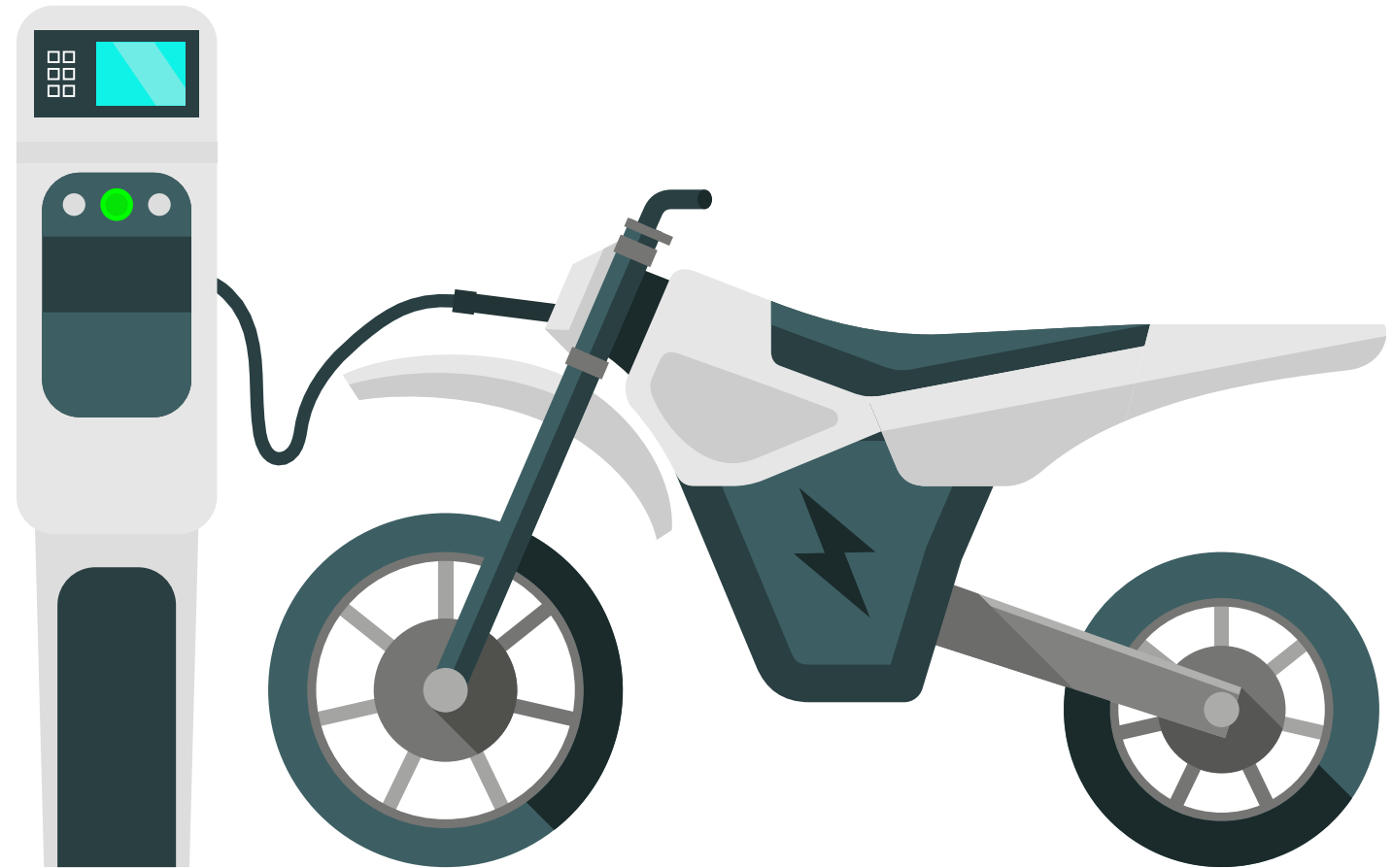


Opportunity and investment potential for electric vehicles in Kenya

Manufacturing Africa

October 2021



 **GREAT** *for* **GROWTH**
BRITAIN & NORTHERN IRELAND


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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 companies and 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

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- Making economics of locally-assembled E2Ws favourable
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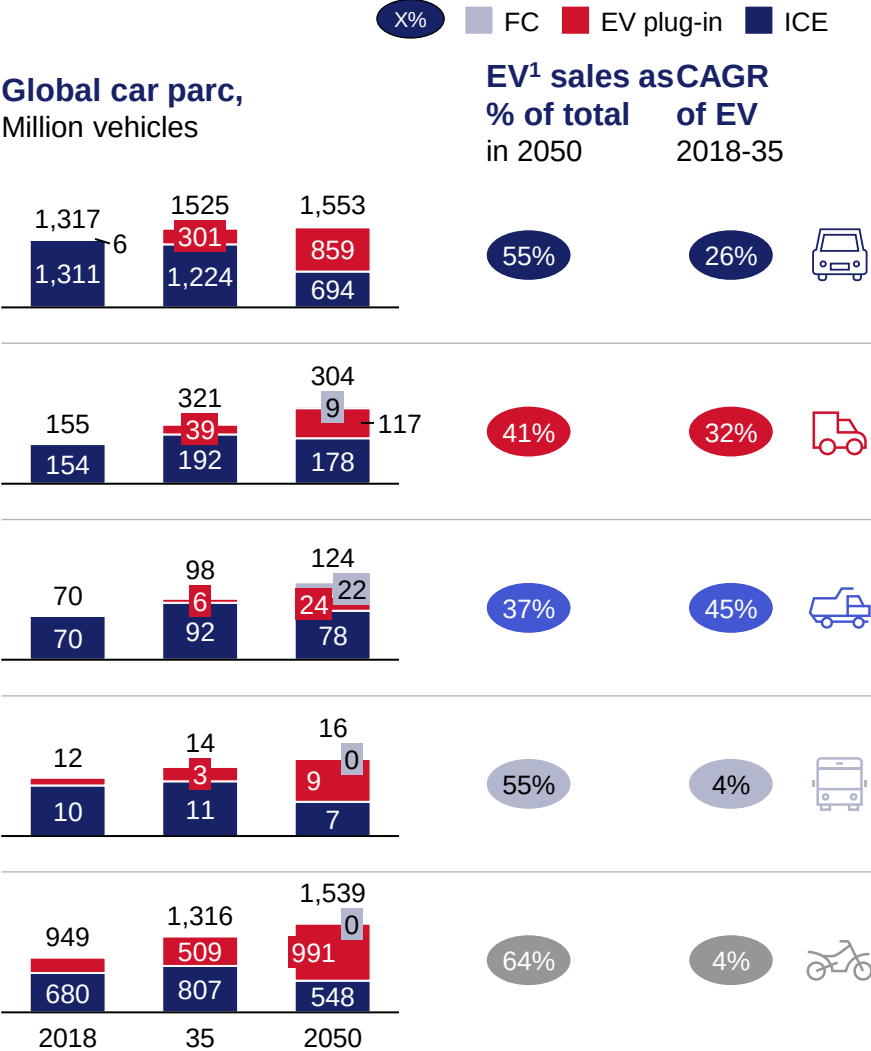
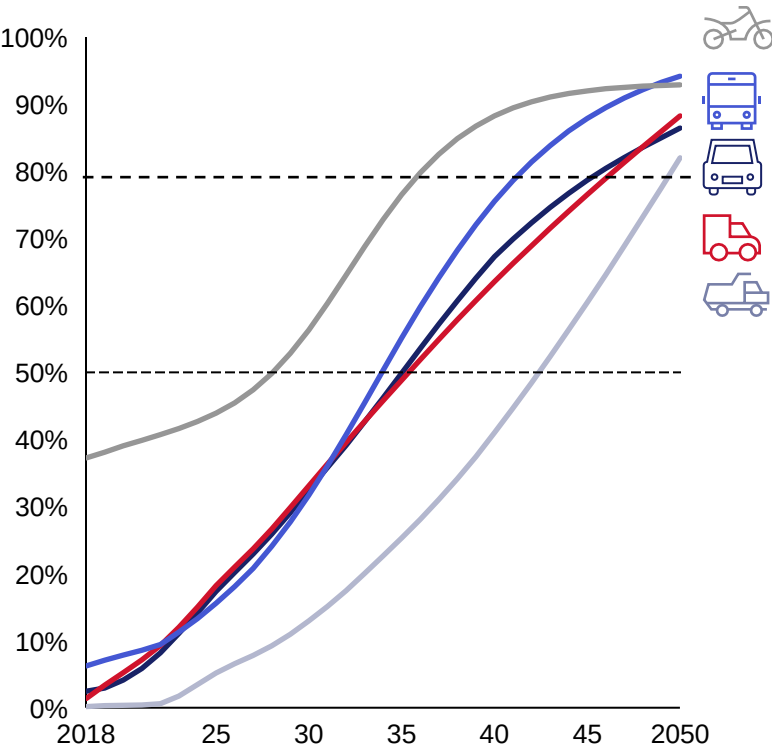
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Electric motorbike pilot

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 segment¹
% of global vehicle sales



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

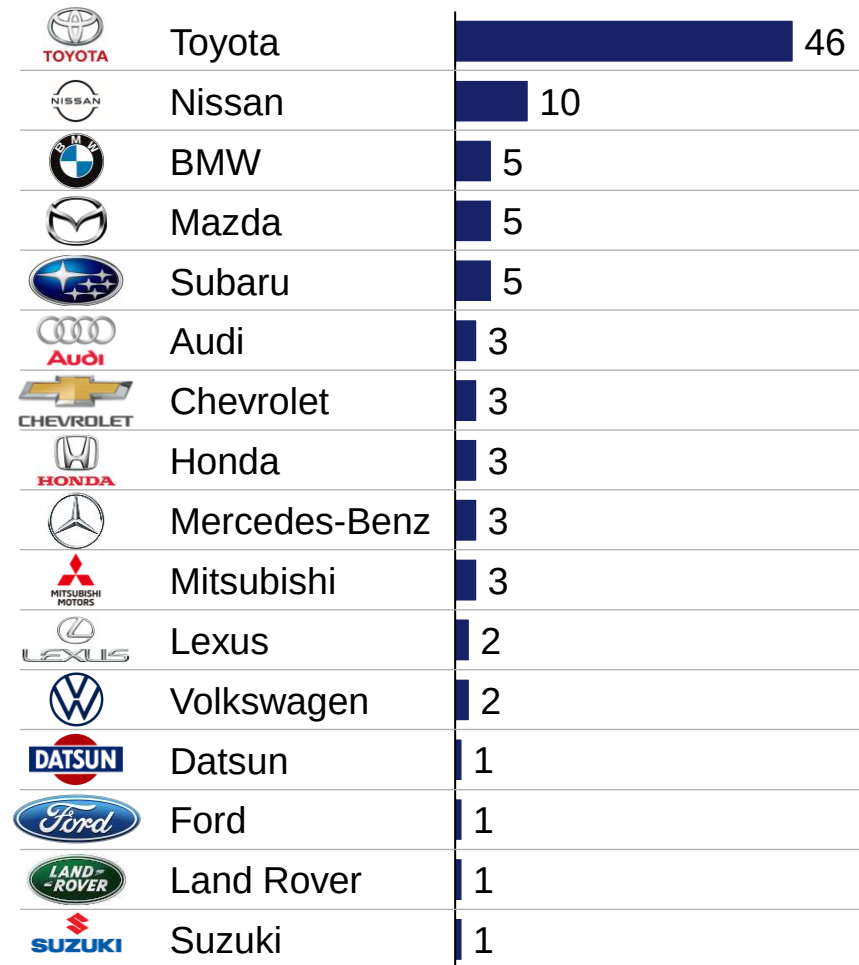
Electric two-wheelers (E2Ws) is the segment with the **highest degree of electrification today**, driven by the large number of E2Ws in China

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

2040 ¹
2030
Will reduce ICE by 50% from 2021
-
-
2035
-
2022 (in Europe)
2039 ²
-
-
2026
-
2040
Around 2036
-

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**

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 CO₂-free fleet by 2039; however, Mercedes-Benz could offer 100% electric cars as early as 5 or 8 years earlier

Source: Statista, press search

SSA¹ 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

Implications for e-mobility

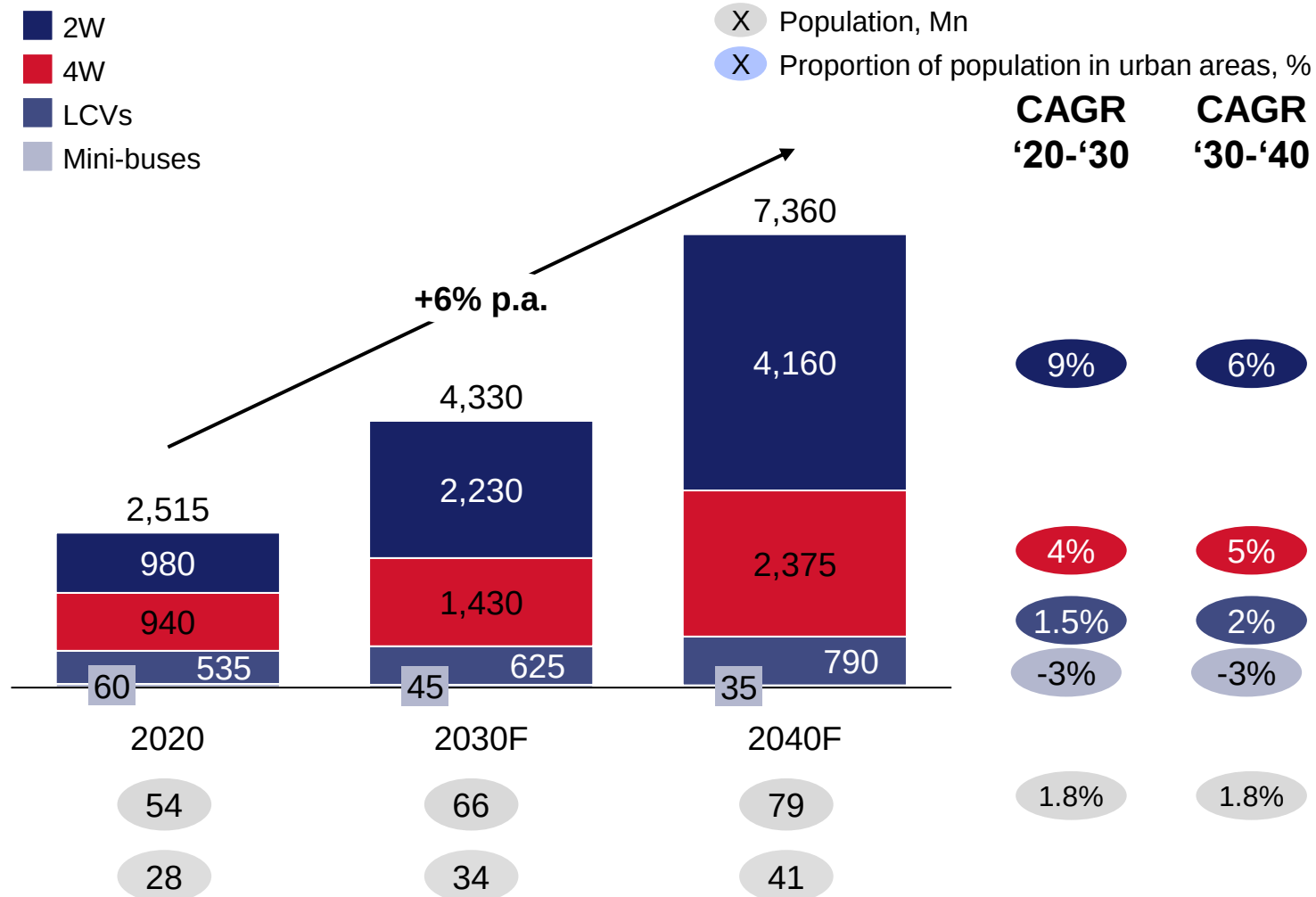
Current vehicle owners are mostly in **urban areas** and typically have **access to electricity**, which **supports EV adoption**

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



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			Notes
	High	Medium	Low	
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 alternative fuel sources	Sustainable alternative fuel sources available	EV adoption is more feasible if there is no sustainable alternative

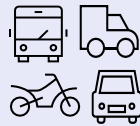
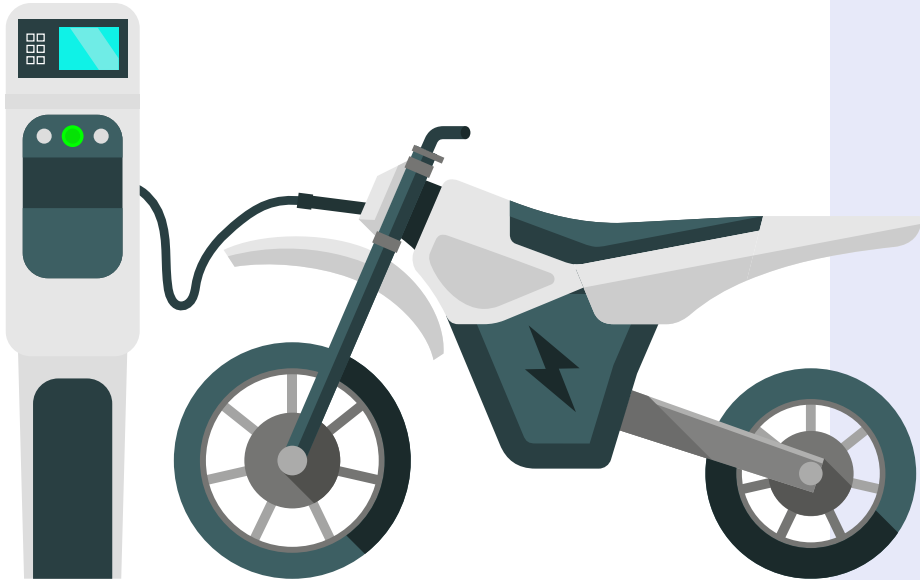
These suggest 2Ws are most feasible for EV adoption, followed by LCVs

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

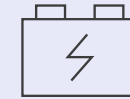
The potential of the EV market is driven by the underlying growth of the overall automobile market and expected EV uptake rates



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

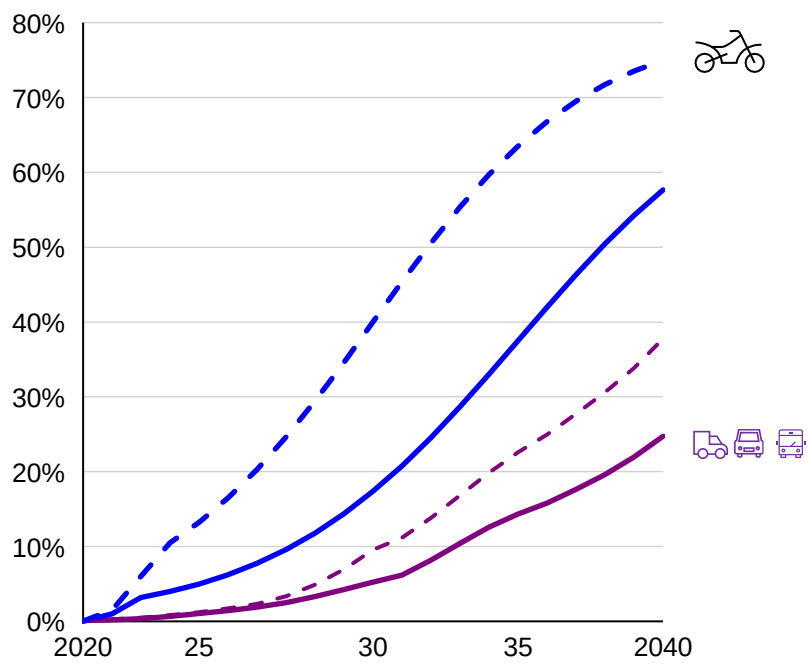


- Cost comparison between EV and ICE vehicle
- Operating costs
- Market maturity, considering:
 - Availability of charging infrastructure
 - Availability of appropriate EV models and spare parts

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

Electric vehicle¹ sales uptake by segment, % of vehicle sales

Other vehicles (Base case) 2W (Aggressive case)²
2W (Base case)
Other vehicles (Aggressive case)



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 **\$190-360m⁴**, 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 | 4 Average selling price or \$1500

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 infrastructure	Financial services	EV Rental	Examples
Importer – financier	⊙ Bodawerk locally assembles the battery	⊙ Imports CBUs	⊙	⊙	⊙ Offers vehicle financing on a lease model; some players offer unsecured lending		 
Assembler – financier	⊙ Imports CKDs and assembles locally		⊙	⊙ Provides tailored charging infrastructure	⊙	⊙ REM sells E2Ws without batteries, and then rents out batteries only	  
Pureplay importer or assembler	⊙ Either imports or assembles locally	⊙ Either imports or assembles locally	⊙	⊙ Provides tailored charging infrastructure			 
Pureplay vehicle financier model (not EV-specific)					⊙ Offers vehicle financing; some players offer unsecured lending		  
Distribution – financier			⊙ 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		

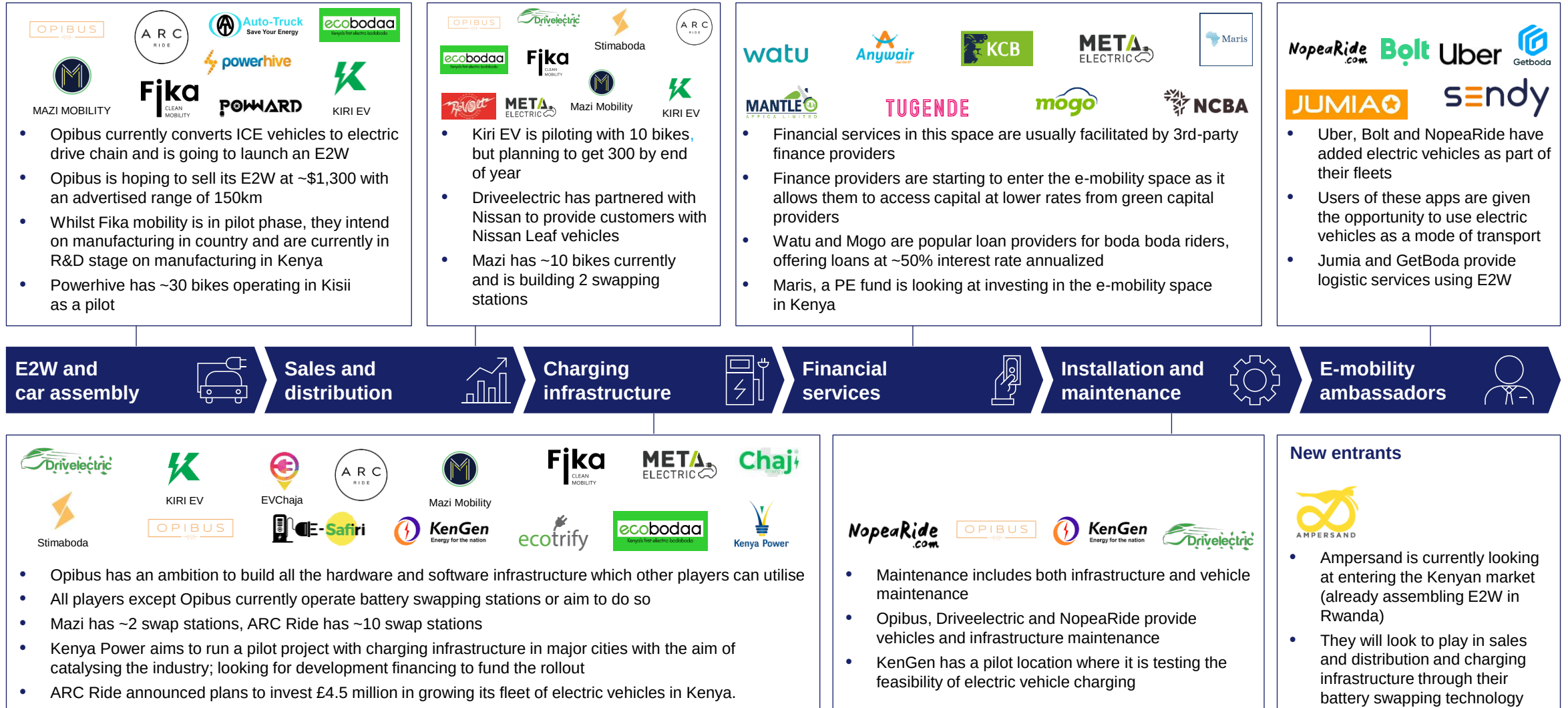
Key takeaways

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

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



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

Focus of this document

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

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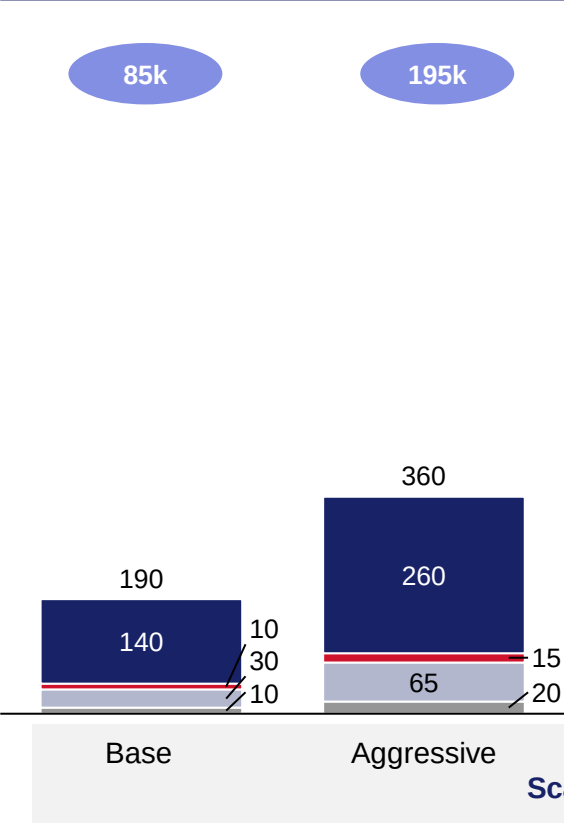
Appendix

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

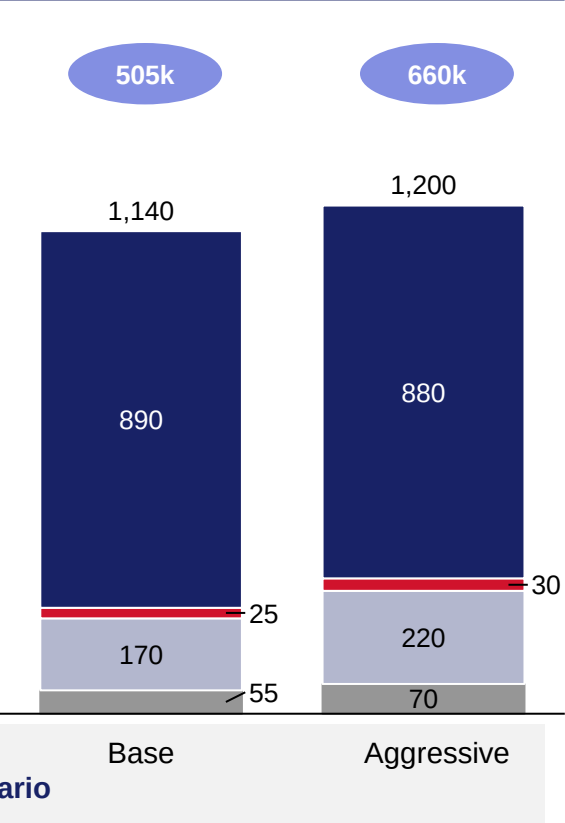
2030 chart not to scale with 2040 chart

Estimated revenue potential for E2W industry in Kenya

2030, \$m



2040, \$m



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**

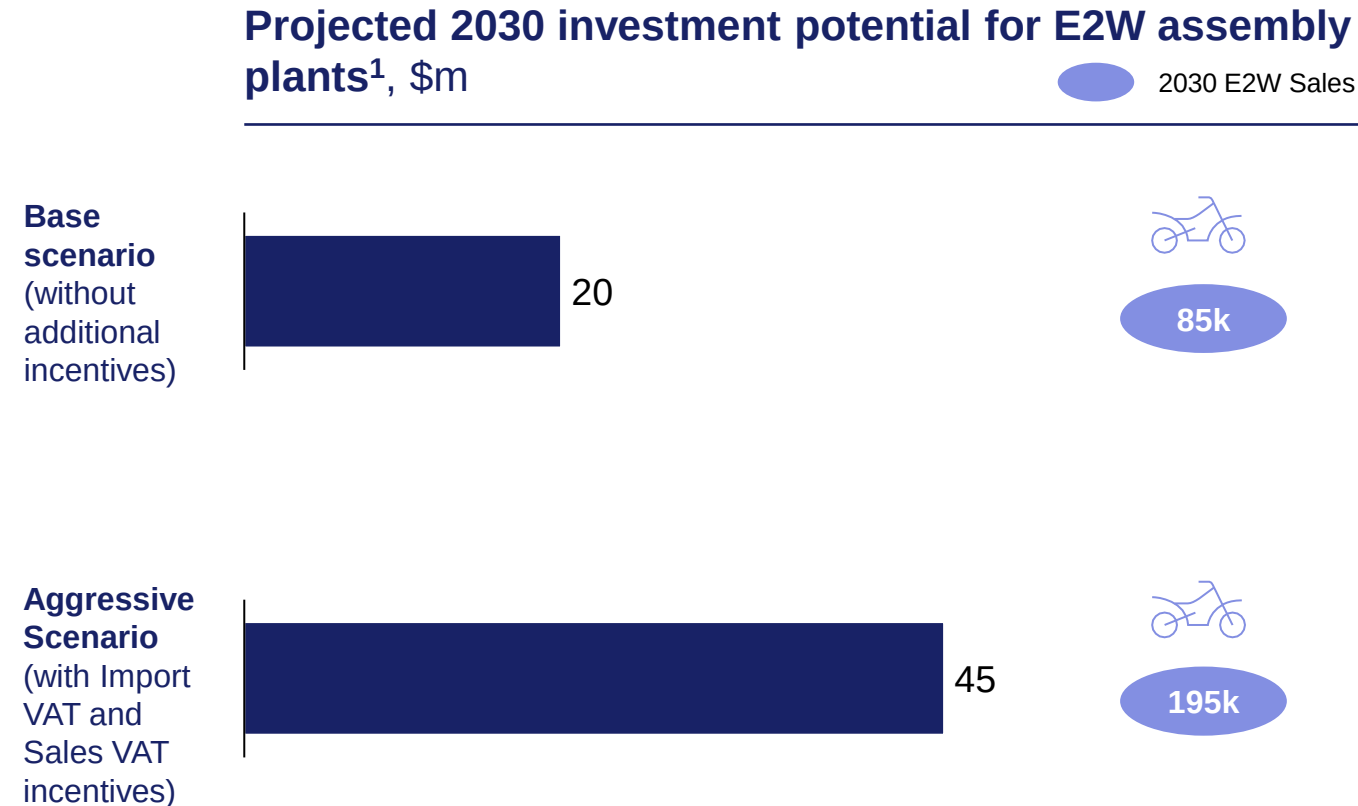
In 2040, **revenues** for the **E2W industry** market **could range** from **\$1.14-1.20b** **depending** on the scale-up **scenario**

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

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

Investment required for E2Ws in 2030, with and without incentives



Key insights



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

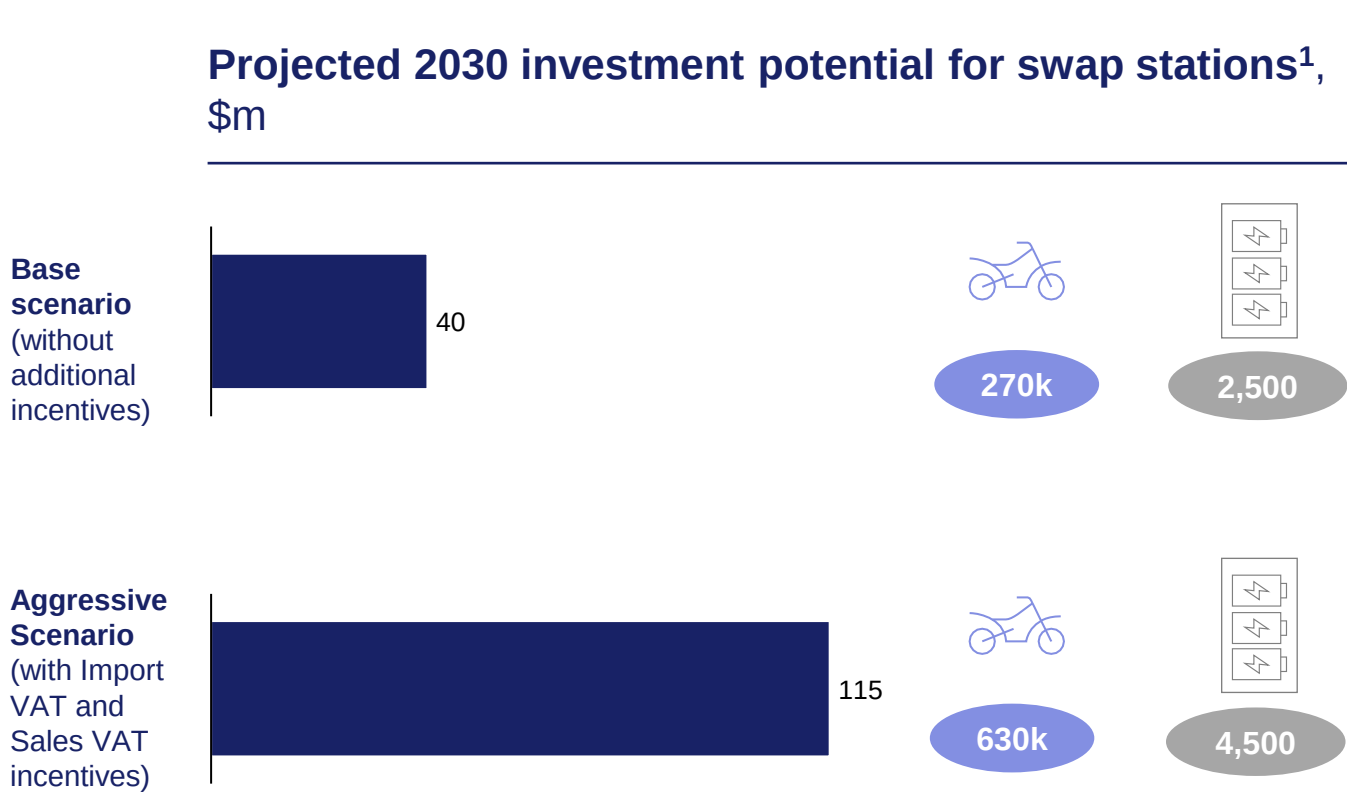
In 2030, investors can also expect:

- **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

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

E2W swap / charging station investment required for 2030



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

Increasing the E2W parc to ~50% of total 2W parc can decrease CO₂ emissions from motorbikes by ~46% in 2040, if all incentives are applied

ICE 2W emission intensity
2040³, million tonnes CO₂

E2W and ICE 2W emission intensity
2040³, million tonnes CO₂

● % E2W parc of total 2W parc ■ ICE¹ ■ E2W²



Key insights

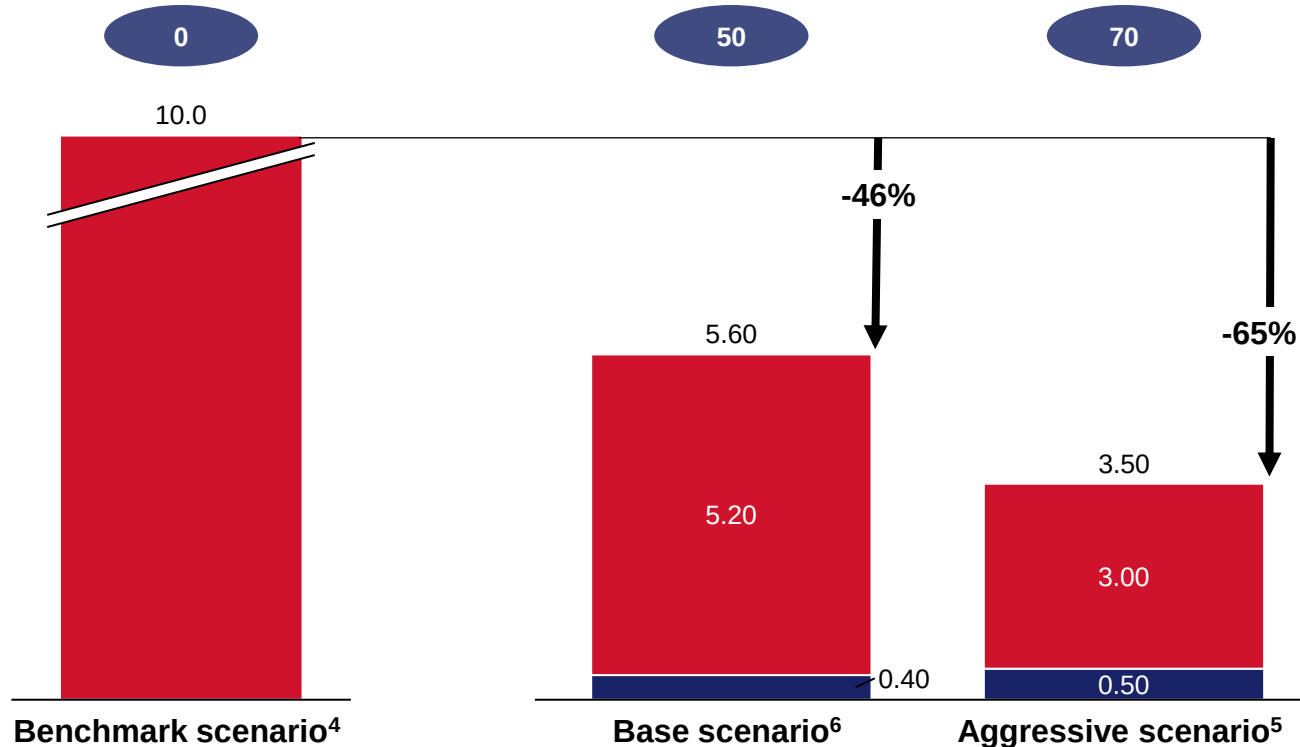
In the **base scenario**, increasing the **E2W sales to ~50%** can decrease CO₂ emissions from motorbikes by ~46% by 2040

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



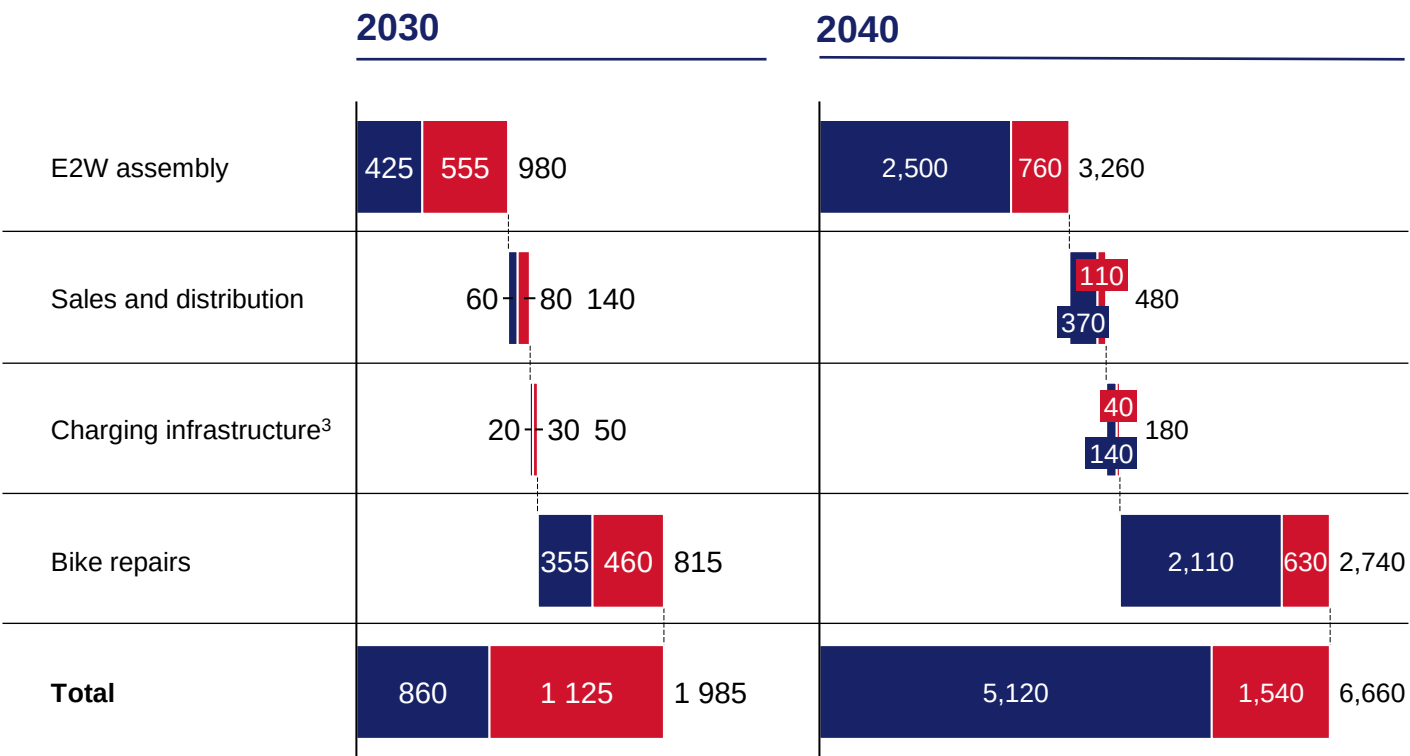
1. Assumes an ICE 2W CO₂ emission intensity of 113 gCO₂/km | 2. Assumes an ICE 2W CO₂ emission intensity of 8 gCO₂/km, grid emission intensity of 199 gCO₂/kWh, E2W battery efficiency of 0.04kWh per km | 3. Assumes that both ICE 2W and E2W travel 90km per day | 4. This scenario assumes there are no E2Ws 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

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

■ Jobs created with no incentives² ■ Additional jobs from incentives applied¹

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

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	Rwanda	Liberia
		
 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 	 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 	 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

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

2020 data

	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/ manufacturing	Driving side ¹	Degree of EV market activity	Electrification target	Nuance on vehicle segments
 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	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
 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	

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 stymie 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

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 exemptions	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

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

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

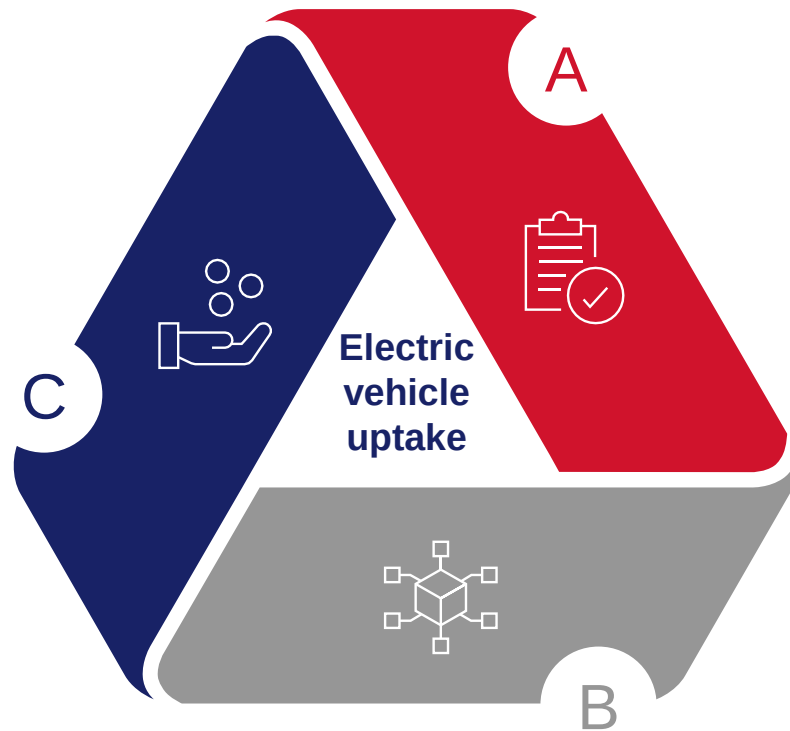
Laggard in EV scale-up

- **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



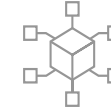
A



Regulatory push

-  Subsidies and incentives
-  ICE bans and restrictions
-  Fuel efficiency and CO₂ 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

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

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



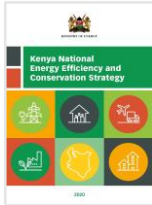
Local assemblers will only be able to scale up if **range anxiety is mitigated** by establishment of a **network of charging infrastructure**, including **battery swap stations** for E2Ws, and a broader **plug-in network** for EVs, especially across **long distances** interconnecting Kenya’s major cities 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

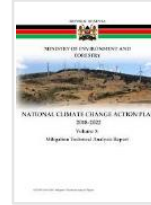
Green economy-related strategies:



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

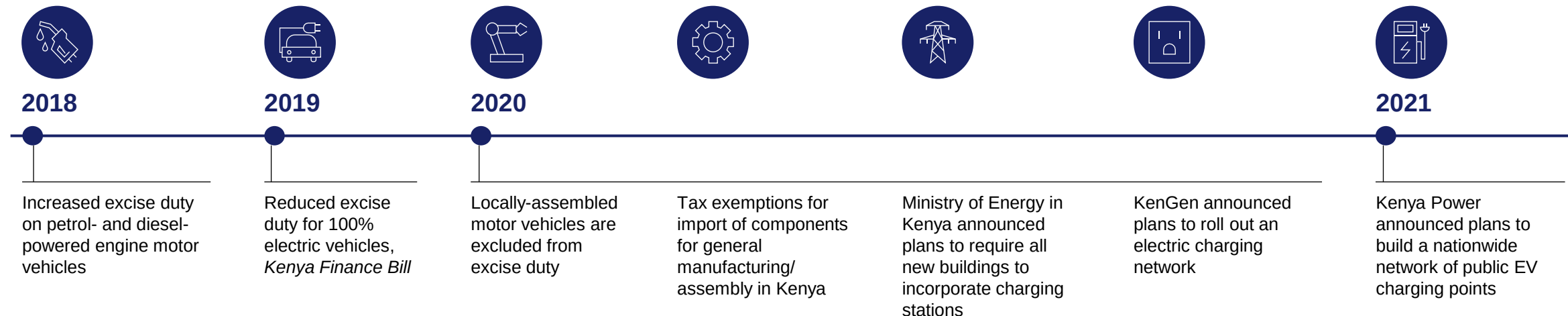


Updated Nationally Determined Contribution, 2022: commits to 32% reduction in CO₂ emissions by 2030 relative to business-as-usual scenario



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

Policies in place that support local EV assembly:



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



PRELIMINARY DRAFT

Industry stakeholder assessment on relative benefit: ● High ● Medium ● Low

✕ 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	●	
	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	●	
	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 (<i>solve KRA registration issue first</i>)	●	
	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	●	
	5 Sales VAT exemption or reduction (16% to 0% or 5%) on all EVs	●	
	6 Define KRA registration parameters¹ to allow correct application of excise duty for imported EV products (knock-down kits, full vehicles or parts)	●	
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	●	
	8 Avoid regulation of E2W battery standards but adopt charging station health and safety standards already well developed in countries such as China	●	

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"

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 ~31,000¹ 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 incentives² 	1 Define KRA registration parameters for imported EV products (knock-down kits, full vehicles or parts) 2 Demand incentives such as free parking for all electric vehicles and Green Zone access 3 Government procurement policy includes EVs 4 Import VAT exemption 5 Sales VAT exemption 6 Reduced electricity tariff for electric vehicles below the business price at charging stations 7 Extensive, fast and reliable charging infrastructure for E4Ws 8 Defined safety standards for charging stations	Ensure that E4W and spare parts are charged the correct Excise duty decreasing the overall price of the E4W Drive uptake of E4Ws by providing consumers E4W-specific benefits Send a powerful positive message to the public that E4Ws are a choice means of transport Bring the price of E4Ws close to parity with ICE , encouraging consumers to purchase E4Ws Bring the price of E4Ws close to parity with ICE , encouraging consumers to purchase E4Ws Reduce E4W charging cost , which can be the largest cost component for an E4W owner Alleviate E4W range anxiety for consumers who travel within cities and across large distances 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

Contents

EV potential aspiration and current landscape

The environmental and socio-economic opportunity

Critical enablers to support scale-up of local EV assembly

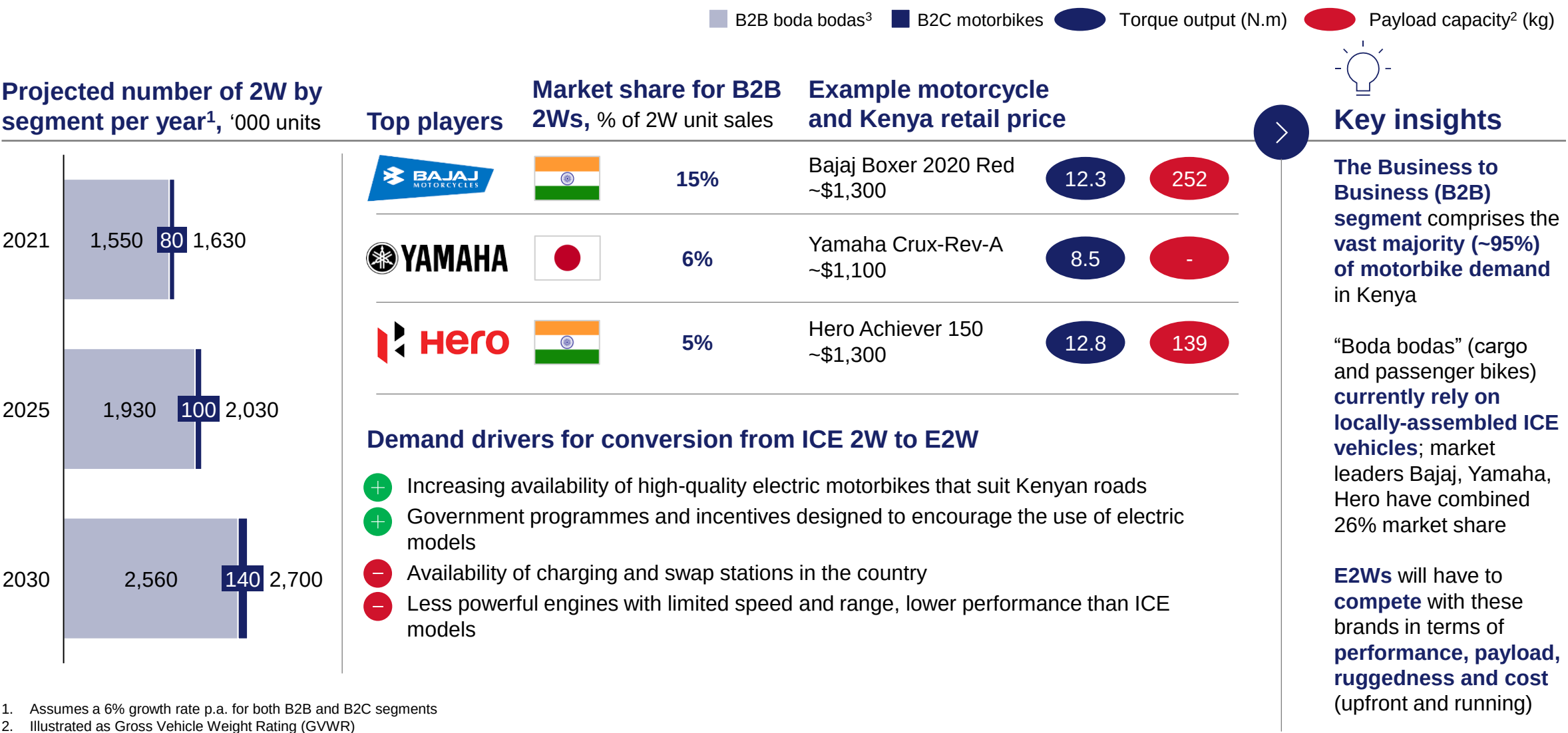
- **Making economics of locally-assembled E2Ws favourable**
- Establishing accessible and reliable charging infrastructure

Financing solutions

Electric motorbike pilot

Appendix

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



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 year



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



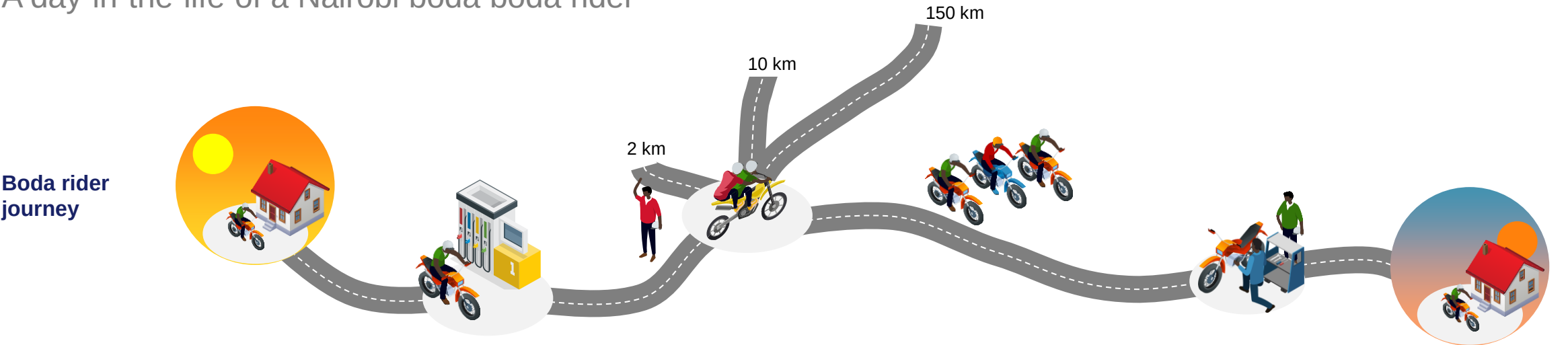
Long-lasting battery with conveniently located **battery swap stations** to ensure that work is not disrupted



Accessible through **leasing model** to ensure upfront cost does not act as a barrier to adoption

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

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**?

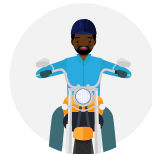


“
Will the **electric motorcycle** be able to **handle heavy loads**?



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

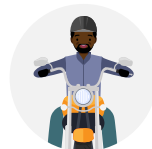
... but were quickly excited by the E2Ws and potential benefits ...



“
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**



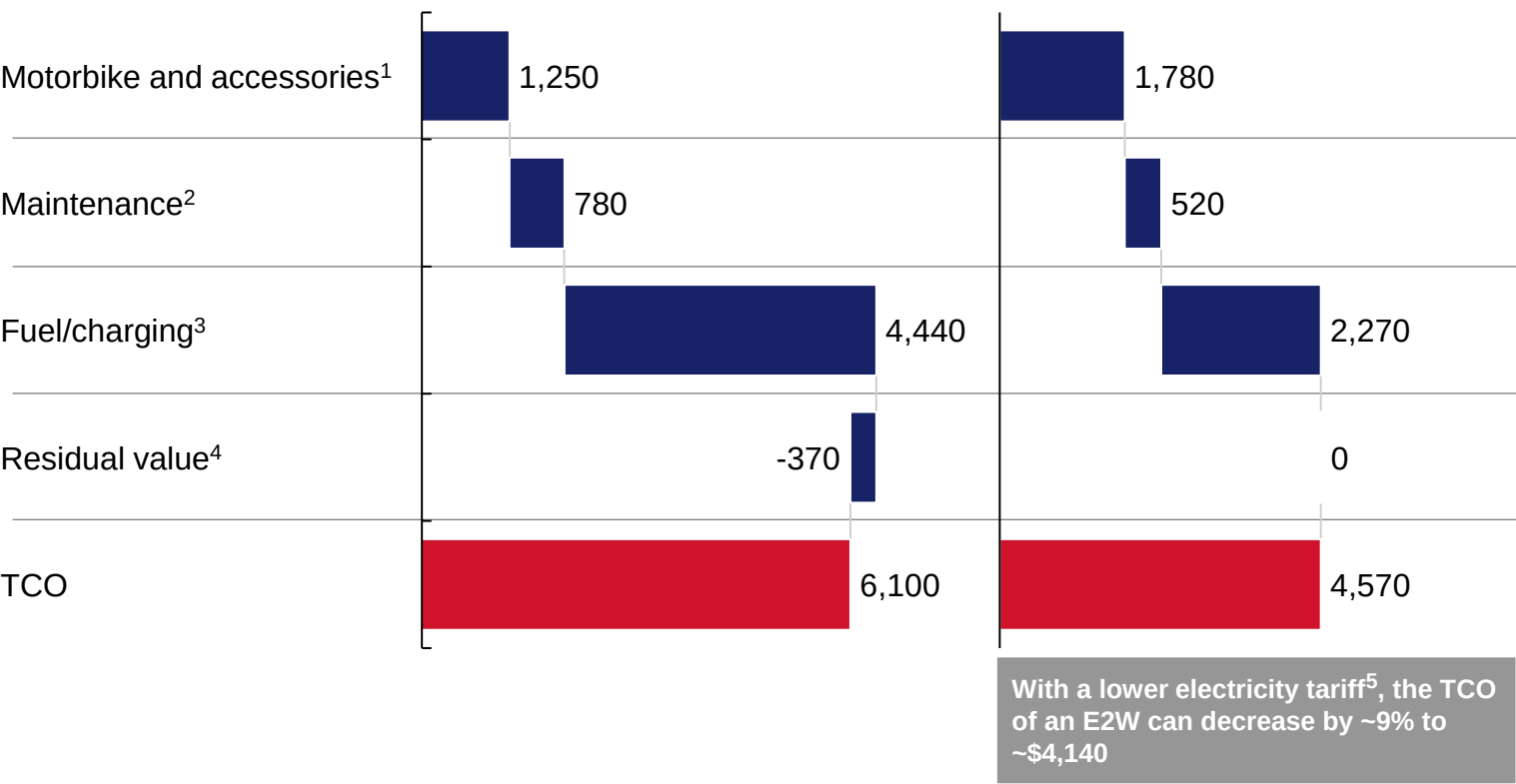
“
I usually spend between **1-2 hours** per day **idle waiting** for customers, so could **charge during this time**, especially if **swap stations** are **placed at stages and petrol stations**

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

Locally assembled ICE, \$

Locally assembled E2W, \$



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 tariff⁵**, the **TCO can decrease by a further ~7%**

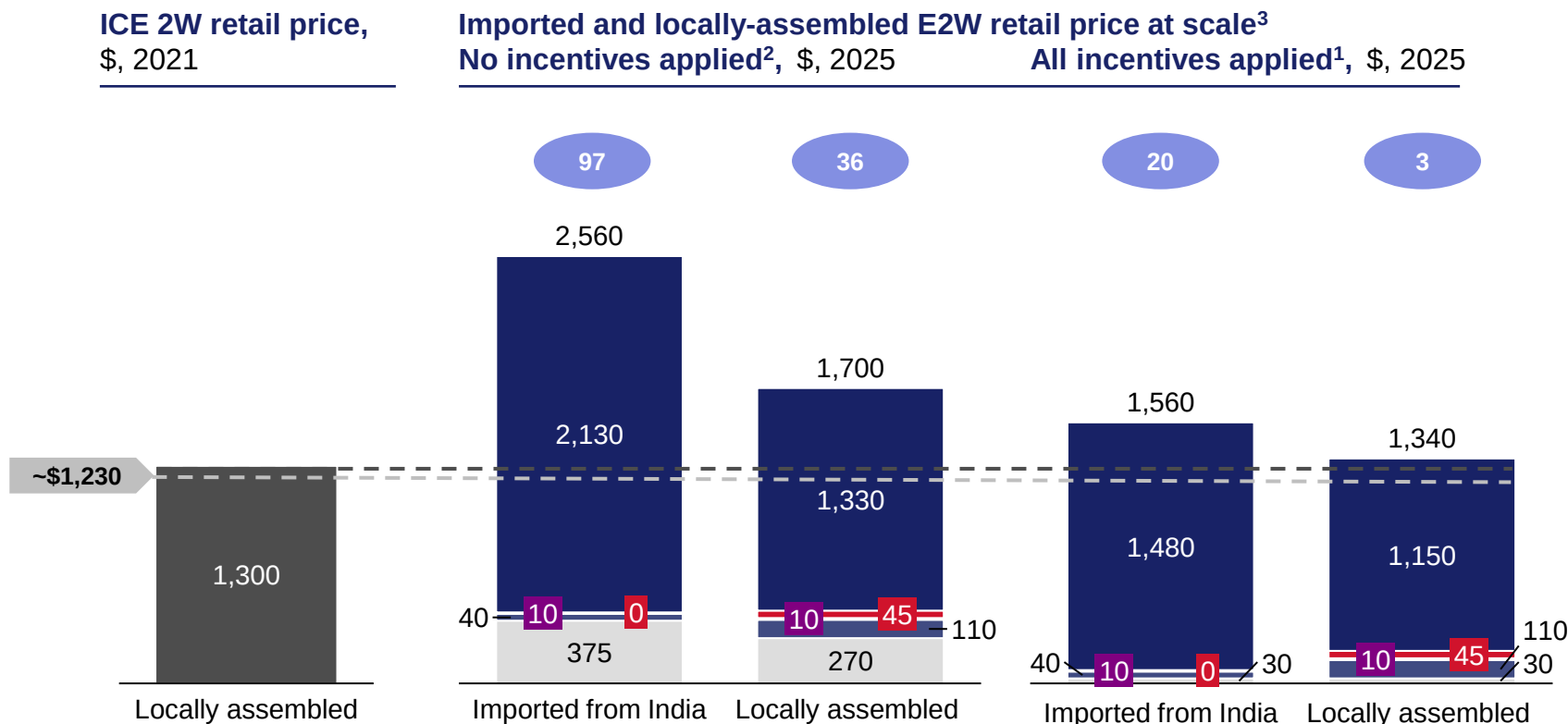
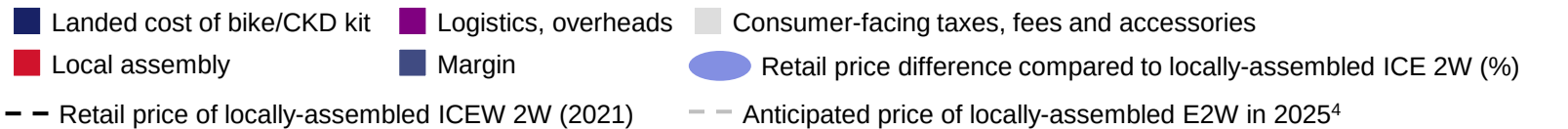
This is driven by **lower maintenance** and **fuel/charging costs** (~33% and ~50% lower, respectively) of an E2W compared to an ICE 2W and with a **lower electricity tariff⁵**, Boda riders can **save up to ~58% on fuel costs**

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

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		USD	Details	Implications for E2W	
Costs	Revenue ¹	40,000	370	Assumes total revenue of KES 2,000 (\$18.5) per day	Revenue likely to be equivalent for E2W
	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	

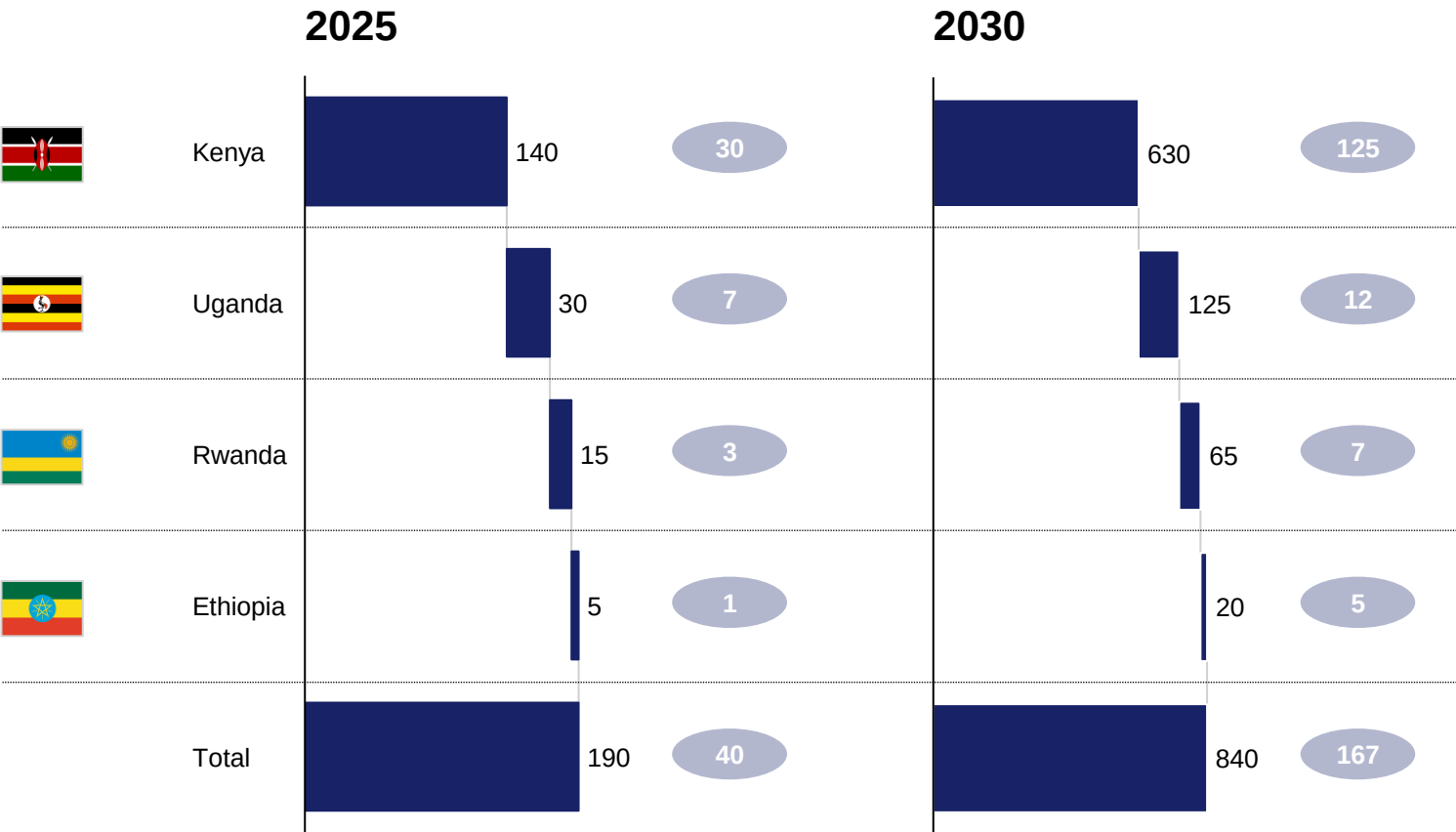
1. Revenue target of KES 1,500 per day plus KES 500-1,500 potential extra
2. Assumes monthly loan repayment cost of KES 2,308 per week
3. Assumes rider works 5 days a week
4. Motorbike taxis that do not use online ride-hailing apps
5. Assumes that electricity tariff decreases to at least street lamp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

Source: Industry expert, Boda rider focus groups

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**

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 parc¹ 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 origin¹ certification** for the export product
- The **preferential tariff³** 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 E2W² 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**

- Rules of origin are criteria to determine the local value addition of a product to be exported
- 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
- 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 at specifically

Source: Expert interviews, EAC rules of origin manual

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 from 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

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

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Globally, E2Ws have yet to have standardized batteries

Battery standards for various regional E2W players

Battery specifications	E2W company and main location				Standards overlap
	 Chinese Mainland	 Taiwan	 India	 Italy	
Power	60 V 35 Ah	1.3 kWh	1.5 kWh	2.3 kWh	
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	
Communication protocol	N/A	App to monitor battery health, charging progress and battery location	Cloud-connected app that monitors battery performance	N/A	
Weight and dimensions	~10 kg (W) 18cm x (L) 30cm x (H)14cm	~9 kg	~12 kg	~15 kg	
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	

Source: Press search, company websites

Degree of standards overlap:  Medium  Low

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**

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: - GB (DC)  - 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: - Slow 5 amp (type D) or 15 amp (type M) wall outlet without communication function to the on-board charger of the EV  - Fast AC Bharat AC-001  - Fast DC Bharat DC-001 	Four technical standards for fast charging: - CHAdeMo (DC)  - Combo 2 CCS (DC)  - Tesla Supercharger (DC)  - 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 Kenya 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

PRELIMINARY DRAFT

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

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

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

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
		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 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 and Volkswagen have both repurposed retired EV batteries from their used cars and used them in automated vehicles within their factories
<i>Confidential</i>		A Kenyan start-up is using retired batteries for solar powered street lighting and other rural needs

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**

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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 financier 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 (<i>also applies for swap station battery imports</i>)	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) – <i>typically requires ~\$40-50M to be viable</i>	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

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:



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

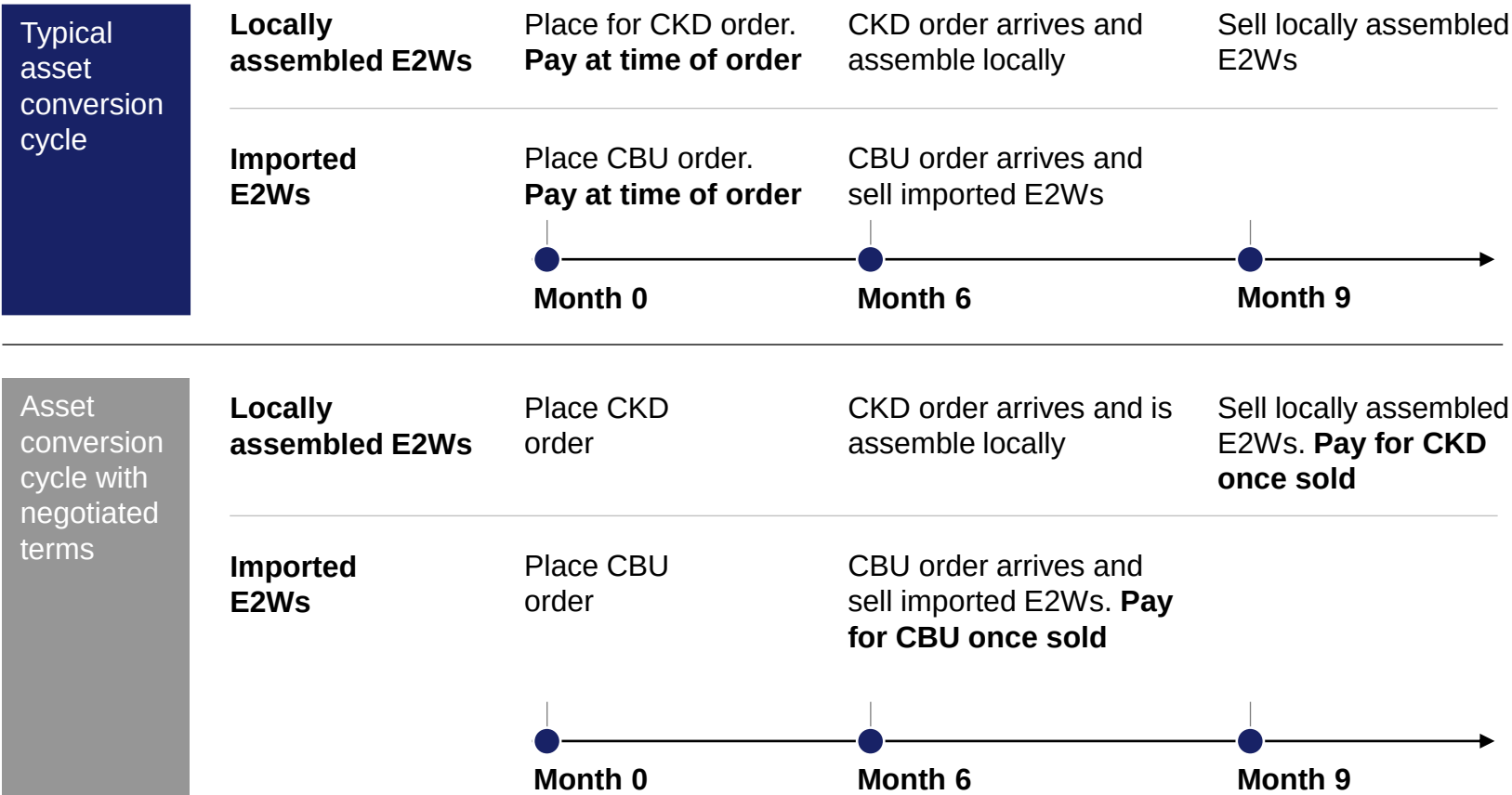


Develop local VCs

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

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:

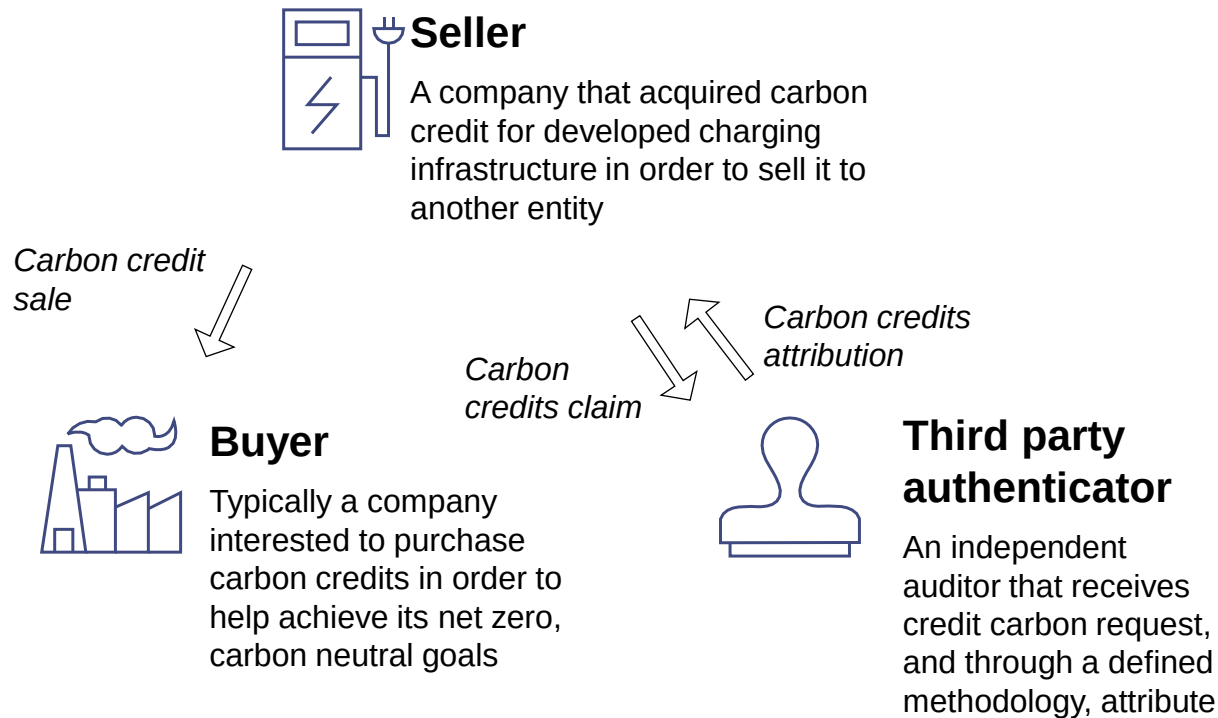


Shell Foundation |

Carbon credits are emerging as a financing mechanism for charging infrastructure

Mechanism and early insights

Mechanism



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

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	  
	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	 
	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	    

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

	Immediate term  <i>(to be implemented within next 1-2 years)</i>	Medium term  <i>(to be implemented within next 2-5 years as market grows)</i>
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	

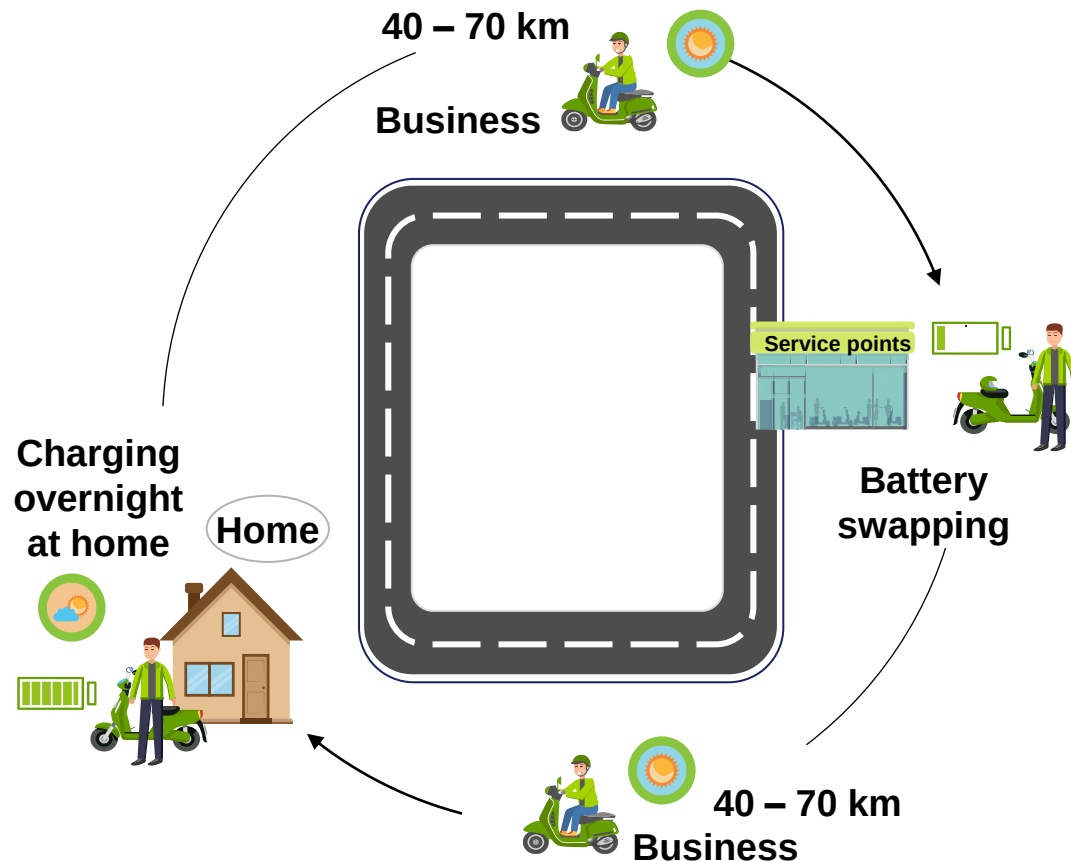
5 initiatives are possible to make swapping/charging business case viable

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

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**

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Case study: 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
- **Partners:**



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)

Analytical outcomes

- **Validated the economics** of going electric – riders could make 35% more, owing to savings on charging and maintenance – and showed that **riders fully understand the potential cost savings** of going electric
- Highlighted that **electric motorbikes being made in Kenya perform as well as, if not better than, petrol motorbikes**, in the opinion of the riders themselves, , with >90% of responses saying the E2W performed as well or better than the ICE 2W on almost all dimensions and terrain¹
- Demonstrated that, **once riders try an electric motorbike**, they are **highly likely to buy** one as their next bike and **recommend** them to other riders (100% likely or very likely to buy an E2W as their next vehicle)
- Confirmed that riders' **main concerns** are upfront **cost** and **range anxiety**

Publicity outcomes

- **Launch event**, hosted by the **British High Commissioner** and attended by **CS of Industry** and **PS of Transport** was **broadcast** on **Citizen TV news**
- **Videos** curated by MA were spread across **multiple social media channels** in Kenya and beyond

1. Speed was the only dimension rated lower at ~70% saying it performed as well or better; this was correlated to the placement of the motor with the hub motor E2Ws performing worse but mid-engine motors performing as well or better than the ICE vehicle

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

Within 2 weeks, riders were convinced of the favourable economics

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

- “ ”

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
- “ ”

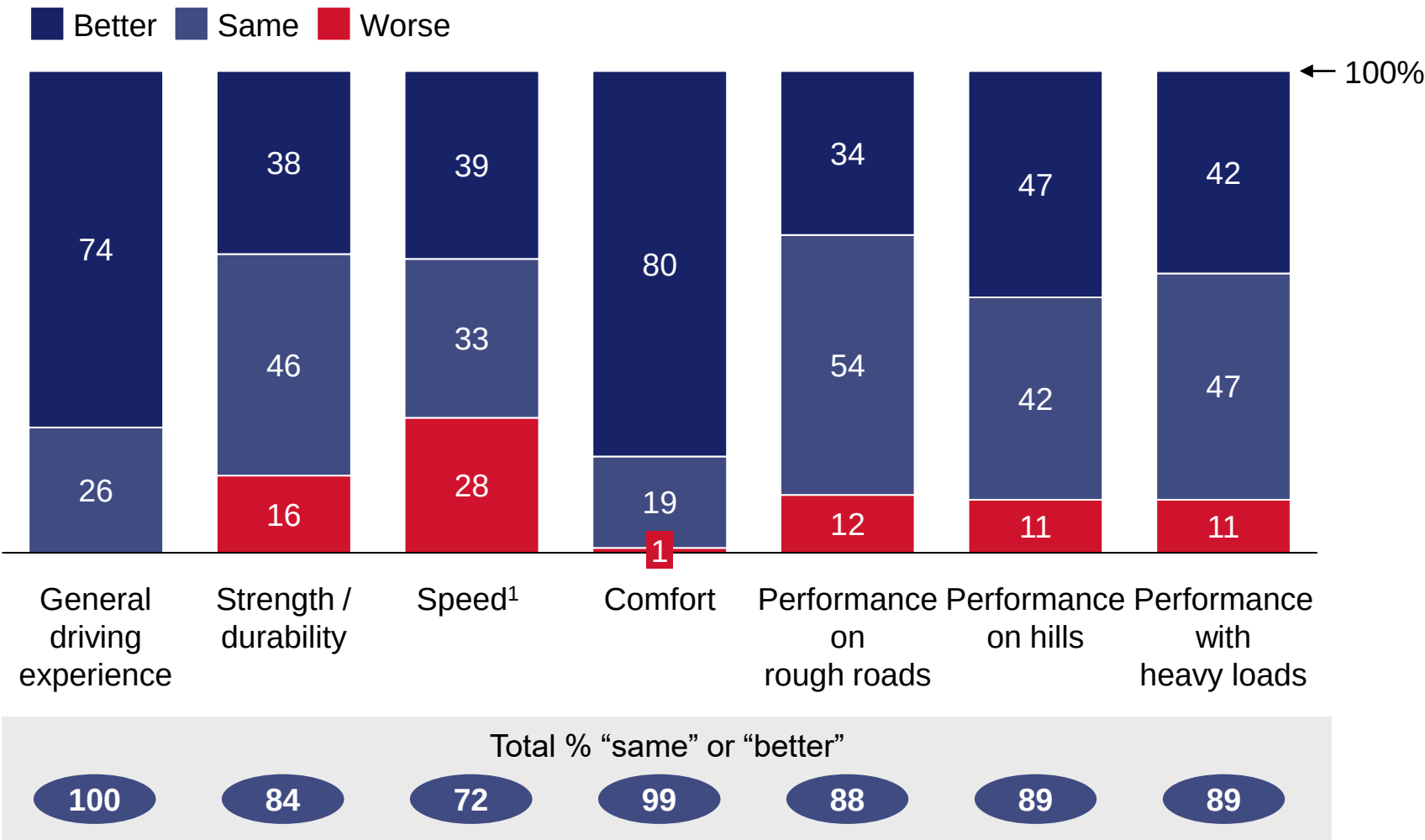
I **make as much money** as when on a petrol bike but **costs are lower**
- “ ”

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**

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

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**”

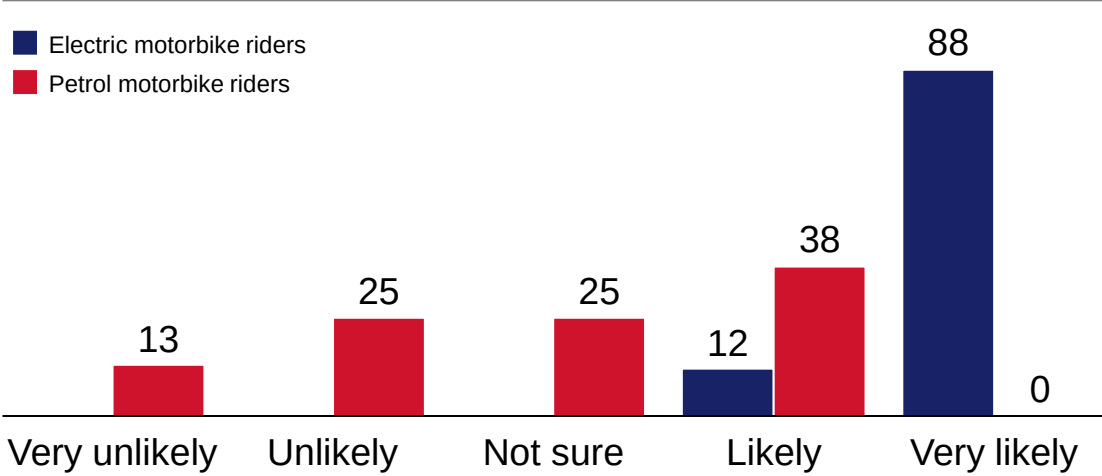
“**Performance on rough roads is better** as the **bike is lighter**”

“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

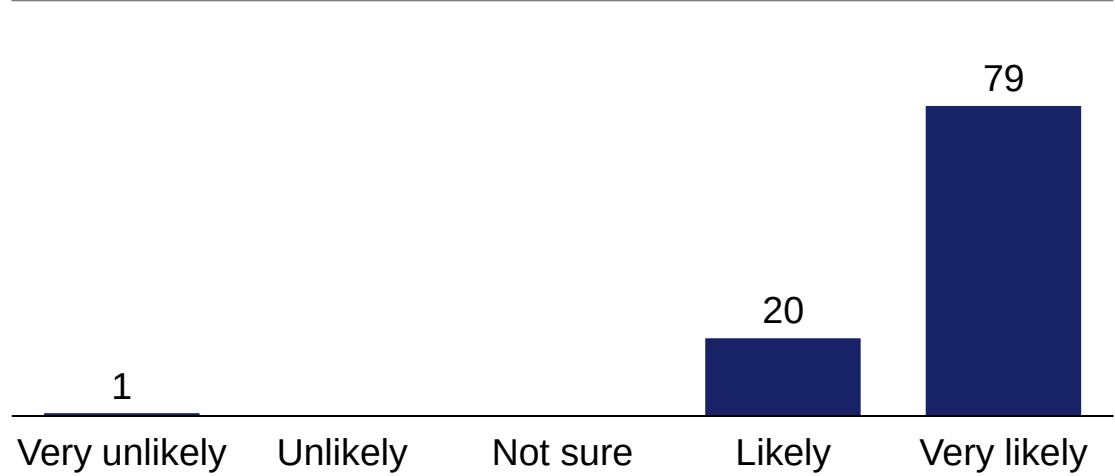


“ ”
The bike is **comfortable, saves money**, contributes to **less pollution** and is **less noisy** – I **won't be going back to my petrol bike**

“ ”
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

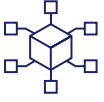
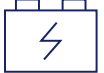
% likelihood of riders recommending an electric motorbike to another rider



“ ”
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**

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

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

Survey results from riders, assemblers and other pilot partners¹

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

Photos from the pilot



Long video link -

<https://www.youtube.com/watch?v=K-L0NSG69Qc>

Viral video link -

<https://www.youtube.com/watch?v=25IRjBdS36Y>

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



MA Project Manager (Chania Frost) moderating a panel of local assemblers



BHC High Commissioner Jane Marriot opening the launch event



Interviewing two electric motorbike riders



Pilot was featured in local newspapers as well as on Citizen TV



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



CS Hon. Betty C. Maina, EGH



The Kenya TA Manufacturing Africa team



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

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

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) <i>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</i>	4 hours	Fast (30 minutes)

Implications

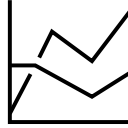
- Most **2W and person-use 4W owners drive short enough distances that Level 1 or battery swap stations should be sufficient for charging**
- Commercial drivers (of 4W taxis, LCVs, or matatus) might also be able to use Level 1 charging as long as they drive <150km/day and are able to charge ~8 hours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

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)

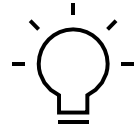
Consider that supply of EVs may be constrained in the short-term but unlikely in the long term

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

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 infrastructure 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

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 states 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

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%**



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 motorbikes 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 CO₂ emission targets

Decrease vehicle CO₂ emissions to **117g CO₂/km in 2020**

N/A

Decrease vehicle CO₂ emissions to **134g CO₂/km by 2022**

Passenger car standards are mandated to **95g CO₂/km for 95% of vehicles in 2020** with **100% compliance in 2021**
The **light-commercial vehicle** standards are mandated to **147g CO₂/km of CO₂ in 2020**

Cut carbon emissions from ~ **55.1g CO₂/km for ICE motorbikes to ~13.3g CO₂/km for electric motorbikes by 2025**

Kenya **commits to 32% reduction in CO₂ emissions by 2030**

No specific targets for vehicles



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

All-electric, fuel-celled autos and plug-in hybrids account for more than **20% of total car sales by 2025**

Taiwan

N/A

India

2030 aspiration set at 30% of electric-four-wheelers (E4W), **80% E2W, 70-80%** in commercial vehicles

Norway

Fully electric vehicles now make up about **60% of monthly sales** in Norway
Government aims to have **100% sales by 2025**

Rwanda

N/A

Kenya

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

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...



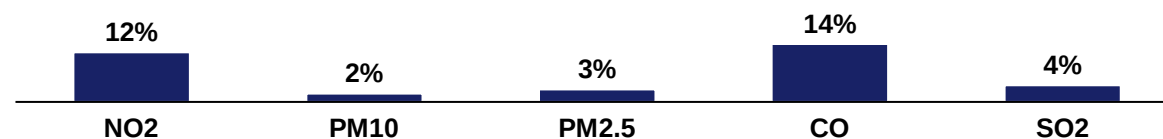
Some cities/countries are already experiencing benefits of electric vehicles on air quality...



In Spain...

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

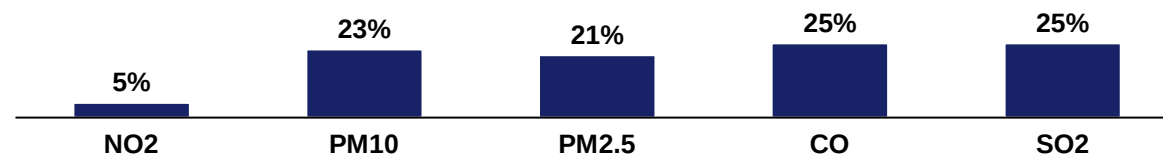
Potential pollutants concentration reduction, (%)¹



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

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

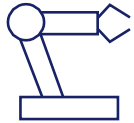
PRELIMINARY

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 parts¹
 - 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

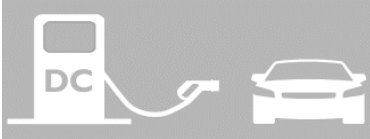


- **Customs Bonded warehouse** is a warehouse **licensed by the Commissioner of Customs** for the **storage of goods** imported into Kenya pending the **payment of duties**
- To receive a bonded warehouse license the owner must:
 - Submit an application with a plan of proposed building and its relation 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

Three modes of charging for EV are relevant globally

	Charging modes for NEV ¹	Connection mode to AC network	Application
Slow Fast	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

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

		Mode			
		4 (Fast)	3 (Mid)	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

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; Instruments: 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 governments and 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, infrastructure, 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, food & water, and Energy	Mainly emerging countries
 European Investment Bank (EIB)	Multilateral Development Bank	Largest International Financial Institution in the world and one of largest providers 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

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

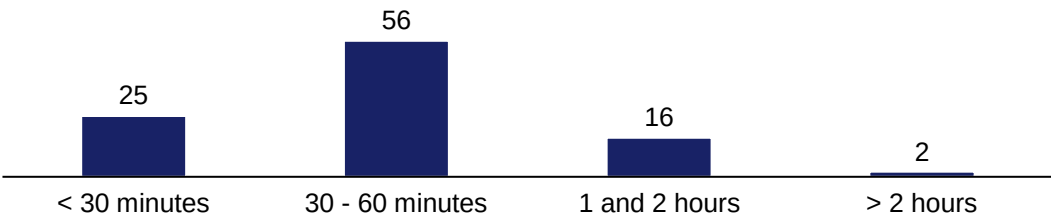
Investor name	Type	Description	Sectoral focus or sector in portfolio	Regional focus	
 Investment Fund for Developing Countries (IFU)	Development Financial Institution	Development Financial Institution owned by the government of Denmark; Instruments: loans and equity	Includes investments in power (recent investment in largest African wind farm), cement, chemical industry	Europe, Asia, Latin America, Africa	
 Standard Bank	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	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 primarily 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	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	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	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	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	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

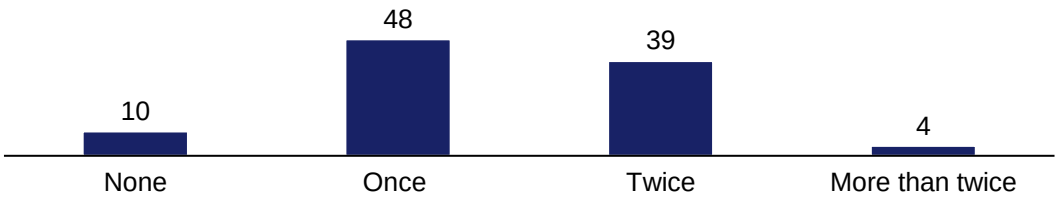
Riders spent ~30-60mins between trips waiting for a new trip

Time spent waiting between trips, % of all responses



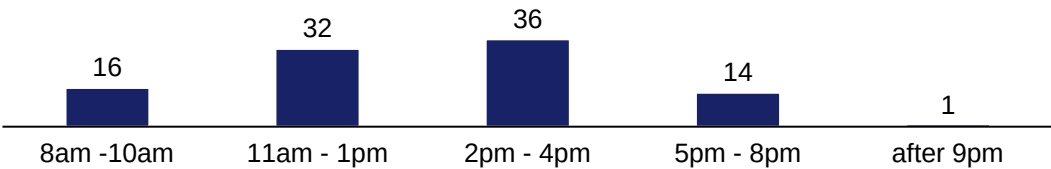
On average riders swapped batteries at least once a day

Number of battery swaps per day, % of all responses



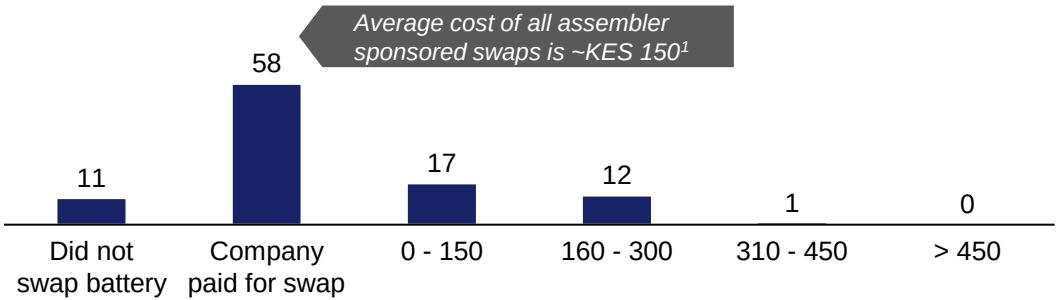
Most swaps occurred between noon and early afternoon

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



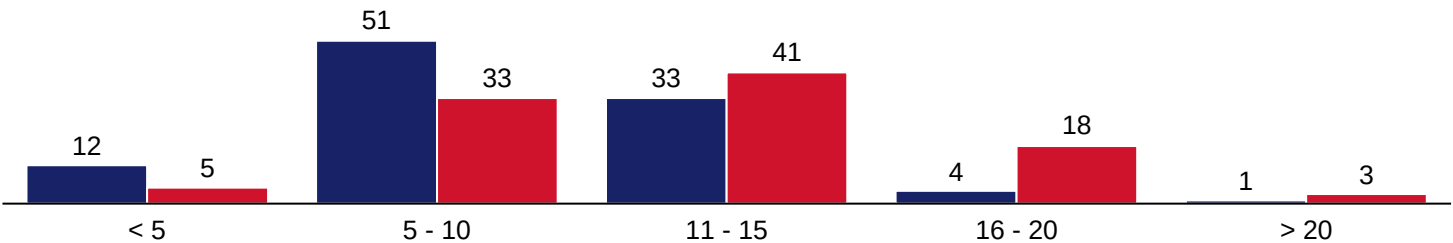
1. Assumes that assembler transfer cost of swap to rider

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

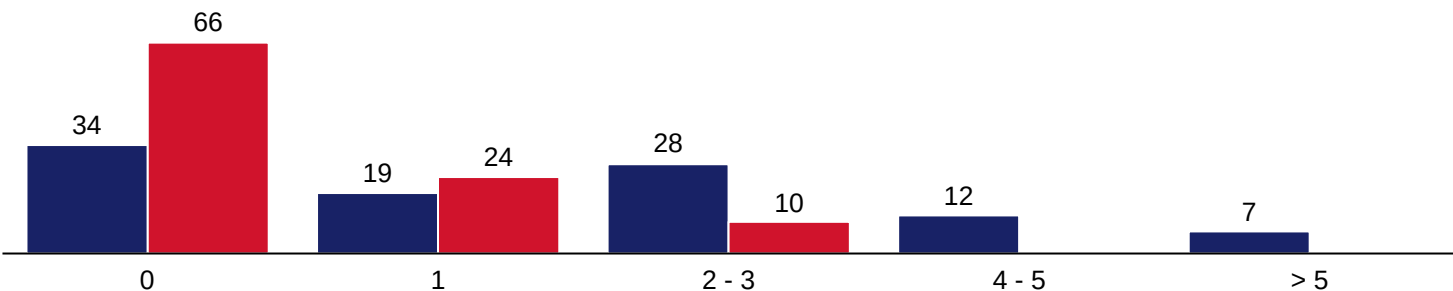
Electric motorbike riders did fewer trips than petrol motorbikes but...

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



■ Electric motorbike riders ■ Petrol motorbike riders

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

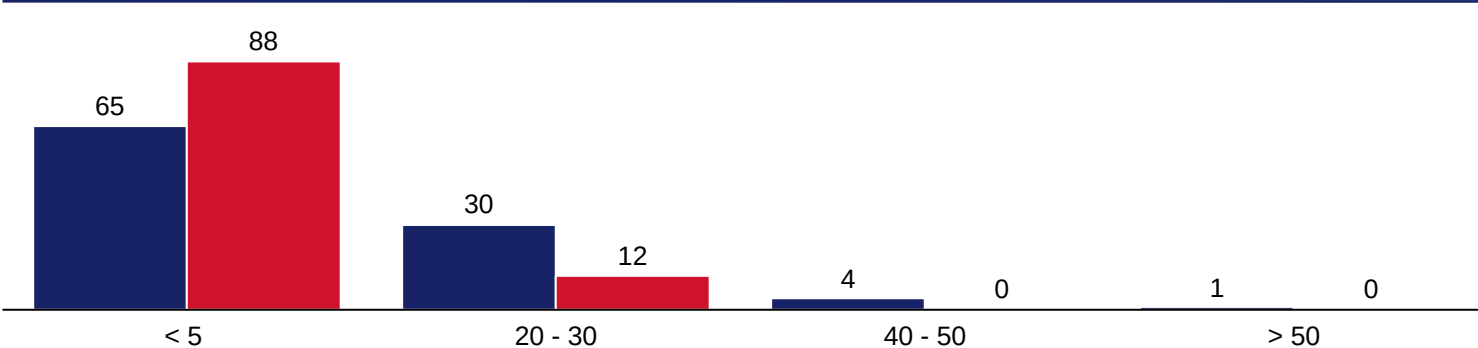
This further **validates** the **positive reactions** to the **electric motorbike performance** being rates as the same or better than petrol motorbikes

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

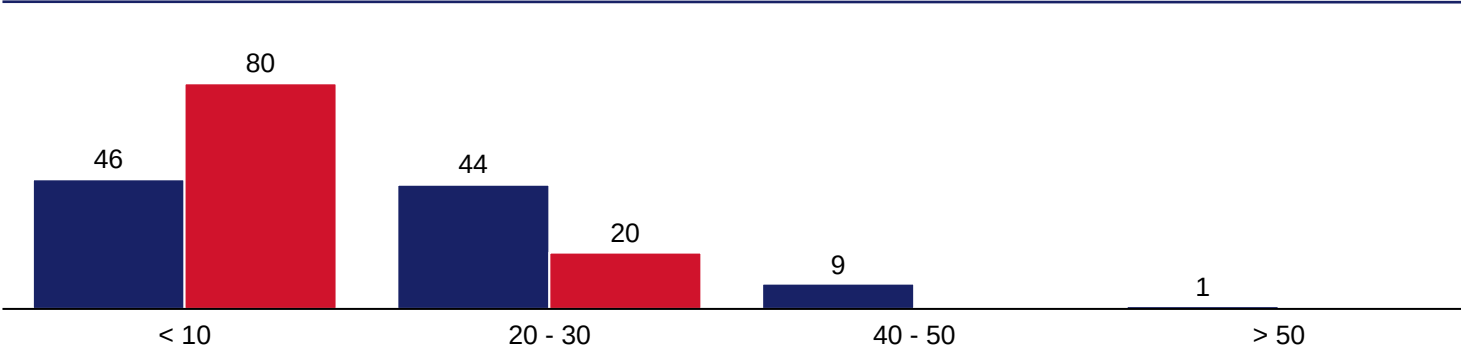
Electric motorbikes spent more time on rough roads...

% of time on rough roads, % of all responses



...and on hills than petrol motorbikes

% of time on hills, % of all responses



■ Electric motorbike riders ■ Petrol motorbike riders

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

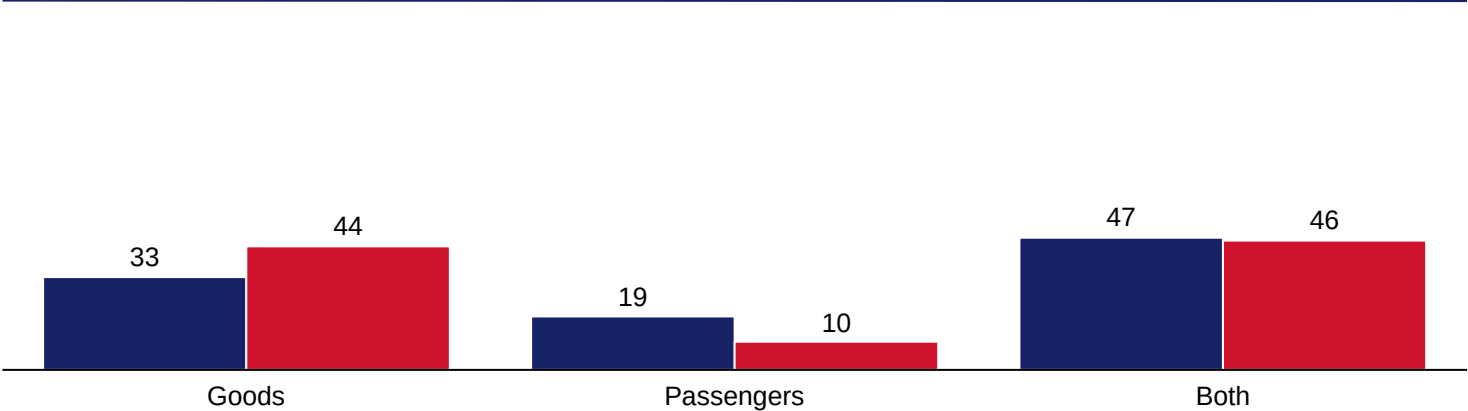
This further **validates** the **positive reactions** to the **electric motorbike performance** on difficult terrain being the same or better than for petrol motorbikes

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

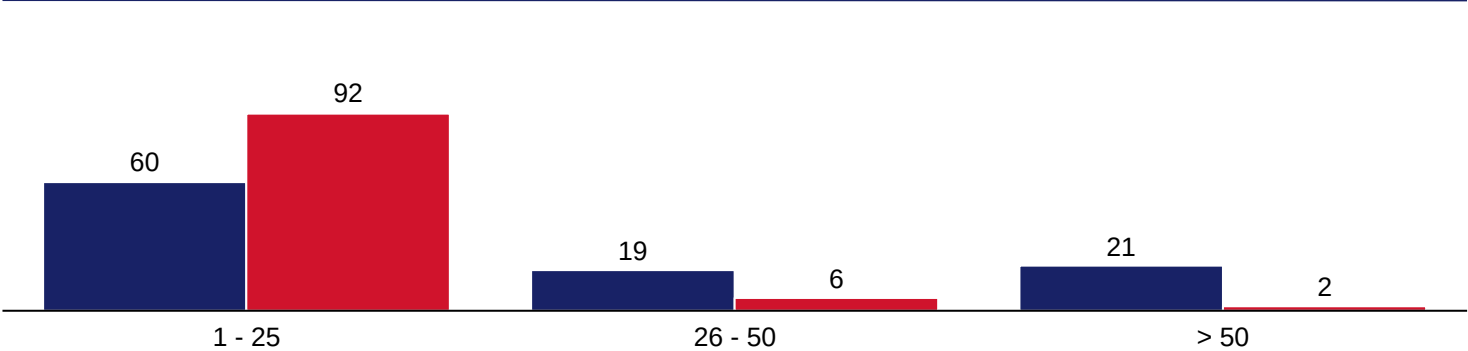
On average, electric motorbikes carried more passengers than goods

Delivery / passenger rider split, % of all responses



Electric motorbike riders transported heavier goods

Weight of goods in kg,% of all responses



■ Electric motorbike riders ■ Petrol motorbike riders

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

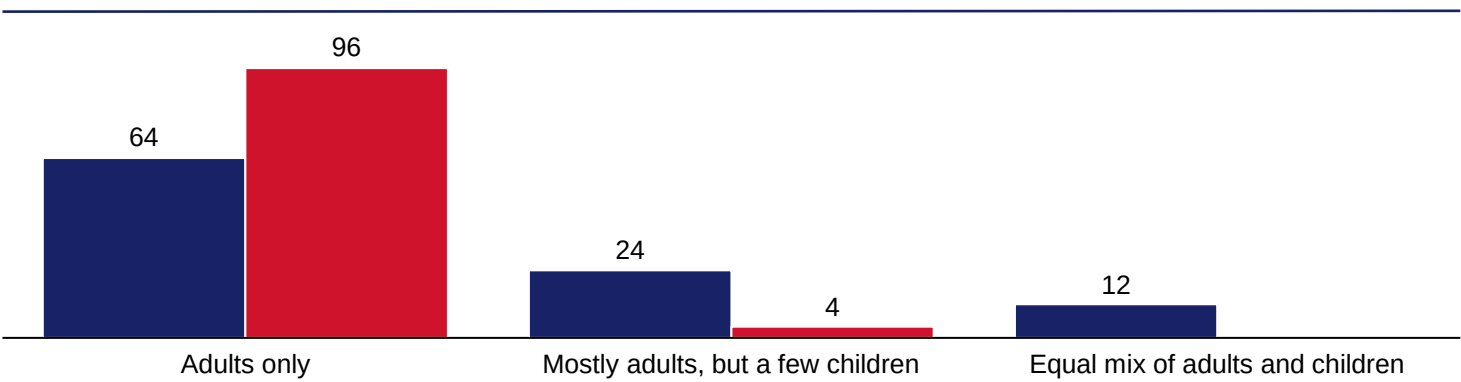
This further **validates** the **positive reactions** to the **bikes' performance** with **heavy loads** compared to the petrol bikes

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

Sample description: mix of passengers carried

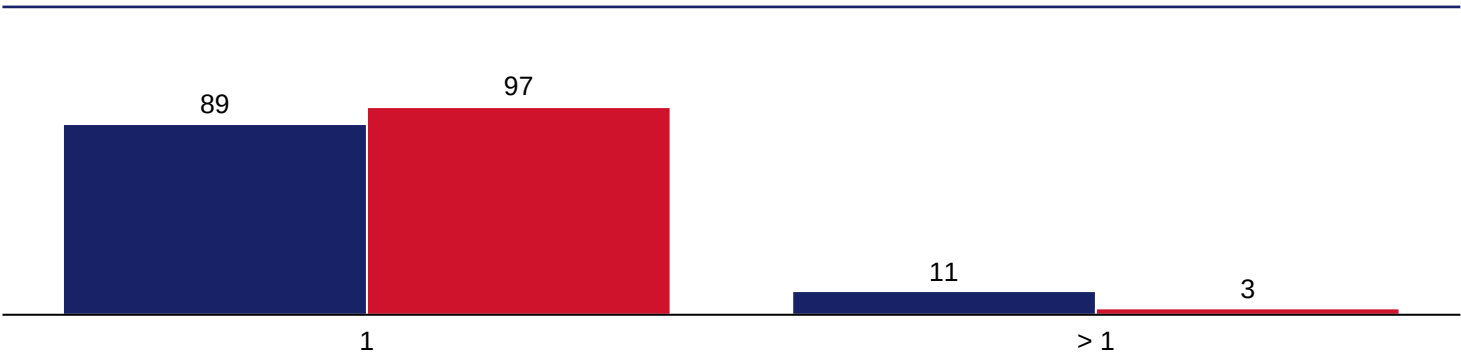
Electric motorbikes carried more children than petrol motorbikes...

Adults / children carried, % of all responses



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

Number passengers carried, % of all responses



Sample description

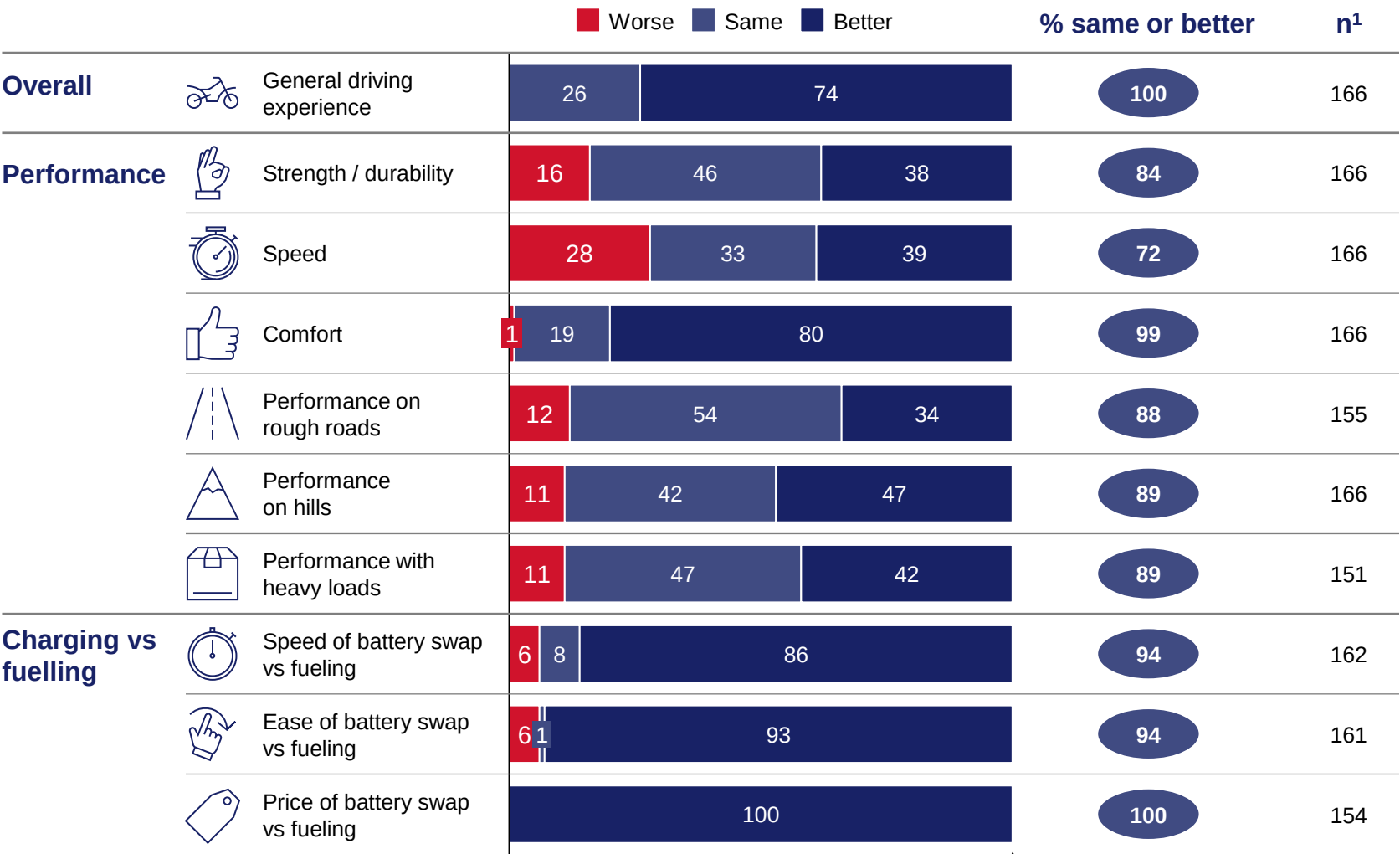
- The samples had fairly similar activity, albeit the electric motorbikes tended to:
- **Carry more children:** on a **third of days** during the pilot **electric** motorbikes carried some **children**, compared with **only 4%** days for **petrol** motorbikes
 - **Carry >1 passenger more often:** On 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

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

↑
100%