
- GB 50140 - code for design of **extinguisher** distribution in **buildings**
- GB 50219 - technical code for **water spray fire protection** systems
- GB 50057 - code for design protection of structures against **lightning**
- DL/T 620 - **overvoltage protection** and insulation coordination for AC electrical installations)

Battery safety certifications

Batteries used for **E2Ws in Kenya** could follow **international safety certification**:

- **The United Nations** and **United States** Department of Transport issues recommendations for the **transport of dangerous goods** worldwide
- **Shipping regulations UN 38.3** is provided only after the battery passes significant **environmental, mechanical,** and **electrical** tests designed to assess battery's robustness during transport and use
- **Independent quality and safety certification** for batteries ensuring that the **quality** of the cells and cell type is as advertised from the manufacturer and that the batteries are **housed in appropriate containers** – water and explosion proof

Considerations

Introducing **swap** and **charging station safety standards** into the **National Building Code** and adopting international **battery transport certification** could help protect EV consumers, businesses transporters and by-standers in this nascent market, and **leverage lessons learned** in other regions where incidents, such as fires, have occurred

This could include **fire extinguishing**, **lightning** and **overvoltage** standards, as well as **environmental**, **mechanical** and **electrical** tests

Source: Press search, UN, Chinese building codes

Repurposed EV batteries show potential to support renewable power but not limited to the power sector

Company	Region	Description
Mercedes-Benz		In 2019 Mercedes-Benz Energy announced a partnership with **Beijing Electric** Vehicles to create an **energy storage system** that uses **retired EV batteries**, that aims to support **renewable energy plants** in China
TEPCO		Tokyo Electric Power (TEPCO), announced in 2020 that they will assemble a **battery storage system** using **retired** Chinese **EV batteries** to support new **renewable energy plants**
enel		Enel Group used **78 retired batteries** from Nissan Leaf cars in an **energy storage facility** for a **thermal plant** in Melilla, Spain
		RePurpose, a Californian start-up, has **retired EV batteries** to **store solar energy** in **factories**
NISSAN		Nissan and Volkswagen have both **repurposed retired EV batteries** from their used cars and used them in **automated vehicles within their factories**
Confidential		A Kenyan start-up is using **retired batteries** for **solar powered street lighting** and **other rural needs**

Source: Press search, company websites

Key insights

Retried EV batteries could be used for **renewable energy projects** – primarily in solar and energy storage

This concept is relatively nascent and Kenya could **become a regional leader** in the space

Manufacturers can also use retired EV batteries in their **manufacturing process** for **automation** or as **energy reserves**

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

- Making economics of locally-assembled E2Ws favourable
- Establishing accessible and reliable charging infrastructure

Financing solutions

Electric motorbike pilot

Appendix

Financing solutions can be prioritized to address the identified challenges faced across the value chain

		Financing solutions	Primary financier
Asset financing	A	Create a **dedicated (ring-fenced) financing facility for E2Ws** with an asset financier with a **first-loss guarantee** from a DFI or ESG financier. Provide asset financiers with financing through a **results-based financing (RBF) facility with a grant provider or DFI designed to reduce cost of lending** to the end-consumer, with either a: • Tiered subsidy depending on sales volume to reduce end-price to the consumer • Tiered loan interest rate that reduces with achievement of certain sales targets Pilot the above financing solution to initially **prove out the credit cycle** for E2Ws and residual values to improve understanding of opportunity for E2W financing before scaling	Asset financer Grant provider / DFI / Government (for first-loss guarantee / RBF)
	B	Co-develop (with a payment provider, asset financier, ride-hailing company, etc.) an **IoT-enabled payment model** that allows payment of loan based on income for commercial vehicles	Asset financier Payment provider / FinTech
EV assembler / importer	C	Set up an **incubator for EV assemblers / importers** with grant financing to assist companies to become investment ready, conduct pilots, and help match companies to investors	Grant provider / VC funder
	D	Provide **credit facility through a commercial bank that de-risks inventory financing for EV assemblers/importers**	Commercial bank / DFI / Equity provider
	E	Negotiate **better payment terms with suppliers** (e.g. of CKDs or fully-assembled bikes) to reduce working capital burden, potentially underwritten by **first-loss guarantee** (*also applies for swap station battery imports)*	EV assemblers / importers; Grant provider / DFI for first-loss guarantee
	F	Raise a **green corporate bond** (with associated “greenium”) to fund assembly and inventory costs (can also be done for swap stations / charging infrastructure) – *typically requires ~$40-50M to be viable*	Commercial bank / DFI
Capital light charging infrastructure	G	Receive **carbon credits earned by setting up charging infrastructure to fund an affordable swapping and charging cost** (e.g., effectively a ‘subsidy’ on the swap fee or electricity price)	Green financier Carbon market facilitator and verifier

1. May be some reluctance to adopt given digital taxes and commercial drivers’ concerns about revenue transparency

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

An incubator for EV start-ups can be established to support start-up creation and scale-up and mobilise funding

Challenge:

Investment into e-mobility has been inhibited by the **lack of coordination between development partners, investment agencies and other financiers** to support start-ups, which face numerous challenges, including:

- Lack of policy coordination
- Data gaps and asymmetries
- Infrastructure challenges
- Limited access to finance
- Skills and capabilities gaps
- Trade barriers complicating imports and reducing exports

Proposed solution:

A **dedicated EV incubator** focused on supporting **African EV start-ups** could help address this by:

- **Bringing together key stakeholders**, including development partners, financiers and government stakeholders
- **Providing access to grant financing together with hands-on support** to ensure that EV assemblers / importers that access grants are supported to sustainable in long term

Potential partner could be Manufacturing Africa programme funded by UKAid:

- Manufacturing Africa programme provided **transaction facilitation** to 3 EV assemblers / importers, with a further 2 in the pipeline
- **Additional technical assistance support** has included developing a **roadmap for EV scale-up** in Africa and **conducting pilots** with EV assemblers

Other partners could include:

THE ECOSYSTEM INTEGRITY FUND, ACUMEN, TotalEnergies, dwb equity

Example objectives of EV incubator:

Support start-up creation and scale-up

- Bring together founders passionate about EVs
- Support start-ups' creation and maturation
- Help navigate the African legal environment
- Support scale-up and fundraising efforts

Mobilise Venture Capital funding

- Attract leading global VCs to Africa
- Develop local VCs

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Negotiating payment terms with suppliers can help reduce the working capital burden for EV assemblers / importers

Potential solution: Negotiate improved payment terms with supplier to reduce working capital burden

		Month 0	Month 6	Month 9
Typical asset conversion cycle	**Locally assembled E2Ws**	Place for CKD order. **Pay at time of order**	CKD order arrives and assemble locally	Sell locally assembled E2Ws
	Imported E2Ws	Place CBU order. **Pay at time of order**	CBU order arrives and sell imported E2Ws	
Asset conversion cycle with negotiated terms	**Locally assembled E2Ws**	Place CKD order	CKD order arrives and is assemble locally	Sell locally assembled E2Ws. **Pay for CKD once sold**
	Imported E2Ws	Place CBU order	CBU order arrives and sell imported E2Ws. **Pay for CBU once sold**	

Key consideration

Negotiation of payment terms is **dependent on relative supplier-to-buyer power** and **previous track record**

To **build up trust** while EV assemblers / imports are in **early stages** and **ordering relatively small volumes**, suppliers may require a **guarantee of payment** which can be **provided by a DFI** or **development partner**

Potential partners:

CDC Investment works | IFC | Shell Foundation

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Carbon credits are emerging as a financing mechanism for charging infrastructure

Mechanism and early insights

Mechanism

Seller

A company that acquired carbon credit for developed charging infrastructure in order to sell it to another entity

Carbon credit sale

Carbon credits claim

Carbon credits attribution

Buyer

Typically a company interested to purchase carbon credits in order to help achieve its net zero, carbon neutral goals

Third party authenticator

An independent auditor that receives credit carbon request, and through a defined methodology, attribute

Early Insights

- The first **World's First Validated and Registered Carbon Offset Project** for Electric Vehicle Chargers has been announced in 2020 by **SCS Global Services**, **Electrify America** and **Verra.** Electrify America planned to validate and obtain credit for its **3500 DC fast chargers** operation in **430 stations** across US
- Some financing entities are also playing in the domain. For example, the **Connecticut Green Bank** (CTGB) in the US, is partnering with other stake holders to accelerate the validation process
- Currently no carbon credits for sales of EVs because of challenges of providing additionality; however, seems there is an emerging case for charging infrastructure that could apply to swap stations

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Partnerships with other stakeholders in the EV ecosystem can facilitate the scale-up of EVs

	Partnership	Objective	Potential partners
	Partnership between at-scale OEMs	Design and launch E2Ws into African market at-scale	BAJAJ, YAMAHA, gogoro
	Partnerships between EV assemblers / importers and high-traffic stores/places for charging infrastructure set-up	Scale charging infrastructure set-up at areas that currently attract high-traffic such as fuel stations and convenience stores	TotalEnergies, Shell
	Regional partnerships between EV assemblers and importers (potentially coordinated by development partner)	Set up a Group Purchasing Organisation to jointly negotiate better payment terms by pooling orders of CKDs and CBUs	OPIBUS, STIMA BODA, AMPERSAND, Fika CLEAN MOBILITY, EZ

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Action can be taken in both the immediate and medium term across financing, partnerships and advocacy solutions

		Immediate term *(to be implemented within next 1-2 years)*	Medium term *(to be implemented within next 2-5 years as market grows)*
Financing	**Asset financing**	Pilot providing asset financing for E2Ws to ensure financiers **understand the credit cycle of E2Ws and address technology risk concerns** Introduce **first-loss guarantees** for asset financiers to allow financiers to charge lower interest rates and therefore make E2Ws more accessible	**Scale asset financing for E2Ws** once credit cycle has been proven by introducing **results-based financing** for asset financiers to increase the amount of funding available Introduce an **IoT payment model** to streamline loan repayments and collect data on driving behaviour to further address credit concerns
	EV assembler / importer	Develop an **incubator** for African E2W start-ups to support them to become **sustainable and attract funding** **Negotiate improved payment terms with suppliers** by providing a guarantee on payment therefore increasing trust between parties	Provide **credit facility** through a commercial bank and partnership with a DFI that **de-risks inventory financing for EV assemblers/importers** Raise a **green corporate bond** to fund assembly and inventory costs
	Capital light charging infrastructure	**Pilot the use of different charging mechanisms** (i.e., L1 charging points or battery swap stations) for E2W to determine the charging infrastructure required for the successful operation of E2Ws **Investigate the potential to use carbon credits** to fund **infrastructure scale-up** given that additionality can be proven	Roll-out the sale of **carbon credits** off the installation of **required charging infrastructure** as shown by the charging infrastructure pilot
Partnerships		Investigate the potential to form **Group Purchasing Organisation for EV assemblers and importers** to negotiate better payment terms from suppliers	Investigate the potential to form a **partnership between at-scale OEMs to design and launch E2Ws into the market at scale** **Develop partnerships between EV assemblers / importers and high-traffic stores/places** to set-up charging infrastructure
Advocacy / regulatory		Set up a GOGLA-equivalent association for EVs in Africa, potentially in partnership with development partners such as UNEP, that can work with **regulators and standards officials** to **develop enablers** (e.g., battery standardization, charging point standardization, targets, financial and non-financial incentives) to catalyse the sector and encourage investment	

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

5 initiatives are possible to make swapping/charging business case viable

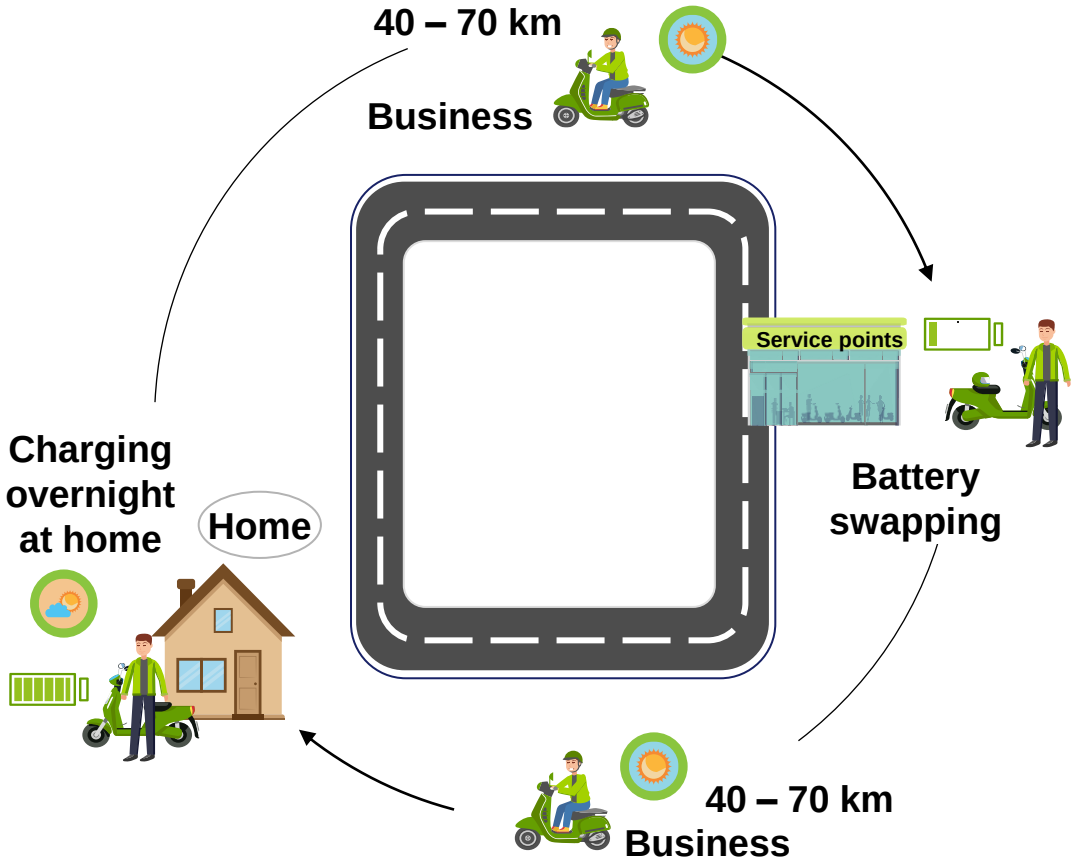
Initiative	Impact	Example
Hardware as a Service (HaaS) business model	Promotes **scale** and therefore **optimises capex** and labour spend, and increase revenues	Gogoro sells its battery technology to partner OEM, and then charge drivers subscription fees for use of battery and charging infrastructure
Partnerships between players in the supply chain to **reduce battery cost**	Creates **synergies** across the value chain to make batteries cheaper	Pertamina and PLN are exploring partnerships with Chinese and South Korean battery manufacturers: Indonesia would provide Nickel at affordable price and leverage battery R&D technology capabilities of Chinese or South Korean players
Discount on electricity tariff for charging station owner	**Decreases energy cost**, therefore increases margin	Bluebird, a transportation company in Jakarta with EV fleet, received a 50% power price discount from PLN
Self-service swapping stations	**Decreases labour cost**, therefore increases margin	Grab/GoJEK, a delivery service in Indonesia, has developed a self-service battery swapping cabinet that provides standardised batteries The company is expecting the cabinets to have high enough utilisation to be profitable and therefore is attracting local partners such as convenience stores to install and operate them without requiring extra labour cost
Batteries **stock optimisation**	**Decreases CAPEX** and improves profitability per battery	Companies exploring limiting the number of battery swaps allowed per month in a subscription business model

Source: Literature search, expert interviews, Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Grab/GoJEK is considering partnering with convenience stores to develop swapping service for its e-hailing riders

Indonesia

Illustration: mobility and charging patterns of e-hailing riders



Business model of fleet-exclusive battery swapping service

- Grab/GoJEK comes from the **fusion of two e-commerce platforms** with delivery services in Indonesia, Grab and GoJEK
- Grab/GoJEK plans to scale battery swapping infrastructure to **support the increased number of E2Ws in its fleet**
- **Swapping cabinets** will be installed at local partners **such as convenience stores**
- To mitigate the **negative business case**, Grab/GoJEK will use **data collected** to **optimise placement of battery swapping cabinets** to in order to **maximise utilisation**

Source: Literature search, expert interviews, Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

- Making economics of locally-assembled E2Ws favourable
- Establishing accessible and reliable charging infrastructure

Financing solutions

Electric motorbike pilot

Appendix

MA ran a 2-week pilot in Nairobi to test the economics and performance of locally assembled electric motorbikes

Electric motorbike pilot overview

Overview

- **2 weeks**, from 25th of October to 5th of November**,** in **Nairobi,** culminating in a **launch event** on **11th of November** at the British High Commissioner's Residence`
- ~**40 riders,** including a control group of ~20 petrol motorbike riders – all using online ride hailing / delivery platforms
- **6 local assemblers**, plus **E-Safiri** (charging) and **Uber**

Objectives

- Test, the **economics of locally assembled electric motorbikes**, including how electric motorbike riders profits compare with Internal Combustion Engine (ICE) bike owners
- Test **performance and reliability of locally assembled electric motorbikes**, including ability to handle heavy payloads and terrain, and track number and cost of breakdowns and repairs
- Gauge **perception of electric motorbikes from the perspective of riders and willingness to transition** from ICE bikes to electric motorbikes
- **Raise awareness** of the **benefits of "going electric",** and reduce concerns associated with adoption hesitation (through videos)

Assemblers

Fika CLEAN MOBILITY, Kiri EV Ltd, ECOBODAA, ARC RIDE, OPIBUS

Partners

E-Safiri, Uber

Nairobi riders on electric motorbikes during the pilot

The pilot validated the economics of going electric – riders could make 35% more, owing to savings on charging and maintenance

Petrol motorbike riders make ~$120 per month, but could save 35% by going electric

Monthly P&L components, KES			USD	Potential saving
Revenue[1]		40,000	$370	-
Costs	Loan repayment[2]	-10,000	$93	-
	Fuel	-8,000	$74	50%
	Maintanance	-1,400	$13	33%
	Insurance	-7,900	$73	-
Profit		12,700	$118	35%

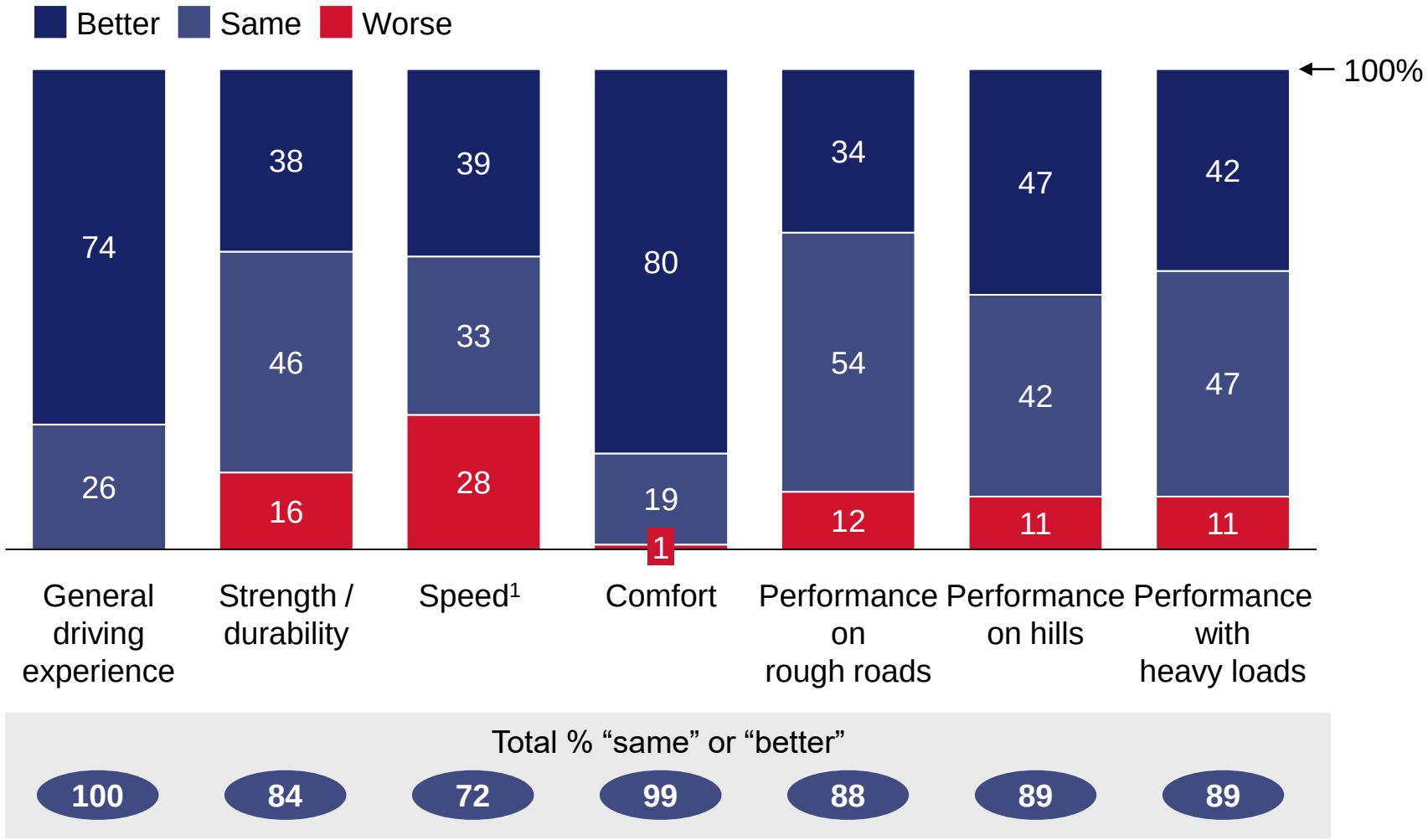
Within 2 weeks, riders were convinced of the favourable economics

- "The electric motorbike has **less maintenance** and **wear** and **tear costs** as there are limited mechanical parts on the bike
- "Its more **than 50% cheaper** to **swap batteries** than to fill my bike with petrol
- "I **make as much money** as when on a petrol bike but **costs are lower**
- "I **know** that the **price** of the **electric motorbike** is more but it will **save** me **more money in the future**
- "The **money** I **save** can be put towards my **children's school fees**

Source: Industry expert, Boda rider focus groups

Riders say electric motorbikes perform as well as, if not better than, petrol motorbikes

Rider rating of electric vs petrol motorbikes for performance dimensions



1. In the pilot focus groups, riders with motorbikes with hub mounted engines tended to be more negative about the bike's speed than those with mid-engine motor configurations

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

The **sample** group of **electric motorbike riders** put the bikes through **more challenging conditions** (longer trips, more time on hills and rough roads, heavier loads) **than** the **petrol bike riders** during the pilot

Quotes

"It is **simple to ride** as I **don't shift gears**, no need to change oil – I can **focus** on **getting work done**"

"Its as **strong** as the **petrol motorbike** which is **good for deliveries**"

"The bike adjusts the gear automatically and so the **general strength is better going up hills**"

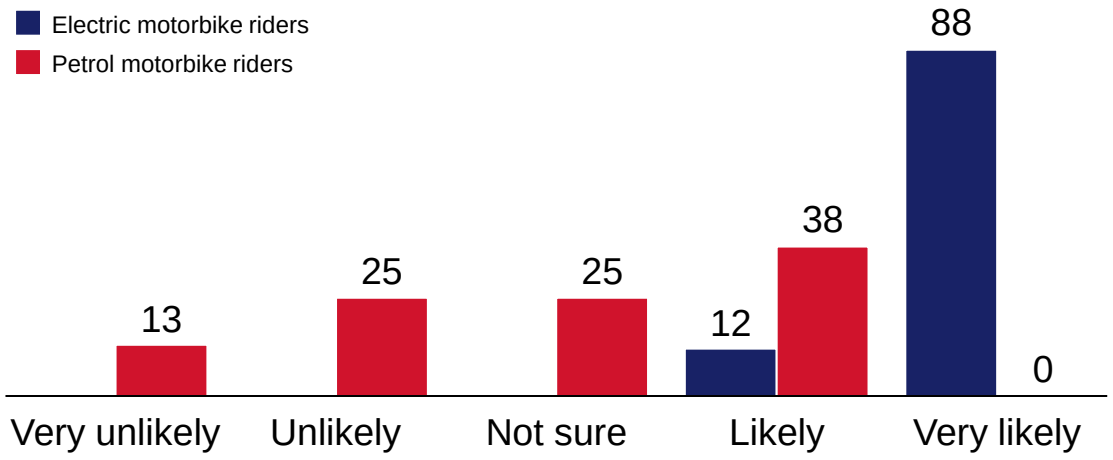
"Performance on rough roads is **better** as the **bike is lighter**"

"There are **less vibrations** and it is a **smoother ride**. Also, **less noise** means my **ears don't hurt** at the end of the day"

Riders who have tried electric motorbikes are highly likely to buy and recommend them, but have range anxiety

Majority of electric motorbike riders are likely or very likely to buy an electric motorbike as their next bike…

% likelihood of riders buying an electric motorbike for their next bike

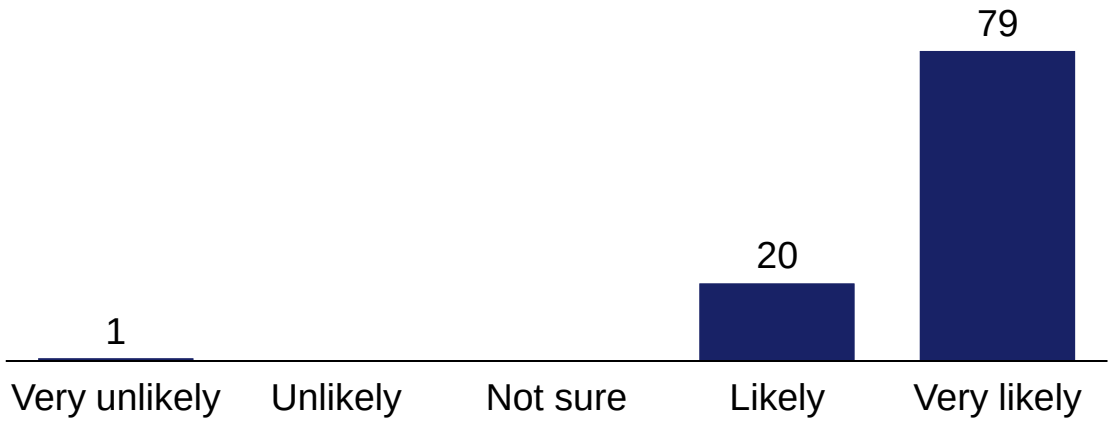


"The bike is **comfortable, saves money**, contributes **to less pollution and is less noisy – I won't be going back to my petrol bike**

"The only **concern** is **battery** and **range – we need more swap stations,** but **otherwise I really love it**

… and are likely or very likely to recommend an electric motorbike to other riders

% likelihood of riders recommending an electric motorbike to another rider



"Other riders will **save a lot of money** and **riders want to save more money**

"I want my **colleagues to experience** the **benefits I have with an electric motorbike**

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

Therefore building out infrastructure is very important, especially as riders go up to 130km per day

Implications	Reason	Rider quote
Need to build up infrastructure	Focus groups indicated that **riders enjoy** electric motorbikes but are **limited due to lack of infrastructure** Some **riders ran out of battery** and were **forced to walk** some distance **to their swap station**	When I started I **wasn't sure where** I could **swap batteries** and this made me **only work** in **certain areas** – I **can't go beyond that**
Combination of charging at home and swapping is needed	**~90% of riders** indicated that **swapping** was **easier** than filling their bikes with petrol Focus groups indicated that **riders enjoy** the **ability** to **charge** at **home** allowing them to **start** the **day quickly**	I **enjoy charging** my bike at **home** but also **enjoy** the **benefits** and **convivence** of a **swap station**
Bikes need an extra battery	Many **riders** indicated that they **wanted to be given** the **opportunity** to **travel further** – between **100-200km** per day – and **operate** more **dynamically** The **average distance** that riders drove was **115km**, with **~40%** needing to **swap batteries** at **least twice** a day	Even though **swapping** is **easy**, **sometimes** I **need** to do it **twice** or **more** – if we could **travel further without swapping** a lot, that would be **great**
Riders have time to charge their bikes during the day	Most **riders waited ~30-60mins between trips** meaning that they have **time** to **charge batteries** during the day **~70%** of **riders swapped** their **batteries** at **noon** or in the **afternoon**	I usually have **time before rush hour** to **swap** my **batteries**, which allows me to **get home with enough battery power to start** the next **day**

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

Feedback on the value and organisation of the pilot was overwhelmingly positive

Survey results from riders, assemblers and other pilot partners[1]

100%

of respondents felt that their daily responsibilities were clear

100%

of respondents felt that the organizing team was friendly and professional

90%

of respondents thought that the pilot was worth it

98%

of respondents thought that the pilot was very well organized

Quotes

"I wish I could **have 5 more days with** the **bike**"

"**Nice working with you guys**… **kudos**!!"

"**I enjoyed every bit of it**"

"**Professional** and **friendly**...**clear** to **understand**!"

"I **enjoyed riding** the **electric motorbike** and my **customer** were **very happy**… **I will go electric**"

"**Awesome experience**"

"With this **survey** I got to **learn about** my day to day **operation**, **expenses** and **earning**"

1. Respondents include: Electric motorbike rider, Petrol motorbike rider, Assembler - leadership, E-Safiri - Leadership, Uber - Leadership, Assembler points of contact

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

Photos from the pilot

Long video link - https://www.youtube.com/watch?v=K-L0NSG69Qc

Viral video link - https://www.youtube.com/watch?v=25lRjBdS36Y

The launch event, hosted at the British High Commissioner's residence, was attended by the CS of Ministry of Industry and PS of SD Transport

CS Hon. Betty C. Maina, EGH of Ministry of Industrialization, Trade and Enterprise Development speaking to local assemblers

Chania moderating a panel of local assemblers

The Manufacturing Africa team

BHC High Commissioner Jane Marriot opening the launch event

Interviewing two electric motorbike riders

PS State Department of Transport Dr. Eng. Joseph K. Njoroge

CS Hon. Betty C. Maina, EGH

BHC High Commissioner Jane Marriot, CS Hon. Betty C. Maina, EGH and Prime Ministers Trade Envoy to Kenya Theo Clarke MP on an electric motorbike

BHC High Commissioner, Jane Marriot, and PS Dr. Eng. Joseph K. Njoroge, CBS on an electric motorbike with

Contents

EV potential aspiration and current landscape

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Financing solutions

Electric motorbike pilot

Appendix

Behavioral analysis suggests most vehicles in SSA could use Level 1 charging (at-home charging), so need limited infrastructure investment

Battery swap stations (E2W only)	Level 1 (AC)	Level 2 (AC)	DC fast charging
Power supply to charge batteries dependent on number of batteries in swap stations, e.g., 25 battery swap station: • Min speed: L1 AC • Max power: 25-50KW DC However, this depends on the charger and swapping system design	Charge at home using: • Standard outlet (slow) • Installed wall charger (faster) All electric vehicles come with Level 1 home connector kit	**Basic home** Non-networks "dumb" chargers that rely entirely on electromechanical controls $350-$450 **Advanced home** Networked charger connects through home Wi-Fi or wireless card Digital user interface and open protocols and standards $500-$700 **Public** Similar to advanced home chargers with additional customer authentication capabilities and more durable housing $2,500-$5,000	**50kw** Control device with open protocols and standards, 5x10 kw power modules, and liquid-cooled power cables. $20,000-$35,000 **120-150kw** Similar to 50kw design with additional power modules. $50,000-$100,000

Time to full charge

Slow (40 hours) — **4 hours** — **Fast (30 minutes)**

However, with <150km per day driving, battery likely only needs ~8 hours overnight charging max. for E4W/minibus/LCV; E2Ws might require much less time

Implications

- Most **2W and person-use 4W owners drive short enough distances that Level 1 or battery swap stations should be sufficient for charging**
- **Commercial drivers (of 4W taxis, LCVs, or matatus) might also be able to use Level 1 charging as long as they drive <150km/day and are able to charge ~8 hours overnight.** However, longer-distances or longer times worked might make this challenging without Level 2 or fast-charging infrastructure

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, McKinsey Centre for Future Mobility

Two scenarios have been considered for EV adoption across vehicle segments – a base case and an aggressive case

Deep-dive to follow

Base case

Assumes market forces

Adoption of EVs **driven largely by economic factors** (i.e., are EVs available at an affordable price, driven by availability of used EVs)

Consider that supply of EVs may be constrained in the short-term but unlikely in the long term

Additional considerations include:

- Awareness of EVs and their benefits
- Access to charging infrastructure
- Driving behaviour
- Range anxiety

Aggressive case

Assumes market-shaping intervention

Government and/or private sector actively shape the market, including:

- **Regulatory mechanisms** to:
  - Make EVs **more affordable** (e.g., tax exemptions)
  - **Incentivise adoption** (e.g., mandating EV use for certain vehicle segments, restricting import of ICE vehicles, aggressively building out charging infrastructure)[1]
- **Introduction of vehicle models affordable** for the market (i.e. OEMs invest in lower cost electric vehicles targeting emerging markets)

1. Subsidies not assumed in our modelling due to lack of fiscal space among African governments

Source: Consumer survey, consumer interviews, stakeholder interviews

Enablers for E2W put in place by regions in Asia, EU and EA (1/5)

Subsidies and incentives (1/3)

PRELIMINARY DRAFT

Chinese Mainland	Taiwan	India	Norway	Rwanda	Kenya
Charging Infrastructure					
Government is **prioritising electric vehicles** for **heavy users** of **public infrastructure** Offering charging **infra-structure subsidies** that are ~**30% of installation cost**	In 2018, government allocated funds to state-owned oil company CPC Corp. Taiwan to **build 1,000 charging stations**, while another **2,310** to be built in **parking areas** near **railway stations** The government is committed to **electrifying all of Taiwan's buses by 2030** and will invest NT$30 billion to achieve this	Under FAME II in April 2019, government introduced **$282m** in demand incentives for E2W buyers **targeting 1m E2W** and **$140m in incentives** for entities **setting up charging stations**	In 2017, the **Norwegian Government** launched programme to **finance** the establishment of at **least 2 multi-standard fast-charging stations every 50km on all main roads** in Norway The **Norwegian Electric Car Association** gives users **access to charging units** all over the country at a **reduced cost**	**Provisions for EV charging stations** in the building code and city planning rule **Introduced technical standards and environmental standards** (e.g., recycling of batteries),	In 2020, MoE required **new buildings** to **incorporate charging stations** In **2021, Kenya Power** announced plans for **nationwide network** of **public charging points** In **2020, KenGen** announced plans to roll out an **EV charging network** **Nopea** set up **charging stations** for **electric cars** at Two Rivers Mall, Hub Mall, Thika Road Mall, Sarit Centre
Electricity tariffs					
Policy permitted all **public charging stations** to charge electricity at **industrial electricity rates**	N/A	N/A	N/A	Electricity **tariffs for charging stations** to be **capped** at the **industrial tariff**	Currently ongoing **negotiations** with Kenyan government stakeholders for **tariff reductions for e-mobility charging**

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

Enablers for E2W put in place by regions in Asia, EU and EA (2/5)

Subsidies and incentives (2/3)

PRELIMINARY DRAFT

Chinese Mainland	Taiwan	India	Norway	Rwanda	Kenya
Purchase/demand incentives					
Purchase bonus for BEVs and PHEV proportional to driving range **Battery EVs do not have license plate quotas**, as opposed to ICE vehicles	N/A	**Central government offers subsidies** on E2W, electric-three-wheeler (E3W), E4W3 and buses in **proportion to battery capacity** **Different st**ates have **different incentive** schemes for EVs FAME I plan in 2015 offers **$110m in subsidy for purchase of all EXW** including E2W and E4W cars in an effort to jump-start EV adoption in India	**For parking lots and parking** areas of new buildings, a **minimum amount of 6%** has to be allocated to **electric cars**	N/A	Currently Kenya has **no purchase/demand incentives**
Caps and quotas					
Price cap on sale price of new electric vehicles	N/A	N/A	N/A	N/A	Currently Kenya has **no purchase/demand incentives**

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

Enablers for E2W put in place by regions in Asia, EU and EA (3/5)

Subsidies and incentives (3/3)

PRELIMINARY DRAFT

Chinese Mainland	Taiwan	India	Norway	Rwanda	Kenya
Tax exemptions					
Exempt from **purchase tax, consumption tax and vehicle and vessel tax**	In 2012, owners of EVs were **exempt from vehicle license tax** In 2016, **electric motorcycles** and **cars** valued at less than $43,411 **are exempt from sales tax** In 2017, manufacturers and importers **of EVs are exempt from commodity tax**	Many state governments offer additional benefits like **exemption from road tax and registration fee** **Goods and services tax** (GST) set at **5%, whereas this is 29-43% for ICE**	**Exempt from import fees**, **VAT** (25% on purchase and leasing price) and **annual road/insurance tax** **Malus tax on ICE vehicles** of an additional 25-50%	**Charging station equipment** will be exempted from **import, excise duties and withholding tax**	**Locally-assembled E2W** are **exempt** from **excise duty** and **import duty is decreased to 10%**

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

Enablers for E2W put in place by regions in Asia, EU and EA (4/5)

ICE bans and restrictions

PRELIMINARY DRAFT

Chinese Mainland

By **2035**, all **new vehicles sold in** Chinese Mainland must be **non-ICE**

Chinese Mainland's **Hainan province** has set targets to **phase out sales** of **new diesel** and **gasoline passenger cars**, **light commercial vehicles, buses, and coaches by 2030**

Taiwan

Government aims to **ban the selling of petroleum** vehicles by **2040**

Replace public buses and **government vehicles** by **electric vehicles by 2030**, **ban** the selling of **petroleum motorcycles by 2035**, and **petroleum automobiles by 2040**

India

No new ICE by **2030**
Proposed a **ban** on all **ICE three-wheelers** by **March 2023**

Norway

Government wants to **end the sale of fossil fuel-powered cars, by 2025**

Rwanda

Government of Rwanda (GoR) aims to **rapidly transition** to **electric motorbike**s and **eventually to electric vehicles more broadly**

President Kagame announced in **August 2019** his intention to **replace ICE motorbikes** with **electric motorbikes**

Kenya

The **National Automotive Policy** will **regulate the age limit** of imported vehicles progressively

This will be implemented from **8 years to 5 years in 2022**; from **5 years to 3 years in 2024** and; from **3 years to zero in 2026**

Fuel efficiency and CO_2 emission targets

Decrease vehicle CO_2 emissions to **117g CO_2 /km in 2020**

N/A

Decrease vehicle CO_2 emissions to **134g CO_2 /km by 2022**

Passenger car standards are mandated to **95g CO_2 /km for 95%** of vehicles in **2020** with **100%** compliance in **2021**

The **light-commercial vehicle** standards are mandated to **147g CO_2 /km of CO_2 in 2020**

Cut carbon emissions from ~ **55.1g CO_2 /km for ICE** motorbikes to ~**13.3g CO_2/km** for **electric motorbikes** by **2025**

Kenya **commits to 32% reduction** in **CO_2 emissions** by **2030**

No specific targets for vehicles

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

Enablers for E2W put in place by regions in Asia, EU and EA (5/5)

Official Electric Vehicle penetration targets (e.g., X% of new vehicle sales by 2030)

PRELIMINARY DRAFT

Chinese Mainland	Taiwan	India	Norway	Rwanda	Kenya
All-electric, fuel-celled autos and **plug-in hybrids** account for more than **20% of total car sales by 2025**	N/A	**2030 aspiration set at 30%** of electric-four-wheelers (E4W), **80% E2W, 70-80%** in **commercial vehicles**	**Fully electric vehicles** now make up about **60% of monthly sales** in Norway Government aims to have **100% sales by 2025**	N/A	National Energy Efficiency and Conservation Strategy 2020: aims to **increase uptake** of **electric vehicles** to **5% of all imported vehicles annually by 2025**

Source: Press search, CNBC, Bloomberg, European Alternative Fuels Observatory, The Board of Investment of Thailand, WEF, India Ministry of Heavy Industries, GoK strategies and policies

In addition to carbon emissions reduction, EVs reduce air pollution

Case examples

The most common air pollutants include particulate matter (PM10 and PM2.5), nitrogen dioxide (NO2), carbon monoxide (CO), and sulfur dioxide (SO2).These pollutants, when highly concentrated in the air, can cause respiratory diseases and lung damage

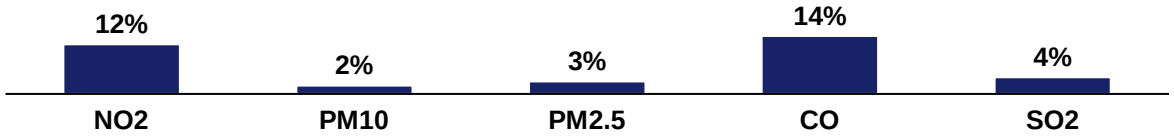
Scientific studies show that EV penetration could reduce the concentration of air pollutants…

Some cities/countries are already experiencing benefits of electric vehicles on air quality…

In Spain…

Research proved that **26% EV penetration** could reduce the concentration of air pollutants by **3-14% in Madrid**:

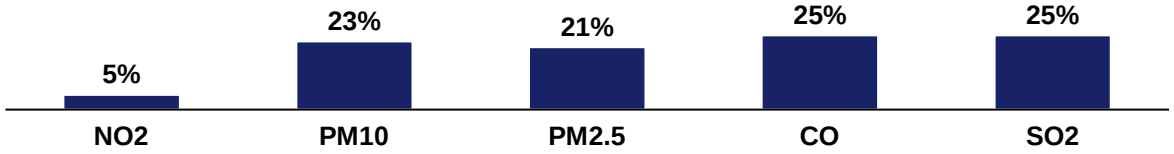
Potential pollutants concentration reduction, (%)[1]



In China…

Another study on Shanghai indicated that, **30% penetration of EV by 2025** could reduce the concentration of air pollutants by **5-25%**

Potential pollutants concentration reduction, (%)[2]



In Taiwan

The government launched a program under which all new **government vehicles** and **public buses** will be replaced by **EVs by 2030**, and sales of non-electric 2W and 4W will be banned by 2030 and 2040 respectively. Early results show a decrease of **~18%** of **PM2.5** concentration in the air (**from 22 to 18 µg/m3**)

In Oslo (Norway)

This part of the world is one of the most advanced in electric mobility penetration, with **50% of new cars** sold being **electric or hybrid**, and current **20%** penetration of EVs in **4W segment**. The city has attained **35% CO2** emissions decrease since 2012, and the **lowest NO2 levels** since 2013

In Delhi (India)

This city has a target of **25% share of electric vehicle** for new vehicle sales by 2024. The anticipated impact is **~160 tons emission reduction** of **PM 2.5** and **~ 4.8 m tons** emission decrease of **CO2 emissions**

1. Albert Soret and al., “The potential impacts of electric vehicles on air quality in the urban areas of Barcelona and Madrid”, 2014
2. Xiaojian Hu and al., "The Potential Impacts of Electric Vehicles on Urban Air Quality in Shanghai City“, 2021

Source: Sub-Saharan Africa e-mobility analysis 2021 funded by the Shell Foundation, UNEP, Research gate, RMI India, Elsevier, Standard, Press search

Advantages of owning an assembler's license and bonded warehouse for locally-manufactured E2Ws

PRELIMINARY DRAFT

	Description	Advantages for assemblers of E2Ws
Assembler's license	• An assembler's license allows **importers of CKD Kits** to **assemble motorbikes in country** • To receive an assembler's license the importer must: – Be incorporated in Kenya – Have an assembly plant – Be tax-compliant – Require a time bound plan to source locally-manufactured motorcycle parts[1] – Provide a plan to for transfer of technology, knowledge and skills through training and mentorships for Kenya citizens • Assembly of motorcycles will **need to be done in a bonded warehouse**	• **Decreased Import Duty** from **25% to 10%** – **Import duty** is only **paid once parts** leave the **bonded warehouse** • **Elimination of Excise Duty to 0%**
Bonded warehouse	• **Customs Bonded warehouse** is a warehouse **licensed by the Commissioner of Customs** for the **storage of goods** imported into Kenya pending the **payment of duties** • To receive a bonded warehouse license the owner must: – Submit an application with a plan of proposed building and its relation to other buildings – Have the premise inspected by a commissioner and indicate that the premise is locked by an approved customs lock – Pay an annual fee of $1,500 p.a.	• **Elimination** of **Import Declaration Fee** and **Rail Development Levy**

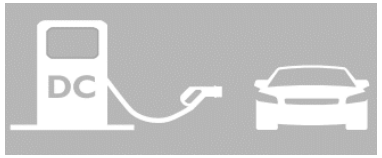
1. Assemblers are given 18 months to show that they can locally source a list of 14 parts. This list includes the E2W battery but as E2Ws batteries can not currently be manufactured in Kenya, SDoT and MoITED allows Kenyan E2W assemblers to continue to hold an assembler's license if they can locally source the remainder of the listed items

Source: Press search, Kenyan Tax Procedures for Unassembled Motorbikes, Kenyan Warehousing Code

Three modes of charging for EV are relevant globally

Slow

Fast

Charging modes for NEV[1]		Connection mode to AC network	Application
Mode 1		Connection via **standardised socket outlets without further effective safety measures** **High risks** of overheating of socket and cable if intense use of several hours and exceeding 2 kW	Eliminated in most countries due to high risks
Mode 2		Connection via **standardised socket outlets with in-cable control box** for safety and communication Risks behind the socket wall in case of non-compliant wiring (e.g., temperature increase)	
Mode 3		Connection via **dedicated wallbox** **Wallbox** with **control pilot function/control equipment**	
Mode 4		Connection via **off-board charger** with control pilot function AC power **converted to DC** in the charging station	

1. Neighbourhood electric vehicle

Source: Research, interviews with EV manufacturers

Adoption of Mode 2, 3, 4 differ depending on user scenarios

Primary · Secondary · None

	Scenario	Mode: 4 (Fast)	Mode: 3 (Mid)	Mode: 2 (Slow)	Typical application
Public	**Highway**	Primary	Secondary	None	Fast-charging station along highway
	Fleet exclusive	Primary	Secondary	None	Car rental company Taxi, bus, sanitation truck Logistics fleet
	Public parking	Secondary	Primary	None	AC charging poles among road parking Inner-city fast-charging station (few)
Semi-public	**Semi-public chargers[1]**	Secondary	Primary	None	At office, apartments, hotels, shopping malls, etc. Or membership exclusive
Private	**Private wall-mount box/pile**	None	Primary	Secondary	Private parking slot or garage

1. At gated locations such as office buildings, shopping malls, or a part of charging programme with exclusive membership, but are shared with a group of people and can be potentially open to public

Source: Literature search, expert interview

Numerous investors are actively looking for opportunities in green manufacturing, transport and infrastructure in Africa (1/2)

Investor name	Type	Description	Sectoral focus or sector in portfolio	Regional focus
Actis Capital	PE firm	Spinout of CDC Group; $7.8Bn assets	Focus areas include energy and infrastructure	Asia, Africa, Latin America
Adenia	PE firm	PE firm investing only in Africa	Focus areas include Agribusiness and Manufacturing	Africa
Africa Finance Corporation (AFC)	Multilateral Financial Institution	Created by sovereign African States to support infrastructure development; $8.7Bn fund invested; Intruments: debt and equity	Focus on power, transportation and logistics, heavy industries, natural resources and telecommunications sectors	Africa
African Development Bank (AfDB)	Multilateral Development Bank	Financial provider to African governements ans private companies investing in the regional member countries	Investments include agribusiness, climate change, energy & power, environment, infrastructure, transport water supply & sanitation	Africa
AfricInvest	PE firm	$1.7Bn asset under management; Investments only in Africa, offices in Africa, France, USA and UAE	Focus areas include manufacturing, renewable energy, oil & gas, petro-chemicals and plastics industries	Africa
Amethis	PE firm	$725M PE fund dedicated to Africa; Average ticket $10-50M	Investments include manufacturing	Africa
CDC Group	Development Finance Institution	UK's Development Finance Institution; Focus on private sector; Instruments : debt, equity (direct and intermediated), guarantees	Investments Include manufacturing, food, construction, infrastructure	Developing countries; 52% in Africa
East African Development Bank (EADB)	Multilateral Development Bank	Common development financing institution for East African countries; Instruments: credit, guarantees, loans, equity	Focus areas: climate change, food security, insfrastructure, regional integration, skills development	East Africa
Emerging Capital Partners (ECP)	PE firm	Pan-African PE firm that has raised over $3.2Bn through funds and co-investments vehicles for growth capital investing in Africa	Focus areas include Infrastructure & logistics	Africa
Entrepreneurial Development Bank (FMO)	Multilateral Development Bank	Dutch development bank, Public-private partnership between Dutch State and commercial banks/trades unions and other private sector players; Instruments : loans, equity, guarantees	Focus sectors include Agribusiness, good & water, and Energy	Mainly emerging countries
European Investment Bank (EIB)	Multilateral Development Bank	Largest International Financial Institution in the world and one of largets privoder of climate finance; ~$80Bn of financing	40% of total EIB financing dedicated to green financing; Among the priorities: - climate and environmental sustainability; - infrastructure	Mainly EU, but also developing countries
Helios Investment Partners	PE firm	Africa-focused PE firm	Includes Clean Energy and Power, Agribusiness	Africa

Source: Company websites, Pitchbook, CrunchBase

Numerous investors are actively looking for opportunities in green manufacturing, transport and infrastructure in Africa (2/2)

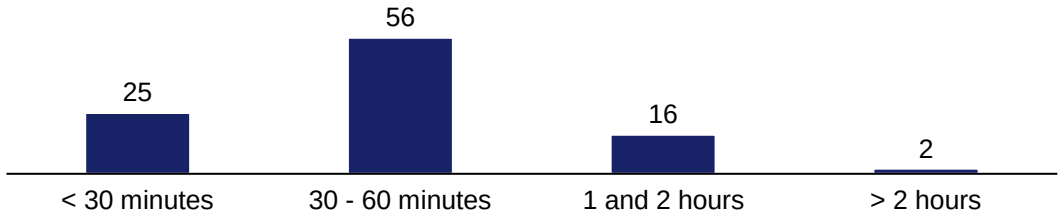
Investor name	Type	Description	Sectoral focus or sector in portfolio	Regional focus
Investment Fund for Developing Countries (IFU)	Development Financial Institution	Development Financial Institution owned by the governement of Denmark; Instruments: loans and equity	Includes investments in power (recent investment in largest African wind farm), cement, chemical industry	Europe, Asia, Latin America, Africa
Standard Bank Group	Financial institution incl. Wealth and investments	South Africa financial services group, Africa's biggest lender by assets	NA	NA, but HQ in South Africa
Swedfund	Multilateral Development Bank	Sweden's Development Finance Institution - mission to combat poverty by developing sustainable business in emerging markets; Investment instruments: Mainly Fund and Debt, but also little Equity	Portfolio includes 35% in "Energy and Climate"	World least developed countries so primarly Sub-Saharan Africa; Africa accounts for 55% of total portfolio
US International Development Finance Corporation (DFC)	Development Financial Institution	Development Financial Institution owned by the US government; Instruments : debt and equity	Across sectors, including energy, infrastructure, technology	Lower and middle income countries; Incl. $8.2Bn investments in Africa
LGT Lightrock	PE firm	Lightrock is a global private equity platform investing in sustainable businesses committed to innovation for systemic change at scale.	On of the investment pillars focuses on Renewables & Circular Economy Transition, Sustainable Food & Agriculture, and Smart Mobility & Transportation	Africa, Latin America, India and Europe
Norfund	PE firm	A private equity company established by the Norwegian Storting (parliament) in 1997 and owned by the Norwegian Ministry of Foreign Affairs	Clean energy, financial services and agribusiness are the three main sectors in which Norfund invests	Developing countries with a strategic focus on Sub-Saharan Africa, and selected countries in Central America and South-East Asia
Novastar Ventures	Venture Capital	Manages more than $200 million across two venture funds.	No sector focus but has invested in clean energy and circular economy businesses (Sanergy, Solar Now, and Max.ng)	East and West africa
DOB Equity	PE firm	DOB Equity is an independent, long-term investor in companies in East Africa	Agribusiness and food, clean energy, retail and distribution, waste, mobile technology enabled services, and natural resources	East Africa
TotalEnergies Ventures	Venture Capital	TotalEnergies Ventures is the venture capital arm of TotalEnergies.	Renewables, Distributed Energy, New Mobility, Energy Access, Energy Storage, Bio-Plastics & Recycling, Artificial Intelligence, and IoT.	Emerging markets including Africa

Source: Company websites, Pitchbook, CrunchBase

Per day, riders spent 30-60min waiting between trips, swapped batteries once between 2-4pm and spent ~ KES 150 on battery swaps

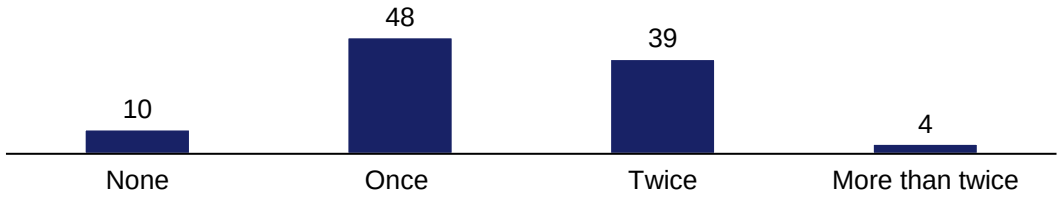
Riders spent ~30-60mins between trips waiting for a new trip

Time spent waiting between trips, % of all responses



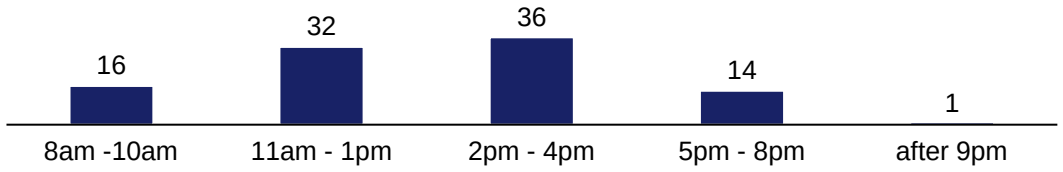
On average riders swapped batteries at least once a day

Number of battery swaps per day, % of all responses



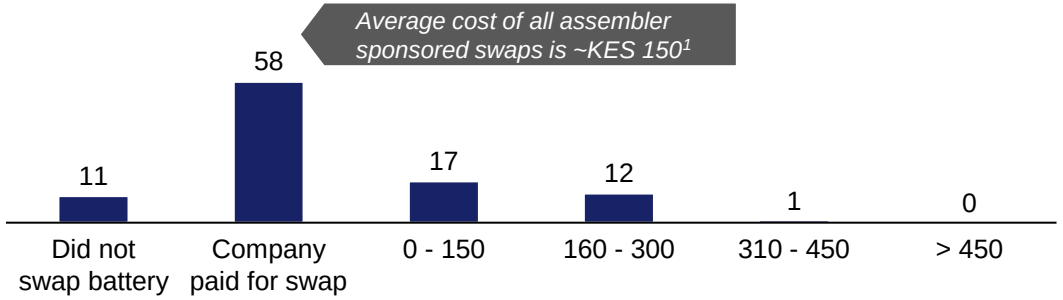
Most swaps occurred between noon and early afternoon

Time of day a battery swap occurred, % of all responses



The average swap cost to a rider was ~KES 150

Cost of battery swap per day, % of all responses



1. Assumes that assembler transfer cost of swap to rider

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

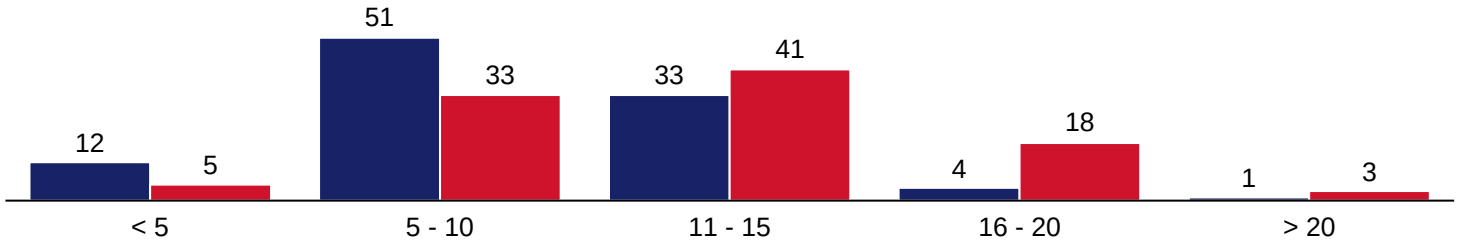
The sample group of electric motorbike riders put the bikes through more challenging conditions than the petrol bike riders (1/3)

Sample description: number of trips and distance

Electric motorbike riders | Petrol motorbike riders

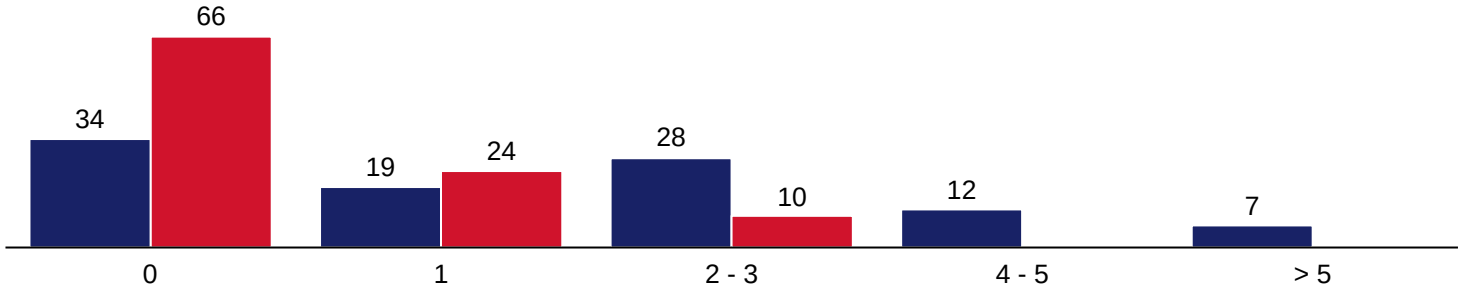
Electric motorbike riders did fewer trips than petrol motorbikes but…

Number trips per day, % of all responses



…the trips tended to be longer, with more 15km+ journeys than petrol motor bike riders

Number trips >15 km, % of all responses



Sample description

On **average** during the pilot, an **electric motorbike travelled ~115km per day**, compared to the **~130km travelled** by the **petrol motorbike**

The samples had fairly similar activity, albeit the electric motorbikes tended to **do longer, but fewer, trips each day**:

- On **most days** (63%) days **electric motorbike riders** did **<10 trips** and very rarely (5% days) did over 16 trips, whilst petrol bike riders tended to do more trips each day, with only 38% doing <10 trips and 21% doing more than 16 per day
- On **any one day**, **half** (47%) electric motorbike riders did **more than two 15km trips**, compared to only 10% petrol bike riders

The sample group of **electric motorbike riders** put the bikes through **more challenging conditions than** the **petrol bike riders** during the pilot

This further **validates** the **positive reactions** to the **electric motorbike performance** being rates as the same or better than petrol motorbikes

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

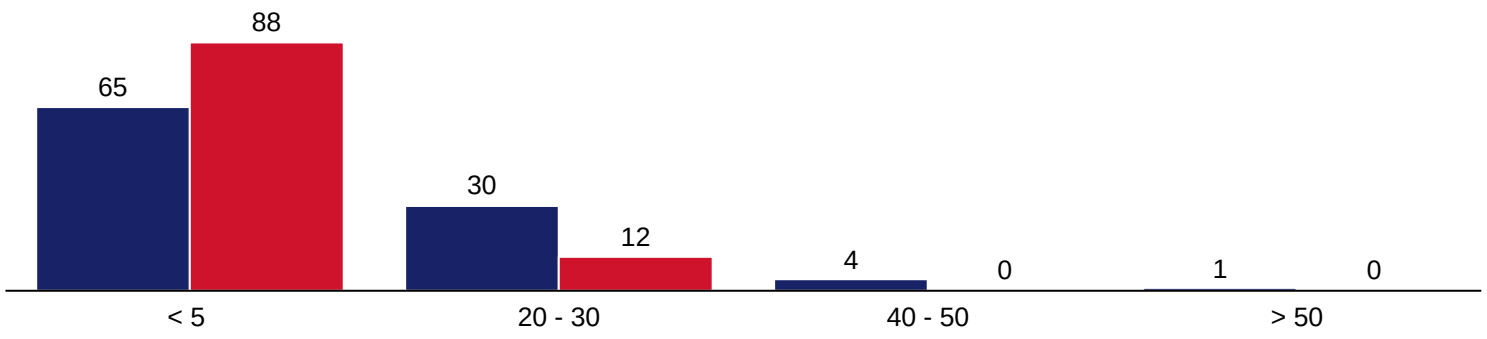
The sample group of electric motorbike riders put the bikes through more challenging conditions than the petrol bike riders (2/3)

Sample description: terrain travelled on during the pilot

Electric motorbike riders | Petrol motorbike riders

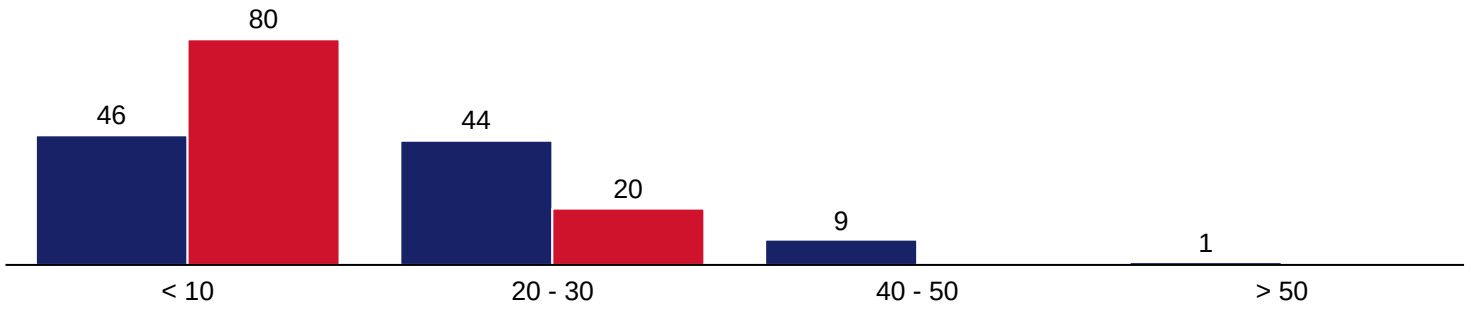
Electric motorbikes spent more time on rough roads…

% of time on rough roads, % of all responses



…and on hills than petrol motorbikes

% of time on hills, % of all responses



Sample description

The samples had fairly similar activity, albeit the electric motorbikes tended to **spend more time on rough roads and hills:**

- **One in 3 electric** motorbike riders (35%) spent over **20%** of their time on **rough roads**, compared with only **one in 10** (12%) of **petrol** motorbike riders
- Over **half electric** motorbike riders (54%) spent over **20%** of their **time on hills**, compared with **only one in 5** of **petrol** bike riders

The sample group of **electric motorbike riders** put the bikes through **more challenging conditions than** the **petrol bike riders** during the pilot

This further **validates** the **positive reactions** to the **electric motorbike performance** on difficult terrain being the same or better than for petrol motorbikes

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

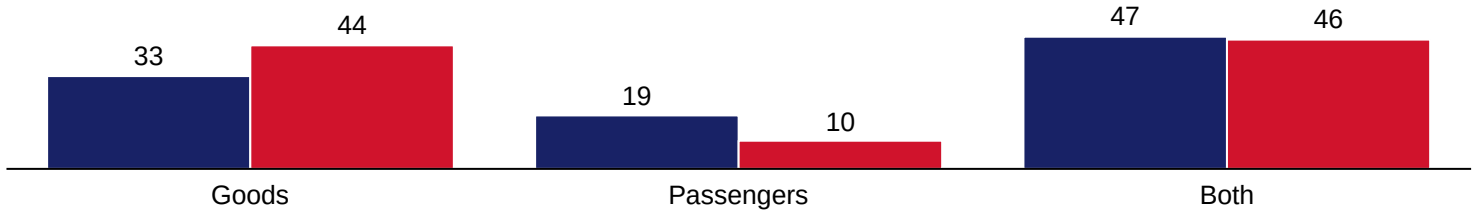
The sample group of electric motorbike riders put the bikes through more challenging conditions than the petrol bike riders (3/3)

Sample description: type of loads carried and weight of loads

Electric motorbike riders Petrol motorbike riders

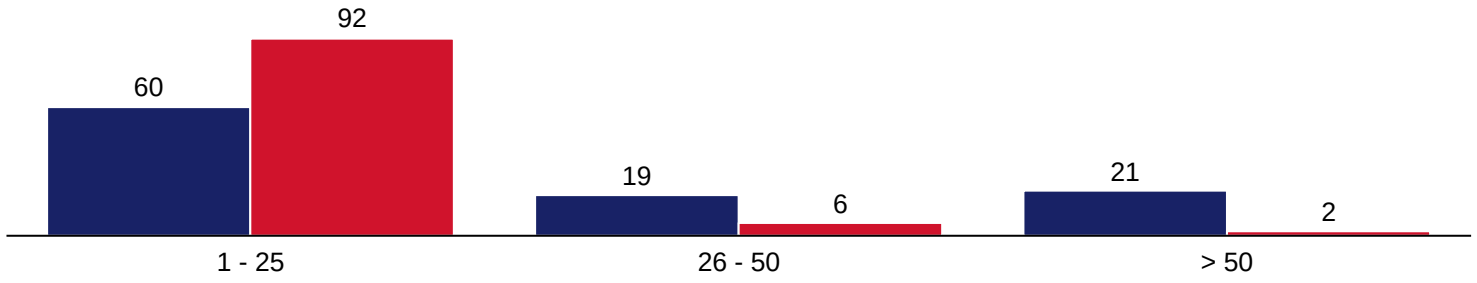
On average, electric motorbikes carried more passengers than goods

Delivery / passenger rider split, % of all responses



Electric motorbike riders transported heavier goods

Weight of goods in kg,% of all responses



Sample description

The samples had fairly similar activity, albeit the electric motorbikes tended to:

- **Carry more passenger than goods**: of all riders, 33% carried goods and 19% carried passengers vs, vs petrol bike riders at 44% and 10% respectively
- **Transport heavier goods:** 21% electric motorbike riders carried goods >50kg vs only 2% petrol bike riders

The sample group of **electric motorbike** riders put the bikes through more **challenging conditions** by **carrying heavier goods** in their day to day work

This further **validates** the **positive reactions** to the **bikes' performance** with **heavy loads** compared to the petrol bikes

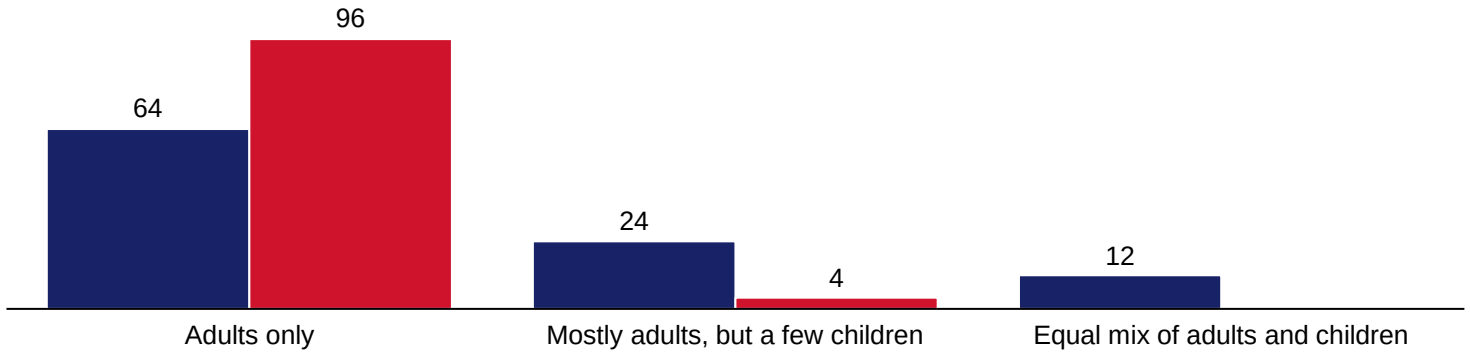
Source: Manufacturing Africa Kenya Electric Motorbike Pilot

The electric motorbike group likely carried similar passenger loads compared with the petrol motorbike control group

Sample description: mix of passengers carried

Electric motorbikes carried more children than petrol motorbikes…

Adults / children carried, % of all responses



… and more electric motorbikes carried >1 passenger, more often

Number passengers carried, % of all responses

Sample description

The samples had fairly similar activity, albeit the electric motorbikes tended to:

- **Carry more children**: on a **third of days** during the pilot **electric** motorbikes carried some **children**, compared with **only 4%** days for **petrol** motorbikes
- **Carry >1 passenger more often**: On one in 10 days, electric motorbike riders carried more than 1 passenger, compared to only 3% days for petrol motorbikes

The **electric motorbike** riders and control group of petrol bikes may have carried **similar passenger loads**, given electric motorbikes carried children more often, but also carried more than one passenger more often (presumably an adult accompanying the child)

This further **validates** the **positive reactions** to the **electric motorbikes' performance** compared to the petrol bikes

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

Riders say electric motorbikes perform as well as, if not better than, petrol motorbikes

Rider rating of electric vs petrol motorbikes for performance dimensions

		Worse	Same	Better	% same or better	n[1]
Overall	General driving experience		26	74	100	166
Performance	Strength / durability	16	46	38	84	166
	Speed	28	33	39	72	166
	Comfort	1	19	80	99	166
	Performance on rough roads	12	54	34	88	155
	Performance on hills	11	42	47	89	166
	Performance with heavy loads	11	47	42	89	151
Charging vs fuelling	Speed of battery swap vs fueling	6	8	86	94	162
	Ease of battery swap vs fueling	6	1	93	94	161
	Price of battery swap vs fueling			100	100	154

100%

1. n = Number of responses to daily surveys

Source: Manufacturing Africa Kenya Electric Motorbike Pilot

Key insights

Riders report that on most days (~75%) the **experience** of driving an **electric motorbike** was **better** than a **petrol bike**

Performance of the electric motorbikes was **ranked the same if not better ~70-90% of the time,** across all metrics

Almost all – **80%** – said electric bikes are **more comfortable**

Charging wes seen as **faster**, **easier** and **cheaper** than fuelling in almost all reports (86%, 93% and 100%, respectively)