

# CATALYZING INVESTMENT IN ELECTRIC MOBILITY

The case for Africa and the Middle East

APRIL 2022



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## EXECUTIVE SUMMARY

The electric mobility (e-mobility) ecosystem is comprised of four interdependent segments:

1. **Electric vehicles (EVs)**, which include land vehicles as well as water- and air-borne mobility solutions (boats, drones);
2. **Electric mobility as a service (E-MaaS)**, through a variety of business models ranging from rental to ride-sharing;
3. **Infrastructure for on- and off-grid energy** production, distribution, and charging networks necessary to power EVs; and
4. **Policy and regulation**, including the monetary and non-monetary incentives for the use of e-mobility solutions.

Achieving mature e-mobility ecosystems requires a range of mutually reinforcing conditions to be present. These often emerge organically and in uneven ways across stages of ecosystem growth, from initiation to maturity. They include:

1. **Inputs:** Access to sufficient sources of high-quality raw, processed, and manufactured inputs (e.g. batteries) to bolster the e-mobility value proposition;
2. **Capital:** Diverse funding ecosystem and sufficient flows of (concessional) growth and working capital to meet investee needs;
3. **Energy:** Reliable energy infrastructure (on- / off-grid) to power e-mobility solutions; minimal fossil fuel subsidies to encourage transition;
4. **Market:** An addressable consumer base large enough to support the transition of a market from being nascent to mature; and
5. **Policy framework:** A policy and business environment conducive to the provision of EVs and charging infrastructure.

There is promising movement in the nascent e-mobility ecosystem in Africa and the Middle East, driven by trends in investment, electricity access, and governmental priorities. Rich deposits of minerals used in batteries and EVs could enable the local development and production of batteries with the right price/performance mix. Commercial investors and development finance institutions (DFIs) are increasingly active in e-mobility across the region, with tech-focused venture capital (VC) funds providing \$105m to the African mobility sector in 2021. Access to electricity is also growing in Africa (from 34% in 2010 to 46% in 2019), but still requires improvement in terms of network reliability and reduced gasoline subsidies. The regional consumer base is large and growing due to favorable demographics, urbanization and economic growth, which has resulted in an EV market forecast growth of 15% CAGR over the next five years. Finally, governments are increasingly focused on supporting the e-mobility sector, with ECOWAS countries adopting a roadmap for the transition to fuel-efficient vehicles and other nations developing policy frameworks for e-mobility. Building on these conditions, impact-focused actors are reinforcing e-mobility ecosystems through market shaping efforts, such as direct investment (including in public transport and business model innovation), infrastructure development, and policy support to governments and market players.

However, challenges at the consumer, company, and investor levels could slow or limit the growth of e-mobility in the region. Firstly, subsidized petrol prices and high sticker prices can undermine the monetary incentive to adopt EVs. Scarce and hard-to-find charging infrastructure leads to range anxiety, and low consumer awareness on the comparative advantages of EVs and limited non-monetary incentives (e.g., free parking, bus lane access) limits mass uptake. Secondly, the nascent risk of internal combustion engine (ICE) vehicle dumping from high-income countries could also limit e-mobility markets, given Africa and the Middle East absorb ~52% of second-hand, 4-wheeler imports. Finally, the e-mobility investment gap plays out on both the supply and demand side, resulting in the dual challenge of lack of capital directed to e-mobility and limited pipeline of e-mobility opportunities for investors.

**Across Africa and the Middle East, several countries have nascent or emerging ecosystems, displaying viable e-mobility investment opportunities and conditions for long-term growth – six markets in particular display strong potential, both in the immediate future and longer term.** Kenya is home to the continent's largest e-mobility start-up ecosystem, has an investment ecosystem that shows increasing interest in e-mobility, and reliable energy infrastructure to support uptake. Ghana has a large EV market, one of the fastest growing automotive production industries in the world, and a diverse range of EV-focused players. Morocco has substantial domestic and export markets, reliable energy, a conducive policy environment, and plans to develop a local battery ecosystem. Egypt has sizable domestic and export markets, reliable energy, a favorable policy environment, and substantial investment in the mobility space. However, it also has significant fossil fuel subsidies that could undermine a switch to EVs. Rwanda has one of the largest EV markets in the region due to its conducive policy environment, but less than half of the population have access to electricity and the size of its domestic and export markets could limit growth. Finally, Uganda has several VC-backed start-ups in the e-mobility space – to capitalize on this early momentum, it will need to develop policies that promote EV use or charging point rollout, as well as strengthen the capacity and coverage of its energy supply.

**Within some of these countries, specific vehicle segments present promising e-mobility opportunities.** The 2/3-wheeler segment is the largest vehicle segment in Kenya, has a high density of e-mobility start-ups and offers comparatively low sticker price and advantage over ICEs in terms of total cost of ownership (TCO). In Morocco, this segment also displays a large and growing market. The fact that there are few EV-focused players could enable first movers to expand quickly and create defensible businesses via partnerships. The 4-wheeler segment in Ghana is the largest vehicle segment and the preferred urban mobility solution, aided by the legal ban on 2-wheeler taxis. Several start-ups have secured funding, and there is a potential niche for vehicles that are low cost and suited to the local terrain. Electric buses are also a promising segment in Kenya. There is a growing start-up ecosystem for e-buses, with players like BasiGo and Opibus securing funding to pilot and scale, enabled by rising demand resulting from initiatives to electrify public transport.

**The most robust e-mobility enterprises have actively expanded across the EV, battery, and charging value chains, which enables them to grow the size of their serviceable markets, reduce cost to serve, and increase the defensibility of their business models.** Promising models also have relative ease of scaling and low TCO for consumers. For instance, pay-as-you-go (PayGo) models increase affordability, reduce sticker price, and quickly enable high sales, and their relatively low CAPEX keeps costs below models like battery swapping. Similarly, models focused on battery swapping and pay per use charging are essential to enabling e-mobility scale in markets that lack charging points, even if CAPEX costs end up being passed onto the consumer.

**Looking to the future, market shaping efforts could strengthen e-mobility ecosystems and enable growth in promising geographies, vehicle segments, and innovations.** These are not limited to those presented in this report. Rural e-mobility business models could present a future opportunity. Additional segments such as micro-mobility and boats also have electrification potential. Finally, innovations in the EV space – including battery storage, common charging standards, and carbon credits for financing – could enhance the viability of e-mobility business models across Africa and the Middle East.

# ANATOMY AND EVOLUTION OF THE E-MOBILITY SECTOR

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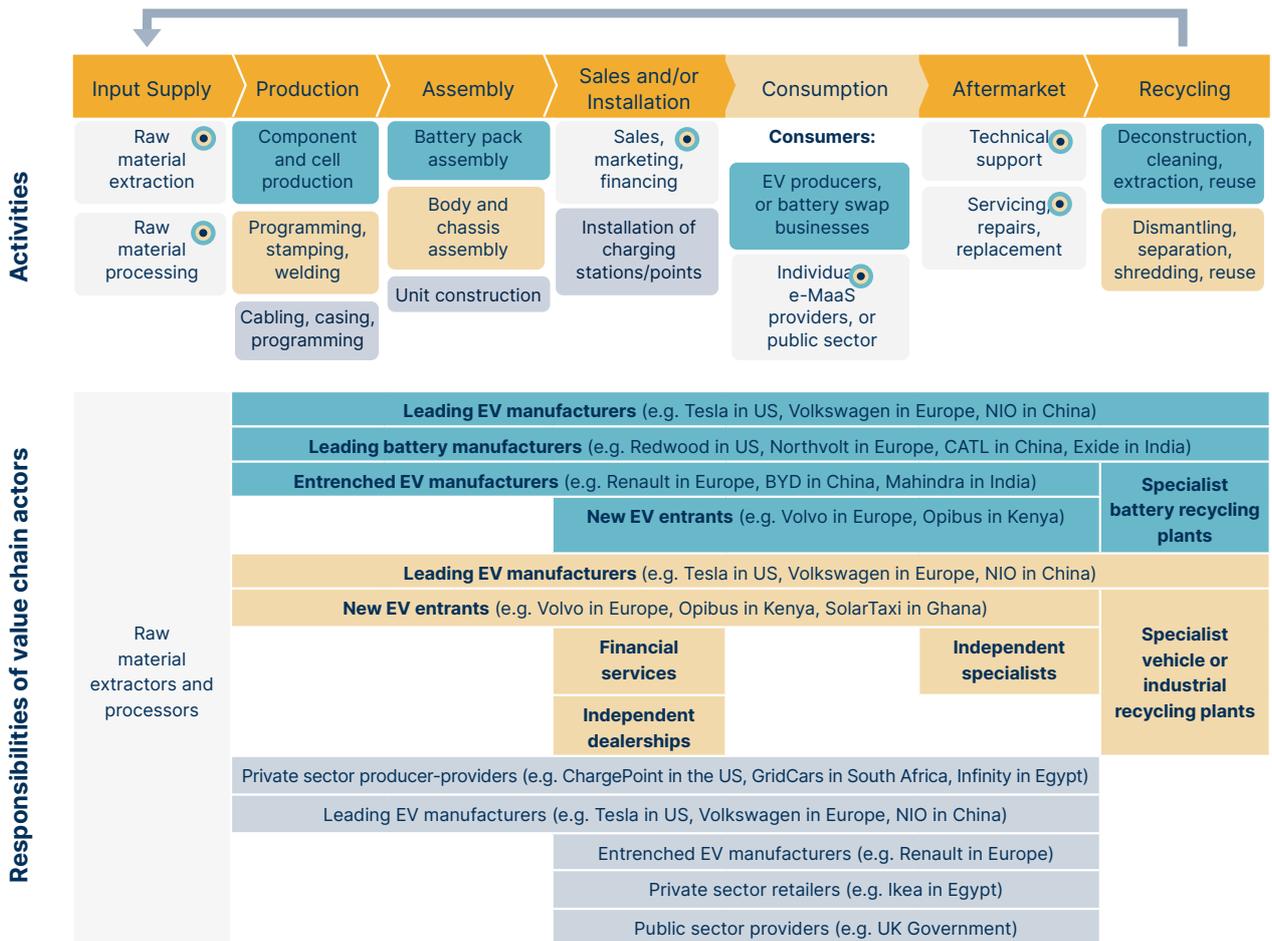
# E-MOBILITY OVERVIEW

The e-mobility ecosystem is made up of four interdependent segments that shape the adoption and use of e-mobility solutions:

1. **Electric vehicles (EVs)**, which include land vehicles as well as water- and air-borne mobility solutions (boats, drones);
2. **Electric mobility as a service (E-MaaS)**, through a variety of business models ranging from rental to ride-sharing;
3. **Infrastructure for on- and off-grid energy** production, distribution, and charging networks necessary to power EVs; and
4. **Policy and regulation**, including the monetary and non-monetary incentives for the use e-mobility solutions.

There are three value chains within the e-mobility ecosystem; batteries, EVs, and charging infrastructure. Actors often sit in more than one segment of the ecosystem. Leading actors have business models that extend across all three value chains, which helps build defensible models while mitigating the impact of first mover hesitancy. Newer actors use partnerships to extend value chain coverage, which can foster mutual growth.

Figure 1: Value chain overview



**Activities key:** All three value chains = ● Battery Value Chain = ● EV Value Chain = ● Charging Value Chain = ●

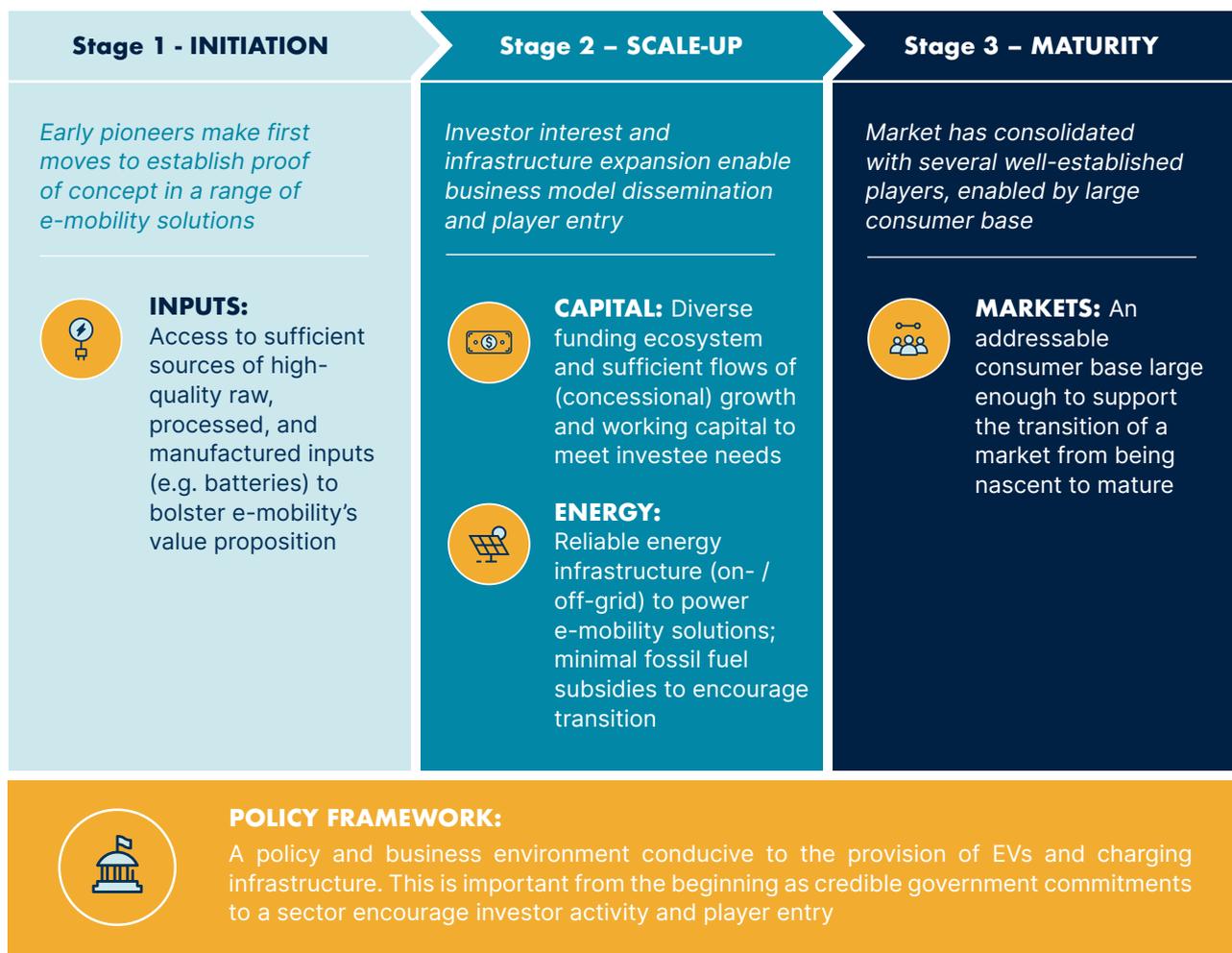
**Responsibilities key:** Battery ● EV ● Charging ●

### Achieving mature e-mobility ecosystems requires a range of mutually reinforcing conditions to be present.

These often emerge organically and in uneven ways across stages of ecosystem growth, from initiation to maturity. They include:

1. **Inputs:** Access to sufficient sources of high-quality raw, processed, and manufactured inputs (e.g. batteries) to bolster the e-mobility value proposition;
2. **Capital:** Diverse funding ecosystem and sufficient flows of (concessional) growth and working capital to meet investee needs;
3. **Energy:** Reliable energy infrastructure (on- / off-grid) to power e-mobility solutions; minimal fossil fuel subsidies to encourage transition;
4. **Market:** An addressable consumer base large enough to support the transition of a market from being nascent to mature; and
5. **Policy framework:** A policy and business environment conducive to the provision of EVs and charging infrastructure.

Figure 2: Stages of e-mobility ecosystem evolution



While these conditions are presented sequentially, they often emerge organically and in uneven ways across stages of ecosystem growth

**Low and Middle Income Countries (LMICs) can draw lessons from China and India**, which have built a foundation for each condition and have used policy and capital to drive growth.

## China



**The e-mobility market in China is strong.** The country saw ~1.3 million EVs sold in 2020, and the EV segment has ~15% market penetration in 2021. To improve access to inputs, China has invested heavily in relationships with input providers and created local supply chains for battery manufacturing and charging. Capital is widely available, with \$100 billion invested in e-mobility from 2009 to 2019. In 2019, government support equated to ~30% of the Chinese EV industry's total revenue. The government has invested heavily in increasing capacity and reliability of renewable energy production, spending \$760 billion between 2010 and 2019. In addition, the Chinese consumer base is strong, given the vast and growing middle class and public procurement mechanisms in place that have incentivized early adoption. Policies ensure almost every aspects of the vehicle value chain is pro-EV (e.g., supply chain, production, sales, licensing, registration, fueling, and parking).

**~1.3 million**  
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2020

**\$760 billion**  
in renewable  
energy

**\$100 billion**  
invested in  
e-mobility

## India



**In India, the scale of e-mobility is lower and progress is still underway.** In 2020, 135,000 EVs were sold, representing around 1% market penetration. As the ecosystem develops, several moves along the conditions for growth have been progressing. India has developed local battery supply, through phased value chain consolidation and incentives that initially focused on assembly and now focus on production. E-mobility start-ups received ~\$175 million in 2021, and the government also rolled out FAME II, aimed at investing ~\$1.6 billion in Indian e-mobility from 2019 to 2022. The government has also invested over \$42 billion in renewable energy production between 2015 and 2021, and energy production has increased by ~63% between 2010 and 2020 (45% increase on a per capita basis). In terms of consumer base, a growing middle class includes 400 million people with annual spending ranging from \$5,000 to \$50,000, and is set to grow at 8.5% by 2030. In addition, an array of conducive policies are focused on encouraging battery production, EV sales, and charging rollout.

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**CHINA HAS CREATED THE  
WORLD'S LARGEST E-MOBILITY  
ECOSYSTEM BY BUILDING A  
STRONG FOUNDATION FOR EACH  
CONDITION AND USING POLICY  
AND CAPITAL TO DRIVE GROWTH**



# E-MOBILITY: IMPACT, OPPORTUNITIES AND CHALLENGES IN AFRICA AND THE MIDDLE EAST

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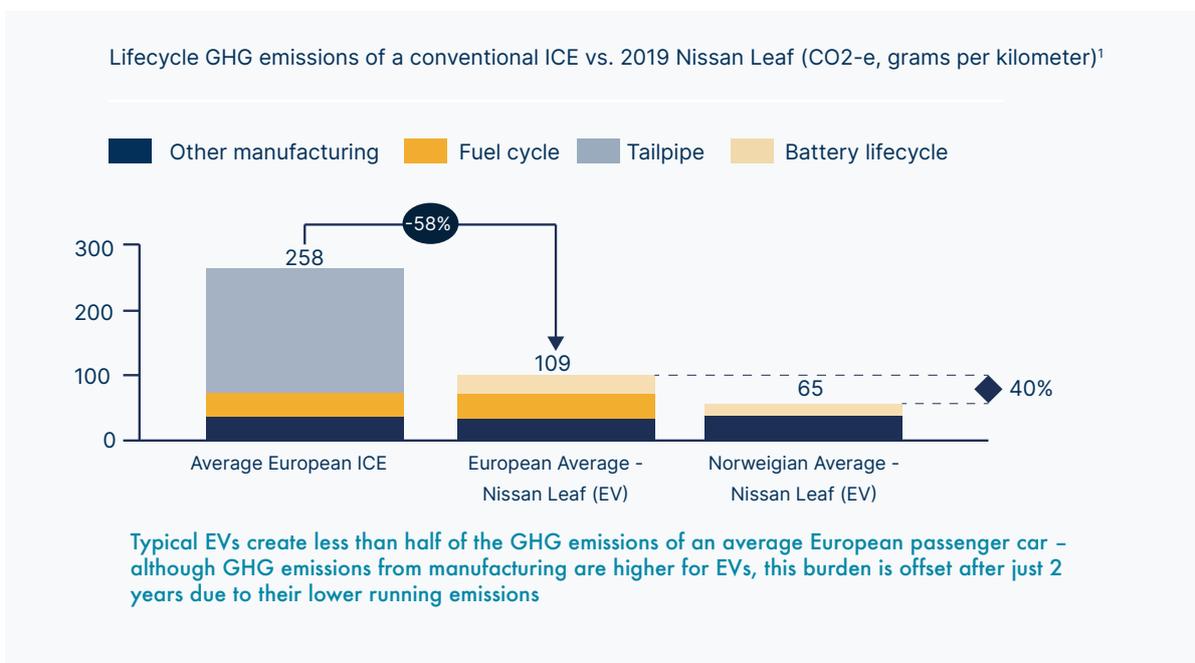


## IMPACT CASE

**Greenhouse gas emissions and air pollutants from the transport sector are high and growing** rapidly as a result of Africa's reliance on outdated second-hand vehicles. Transport emissions result primarily from (ICE) vehicles. They are responsible for 10% of GHG emissions in Africa and are set to increase in line with current vehicle parc projections of 60 million by 2040. Deaths as a result of air pollution grew to 1.1 million in 2019 and, in Ethiopia alone, created a loss in economic output of \$3 billion (1% of GDP).

**Therefore, tackling transport emissions is a priority in Africa and the Middle East**, with e-mobility identified as a major component of regional climate plans. 'Low-carbon mobility' is one of the four pillars of the Middle East & North Africa Climate Roadmap (2021-2025), and 'green mobility' is one of five strategic directions outlined in the Africa Climate Business Plan (2020).

Figure 3: ICE vs. EV emissions



**EVs advance SDGs 3 (Health and Wellbeing) & 13 (Climate Action)** as they do not emit harmful air pollutants and their net GHG emissions are lower than ICE equivalents. Typical EVs create less than half of the GHG emissions of an average European passenger car and, although GHG emissions from manufacturing are higher for EVs, this burden is offset after just 2 years due to their lower running emissions.



Advancing **e-mobility** also has the potential to address a range of other SDGs – [see Annex for details]



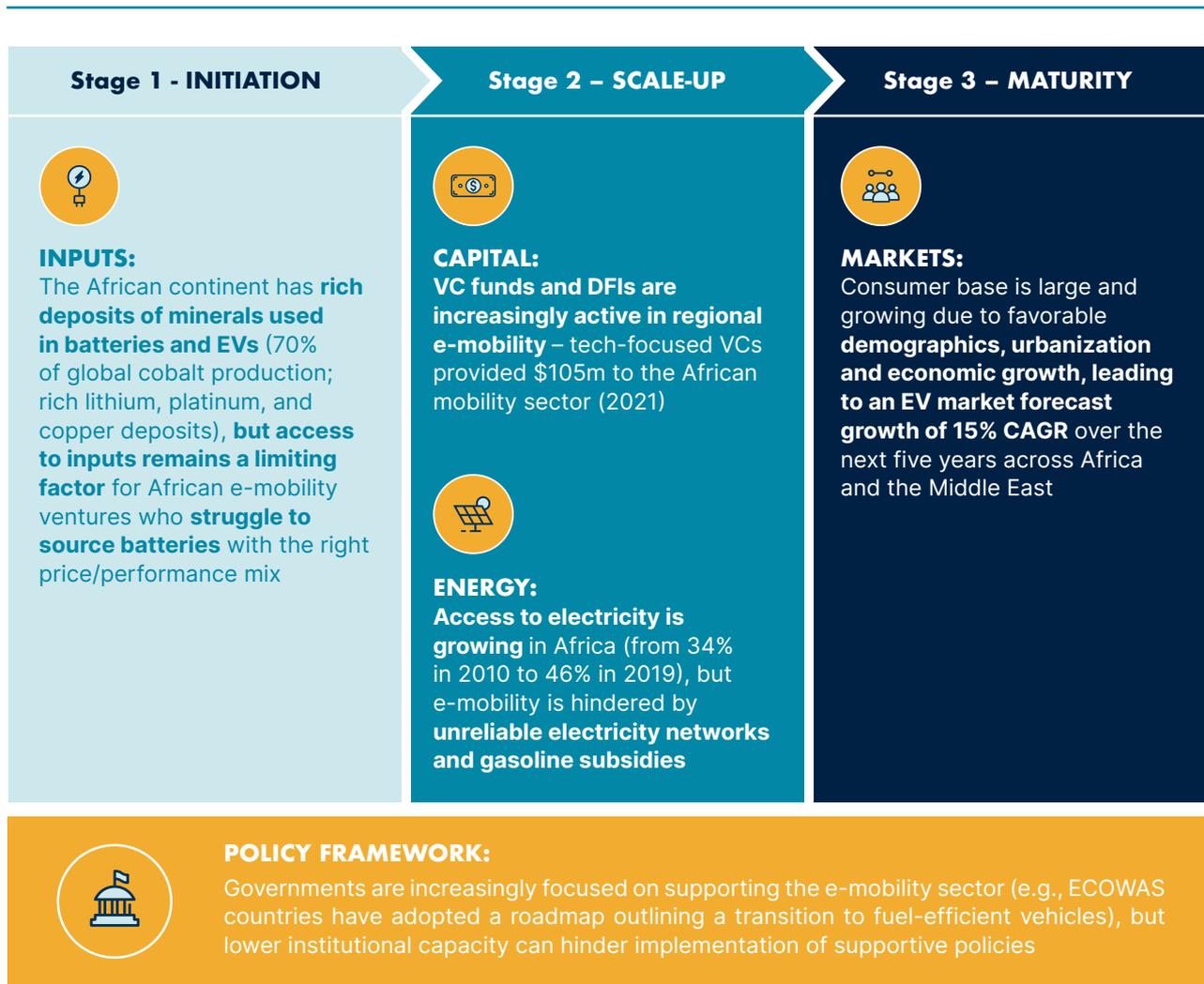
1. Carbon Brief, How electric vehicles help to tackle climate change, 2019.

## INVESTMENT CASE

### Regional trends

There is promising movement in the nascent e-mobility ecosystem in Africa and the Middle East, driven by trends in investment, electricity access, and governmental priorities. Rich deposits of minerals used in batteries and EVs could enable the local development and production of batteries with the right price/performance mix. VC funds and DFIs are increasingly active in e-mobility across the region, with tech-focused VCs providing \$105m to the African mobility sector in 2021. Access to electricity is also growing in Africa (from 34% in 2010 to 46% in 2019), but still requires improvement in terms of network reliability and reduced gasoline subsidies. The regional consumer base is large and growing due to favorable demographics, urbanization and economic growth, resulting in a forecasted EV market growth of 15% CAGR over the next five years. Finally, governments are increasingly focused on supporting the e-mobility sector, with, for instance, ECOWAS countries adopting a roadmap for the transition to fuel-efficient vehicles and other nations developing policy frameworks for e-mobility<sup>1</sup>.

Figure 4: Conditions present in the e-mobility ecosystem in Africa and the Middle East



Across countries in Africa and the Middle East, these conditions are emerging in non-sequential ways – targeted support can accelerate the growth of e-mobility ecosystems in the region

1. For other examples of policies piloted and implemented by governments in the region, please go to the Annex section

Global e-mobility trends are also encouraging the growth of these nascent ecosystems by removing charging bottlenecks and improving EVs' accessibility.

At the company level, innovative business models allow new customer groups to access e-mobility, and an increase in EV producers expands choice and improves products' adaptation to market. At the sector level, falling battery costs and improving performance ensure EVs have a TCO that is lower and falling faster than that of ICEs. Improvements in infrastructure readiness will also likely reduce range anxiety and remove limits to growth. Finally, at the ecosystem level, e-mobility policies provide incentives to use e-mobility and limit the market for ICEs. The table below provides an overview of how these trends have an impact across markets in Africa and the Middle East.

Figure 5: Impact of global trends in Africa and the Middle East

Level	Global trends	Impact in Africa and the Middle East
Company	 <b>Innovative business models</b> give new consumer groups access to e-mobility	<ul style="list-style-type: none"> <li>• <b>Start-ups are pioneering new business models designed to increase access to e-mobility solutions.</b> Innovative methods include battery swapping (e.g. Ampersand), PayGo (e.g. Metro Africa Xpress), and ride-sharing (e.g. Bolt)</li> </ul>
	 <b>An increase in EV producers</b> expands choice and improves products' adaptation to market	<ul style="list-style-type: none"> <li>• <b>MNCs are gradually entering the market</b> (e.g. VW in Rwanda) while local EV providers are transitioning to production (e.g. Opibus in Kenya)</li> <li>• The market remains small for now and <b>EV producers have yet to demonstrate an ability to scale operations successfully</b> and sustainably</li> </ul>
Sector	 <b>Falling battery costs and improving performance</b> ensure EVs have a TCO that is lower and falling faster than ICEs	<ul style="list-style-type: none"> <li>• <b>Battery performance has risen steadily in recent years which, combined with falling costs, has improved e-mobility's economics.</b> In Kenya, the TCO for two-wheelers is 9% lower than ICE equivalents and the gap is expected to grow to 20% by 2030</li> </ul>
	 <b>Improvements in infrastructure readiness</b> are likely to reduce range anxiety and remove limits to growth	<ul style="list-style-type: none"> <li>• <b>Government and private players are beginning to build charging networks</b>, (e.g. Egypt plans to install 3,000 charging points with private sector support)</li> <li>• Despite this, there is <b>scope for countries to improve their infrastructure readiness</b> as there are less than 100 charging stations in most of the region</li> </ul>
Ecosystem	 <b>E-mobility policies</b> provide incentives to use e-mobility and limit the market for ICEs	<ul style="list-style-type: none"> <li>• <b>10+ governments have created policy environments conducive to e-mobility</b>, with incentives that drive the charging network rollout or enhance EVs' advantages over ICEs</li> <li>• <b>However, most countries have yet to develop an e-mobility policy framework</b></li> </ul>

## Current challenges

Despite promising movement, challenges at the consumer, company, and investor levels could slow or limit the growth of e-mobility in the region.



**On the consumer side**, adoption at scale will require unsubsidized petrol, sticker price parity, charging, and consumer awareness:

- **Unsubsidized petrol prices:** Consumers are primarily driven to shift to EVs due to their lower TCO – running costs are 8 times lower than for an equivalent ICE.<sup>2</sup> The incentive to switch therefore relies on energy being significantly cheaper than gasoline prices. However, in countries like Nigeria, petrol prices are 68% lower than the global average.<sup>3</sup>
- **EV sticker prices:** EVs tend to have a higher purchase price than equivalent ICEs (e.g., the price of a locally-made electric 2-wheeler in Kenya is 2 times that of an ICE). Sticker price parity is important given many consumers cannot afford EVs' significantly higher purchase price and often lack confidence in the argument that EVs have a lower TCO.
- **Charging infrastructure:** Range anxiety is a major barrier to the adoption of EVs, where drivers fear that an inability to charge their battery may leave them stranded. Perceptions of a lack of (suitable) charging stations drive these concerns – in a survey of >3,000 respondents in South Africa, ~60% stated that a lack of charging infrastructure and charging times were disadvantages of EVs<sup>4</sup>. Widespread adoption therefore relies on the rollout of public charging stations at scale
- **Consumer awareness on EVs' comparative advantages:** EVs are still seen as a relatively untested technology, and consumers have a range of concerns, including uncertainty around EVs' durability, reliability, second-hand value, etc. As a result, explicit non-monetary incentives are often required to incentivize early adopters to take on the risk of purchasing an EV. These may include free parking, bus lane access, and traffic restriction waivers, among others.



**On the company side**, challenges that could slow or limit the growth of e-mobility ecosystems need to be addressed:

- **Nascent risk of ICE dumping:** Due to ICE bans, high-income countries' stocks of second-hand ICEs could be dumped in African and Middle Eastern markets at low prices. This could pose a risk for Africa and the Middle East, who absorb the most second-hand imports and account for ~52% of global second-hand 4-wheeler imports. However, ICE dumping is unlikely to invalidate the case for domestic EV production, especially for 2/3-wheelers because there are age limits on imported ICEs (e.g., 1-year limit in Egypt), the worlds' largest markets are unlikely to ban ICE vehicles until at least 2035, and locally produced EVs are likely to have advantages over second-hand ICEs, due to tax incentives and greater scope to tailor vehicles to suit local terrain conditions.
- **E-mobility investment gap:** Large road transport funding gaps exist in Africa and the Middle East. Estimates show a 50% funding gap relative to Africa's needs up until 2040, and similar gaps exist in the Middle East. In Jordan, there is an investment gap of \$10 billion relative to a need of \$24 billion. VC e-mobility funding also remains limited, particularly compared to markets in Asia. Mobility accounts for just 2-5% of tech-focused VC funding, and in 2021, e-mobility start-ups in Africa received 3.3x less funding than those in India (\$54 vs. \$175 million). In addition, equity investment will likely require complementary debt capital given e-mobility's CAPEX-heavy nature limits ease of scalability.
- **Unconducive enabling environments:** Several countries exhibit political instability and conditions not conducive for business. For instance, 19 of the top 20 countries in the Fragile States Index and 18 of the bottom 20 countries in the Ease of Doing Business Index are in Africa or the Middle East. While instability makes it difficult to develop longer term e-mobility strategies, burdensome regulations inhibit innovation. Nonetheless, some countries are successfully developing e-mobility policy frameworks. Countries like Rwanda have enacted a range of policies incentivizing the development of e-mobility markets, and countries like Kenya are also directly supporting e-mobility by purchasing e-buses and creating e-bus lanes.

2. Manufacturing Africa, Innovation in e-mobility in East Africa workshop, 2021; 2. In 2019 and 2020 about 3 trillion Naira (\$7 billion) was spent on fossil fuel subsidies – The Conversation, Fuel subsidies in Nigeria, 2021; 4. AutoTrader, Electric vehicle buyers survey, 2020  
Sources: Briter Intelligence, Deals, 2022; Brookings, Africa's used vehicle market, 2020; Crunchbase, Funding rounds database, 2021; Energy Monitor, Africa's bumpy road to an EV future, 2021; Fund for Peace, Fragile states index, 2021; GIO, Forecasting needs, 2021; Manufacturing Africa, Innovation in E-Mobility in East Africa, 2021; Partech, Africa tech venture capital, 2022; Quartz Africa, The deadly hidden cost of Africa importing used cars, 2020; UNEP, Used vehicles and the environment, 2020



**On the investor side**, different supply- and demand-side financing issues continue to exacerbate the investment gap:

- **On the supply side**, the lack of capital directed to investments in e-mobility results from a combination of an insufficient risk-return ratio to justify entry barriers or time to realize upside, and the lack of information and data that makes it difficult to assess risks and market potential.
- **On the demand side**, the limited pipeline of investable opportunities in the e-mobility sector stem from the lack of appropriate financial products to meet firms' needs (e.g., type, tenor), along with difficulties that firms have in meeting investment criteria (e.g., collateral, managerial capabilities).

Figure 6: Supply- and demand-side financing issues



## Support Required to Drive Growth

**Across countries in Africa and the Middle East, targeted support can accelerate the growth of e-mobility ecosystems.** For instance, impact-focused actors are building on these conditions to reinforce e-mobility ecosystems through market shaping efforts. These include direct investment (including in public transport and business model innovation), infrastructure development, and policy support to governments and market players.



**In terms of direct investment**, development banks and DFIs (e.g., WBG, EIB, EBRD) aim to invest in the electrification of buses and intra-city last-mile movement to improve urban mobility. E-buses and electric 2- and 3-wheelers are expected to be the fastest growing vehicle segments in the next five years. Impact-focused actors also directly support start-ups to catalyze broader market changes. For instance, the IFC provided Moove with \$10 million to invest in energy efficient vehicles, and Siemens Stiftung operates e-mobility incubation programs to test business models and support pilot projects.



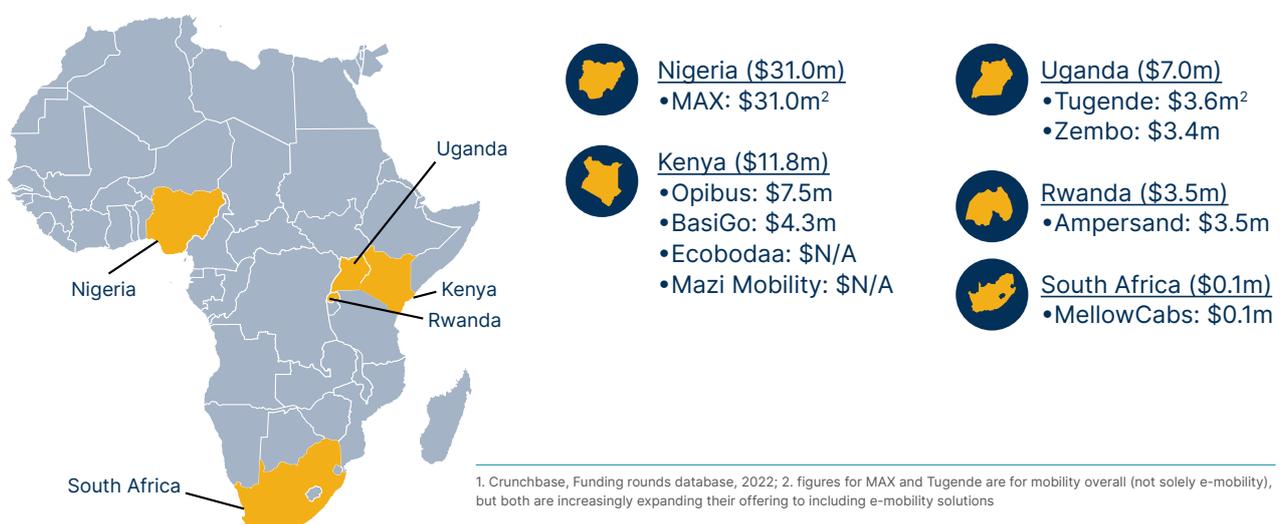
**In terms of infrastructure development**, development banks and DFIs (e.g., AfDB, EBRD, IFC) provide funding and technical expertise to increase countries' power generation capacity – including off-grid power – necessary for e-mobility. Players are equipping banks and other financial institutions with the tools necessary to lower the cost of financing e-mobility projects, currently a critical bottleneck. DFIs and foundations also support the development of e-mobility infrastructure through market research (e.g., studies on best practices and opportunities to expand e-mobility infrastructure) and funding to build infrastructure.



**In terms of policy frameworks**, international organizations support governments to develop e-mobility policies and build capacity. UNEP's Global Electric Mobility Programme works with over 50 LMIC governments, while the IFC's \$8bn Cities Initiative provides green advisory and investment services to municipalities. Organizations are also actively building networks to facilitate investment ties and knowledge transfer. For example, UNEP manages an e-mobility platform in Africa where countries can meet with technology providers and financiers to develop e-mobility programs.

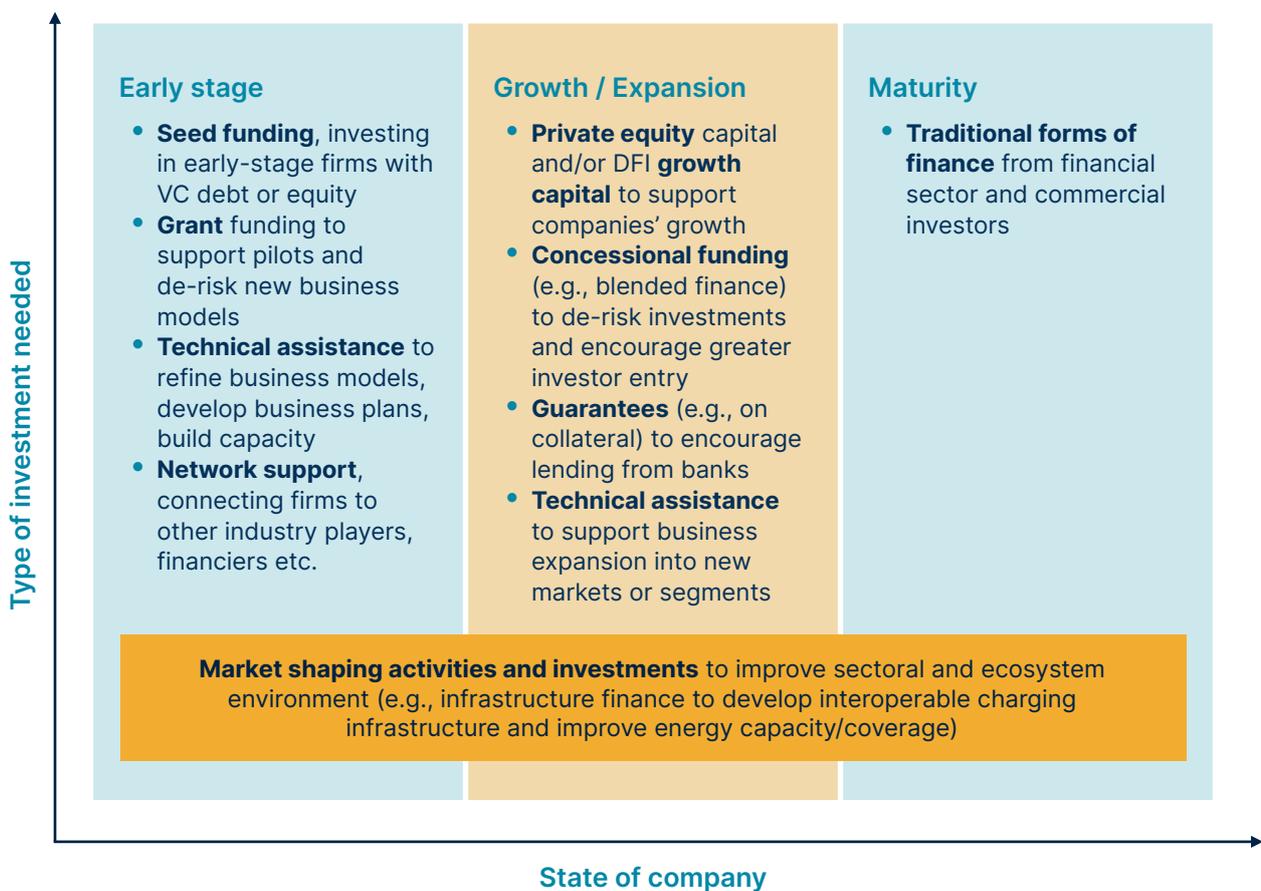
**Recent trends also show promising signs with an increasing number of VC funds entering the space, attracted by e-mobility's nascent opportunities.** Over the past year several high-profile funding rounds took place as VC funds entered the e-mobility space. Investors are attracted by the range of growth opportunities open to e-mobility start-ups and their capacity to gain a first mover advantage. Growth opportunities include developing alternative business models, expanding into other ecosystem segments, expanding across different EV segments, and growing into new regions. Funds are also attracted by the potential to gain first mover advantage, as the scarcity of players means early movers could obtain a large market share. Entry barriers improve early firms' chances of keeping this advantage, provided that new firms develop distribution channels and products adapted to the market. In this regard, advanced markets provide lessons that can mitigate first mover risks. For example, the Taiwanese firm Gogoro has provided African first movers with a battery swapping blueprint.

Figure 7: Value of VC funding for e-mobility from Feb 2021 to Feb 2022<sup>1</sup>



However, unlocking ecosystem growth will require deploying the right mix of commercial and concessional capital, including using blended finance tools. Different types of capital have strengths and challenges, and when used in a complementary manner can overcome their individual challenges. Local funds with specialist expertise in a sector or region are able to identify and invest in early-stage, high-potential start-ups, but may struggle to access sufficient pools of capital due to the high-risk nature of investments. By contrast, larger investors (both development-focused and commercial) have access to greater volumes of capital, but can struggle to build robust pipelines due to mandates in larger ticket sizes with lower risk tolerances. Deploying a range of tools (equity and debt, as well as blended finance and market shaping support) can enable investors to cater to growth stages of individual enterprises and connect pipelines across ticket sizes and hurdle rates.

Figure 8: Types of capital best suited to different stages of e-mobility ecosystem growth

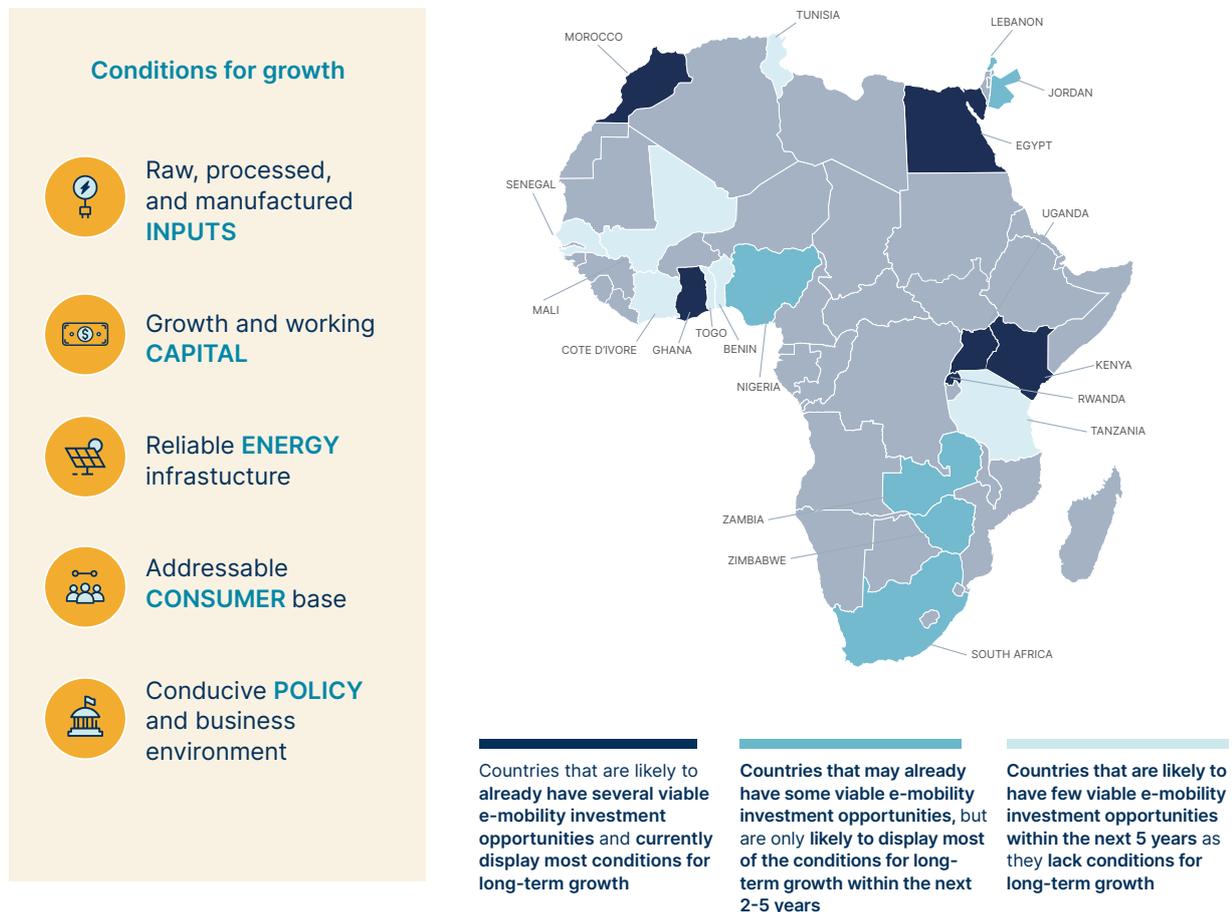


# COUNTRY ASSESSMENT AND GROWTH OUTLOOK



Across Africa and the Middle East, several countries have nascent or emerging ecosystems, displaying viable e-mobility investment opportunities and conditions for long-term growth.

Figure 9: Countries displaying conditions specifically relevant to the e-mobility start-ups ecosystem<sup>1</sup>



**Six markets show strong potential in the immediate future.** They have an existing and growing domestic e-mobility market and nascent or emerging ecosystem, and they display most of the conditions for long term growth. **Kenya** is home to the continent's largest e-mobility start-up ecosystem, bolstered by start-up investors increasingly turning towards e-mobility. The country also has reliable energy infrastructure to support uptake. **Ghana** has a large EV market, one of the fastest growing automotive production industries in the world, and a diverse range of EV-focused players. **Morocco** has substantial domestic and export markets, reliable energy, a conducive policy environment, and plans to develop a local battery ecosystem. **Egypt** has sizable domestic and export markets, reliable energy, a favorable policy environment, and substantial investment in the mobility space. Egypt also has significant fossil fuel subsidies that could undermine a switch to EVs if not addressed. **Rwanda** has one of the largest EV markets in the region due to its conducive policy environment. However, less than half of the population have access to electricity and the size of its domestic and export markets could limit sector growth. **Uganda** has several VC-backed e-mobility start-ups, but lacks a comprehensive policy framework to promote EV use or charging point rollout, and sector growth may be limited by an intermittent energy supply with relatively low capacity and coverage.

The following pages provide further details on each of the six countries with strongest current potential for e-mobility.

1. For more details on the country assessment methodology and criteria, please go to the Annex section (page 53)



**KENYA** satisfies most conditions for long-term growth, has a rapidly growing e-mobility ecosystem, and has access to sizable domestic and export markets

## Potential of the market to grow sustainably over the long term

Kenya has a sizeable domestic market and relatively reliable energy infrastructure, though manufacturing capacity could be improved to match the continent's leaders

### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~ 4 million

Vehicle exports  
\$84 million

Kenya has one of the largest domestic vehicle markets in Sub-Saharan Africa – while it has an emerging automotive export industry, it remains much smaller than major African exporters

### Sufficient energy infrastructure and fuel prices to encourage EV use

70% Energy access

3.8 Outages a month

312 kWh  
Production per capita with access

-8% relative to the world average petrol price<sup>1</sup>

Kenya has spare energy capacity and a relatively reliable energy infrastructure– Kenya generates 50% more electricity than it needs to meet demand, has a higher level of energy reliability than much of Sub-Saharan Africa, and does not subsidize gasoline prices heavily

### Sufficient access to inputs to enable EV production/maintenance at scale

10,000 units  
Maximum vehicle production per annum, since 2010

Although Kenya's vehicle manufacturing capacity is currently low, it is a priority for the government which aims to double capacity between 2019-2025 and has rolled out a National Automotive Policy to boost local automotive production

## Current and future growth of market

Kenya's EV market is nascent, with an emerging start-up ecosystem that may be promising for high-potential VC investment opportunities

### Growing electric vehicle use or sales

EVs in use  
<1,000

Although there are few EVs in use, Kenya has a dynamic e-mobility start-up scene with more than 50 start-ups entering the EV space

### Increasing installation of charging points

Charging points  
<100

Public charging infrastructure is scarce, but efforts are underway to scale it – public (Kenya Power) and private players (e.g., NopeaRide) plan to install or pilot charging points along major highways and elsewhere

### Increasing funding for mobility players

\$26 Million of funding for mobility in 2021

There are now 60 unique investors in Kenya's mobility space who invested a total of \$26 million in 2021; in 2021 Opibus secured Sub-Saharan Africa's largest ever fundraiser for a pure e-mobility player

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness



**GHANA** is one of the fastest growing vehicle exporters in the world and has one of the largest and fastest growing EV markets in the region

## Potential of the market to grow sustainably over the long term

Ghana has access to sizable markets and is an emerging regional leader in automotive production. However, frequent power outages could cause range anxiety, restricting the consumer base for EVs

### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~ 2.5 million

Vehicle exports  
\$27 million

Ghana has a relatively small vehicle market but an emerging automobile export industry – the rapid rise in Ghana's vehicle production capacity will likely lead to growth of both the domestic and export vehicle markets

### Sufficient energy infrastructure, but frequent power outages

84% Energy access

8.4 Outages a month

476 kWh  
Production per capita with access

-15% relative to the world average petrol price<sup>1</sup>

Despite spare energy capacity there are frequent power outages – while Ghana's extensive energy network may aid the development of charging stations, outages will likely contribute to range anxiety, discouraging drivers from switching to EVs

### Sufficient access to inputs to enable EV production/maintenance at scale

N/A Maximum vehicle production per annum, since 2010

Ghana's automotive production industry is one of the fastest growing in the world. The government has identified the sector as a strategic anchor for the economy and production capacity will soon be over 300,000 vehicles a year

## Current and future growth of market

### Growing electric vehicle use or sales

EVs in use  
<10,000

Ghana has one of the largest EV markets on the continent – around 5,000 EVs (mostly hybrid) were imported into the country between 2017 and 2020

### Increasing installation of charging points

Charging points  
<10

Public charging infrastructure is scarce, but plans are in place to grow it – a private company has partnered with the Electricity Company of Ghana to install over 200 charging stations across southern Ghana

### Increasing funding for mobility players

\$66 Million of funding for mobility in 2021

There are now 37 unique investors in Ghana's mobility space who invested a total of \$66 million in 2021

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness



**MOROCCO** is the region's largest vehicle exporter and has a growing market that satisfies all of the conditions for long-term growth

## Potential of the market to grow sustainably over the long term

Morocco has access to large domestic and export markets, reliable energy infrastructure, and plans to develop a local EV battery ecosystem, all of which indicate a high-potential market

### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~4 million

Vehicle exports  
\$4,500 million

Morocco has a large domestic market and is a major automotive exporter, a strength it can leverage in developing a diverse EV market

### Sufficient energy infrastructure and fuel prices to encourage EV use

100%  
Energy access

0.3 Outages  
a month

1,057 kWh  
Production per  
capita with  
access

+2% relative to  
the world average  
petrol price<sup>1</sup>

Morocco is well positioned to use its energy infrastructure and fuel pricing structure to support EVs development – Morocco's energy infrastructure has a high level of reliability and coverage, and above average capacity; fuel prices are slightly higher than the global average, strengthening incentives to transition to EV

### Sufficient access to inputs to enable EV production/maintenance at scale

405,000 Units  
Maximum vehicle production  
per annum, since 2010

Morocco is Africa's leading automotive manufacturer and plans to develop local battery production – Morocco is home to several international automakers that export to markets across Europe and may also soon host a local EV battery ecosystem, with government plans that extends from mining to recycling

## Current and future growth of market

Morocco's EV market shows positive signs of growth, and it is well placed to become a regional leader, though the market is currently nascent with a low numbers of vehicles

### Growing electric vehicle use or sales

EVs in use  
<1,000

Major automakers (e.g., Opel) plan to produce EVs in Morocco, however, strong interest from such firms may limit opportunities for VC relevant start-ups

### Increasing installation of charging points

Charging points  
<100

Public charging infrastructure is scarce, but could scale rapidly – a production line was recently set up, capable of producing 5,000 charging stations per year by the end of 2022

### Increasing funding for mobility players

\$30 Million of funding  
for mobility in 2021

There are 15 unique investors in Morocco's mobility space who invested a total of \$30 million in 2021

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness



**EGYPT** is a growing market that satisfies most of the conditions for long-term growth, but currently has fossil fuel subsidies that may limit EV adoption

## Potential of the market to grow sustainably over the long term

Egypt has access to substantial domestic and foreign markets, sources of quality inputs, and reliable energy infrastructure. However, the attractiveness of EVs may be undermined by significant fossil fuel subsidies

### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~11 million

Vehicle exports  
\$92 million

Egypt has one of the largest domestic vehicle markets on the continent and an emerging automobile export industry that could enable the transition of its EV market from nascence to maturity

### Sufficient energy infrastructure and fuel prices to encourage EV use

100% Energy access

0.8 Outages a month

1,928 kWh Production per capita with access

-52% relative to the world average petrol price<sup>1</sup>

Fossil fuel subsidies prices present an obstacle to Egypt's EV transition – although Egypt's energy infrastructure has a relatively high level of reliability and coverage, as well as above average capacity for the continent, petrol prices are heavily subsidized and create a low TCO for ICEs

### Sufficient access to inputs to enable EV production/maintenance at scale

115,000 Units Maximum vehicle production per annum, since 2010

Egypt has substantial vehicle manufacturing capacity and is looking to develop local battery production – Egypt aims to establish a local battery manufacturing industry with the help of Chinese manufacturers and technology

## Current and future growth of market

Egypt's EV market shows positive signs of growth, but is nascent, with low numbers of vehicles and charging stations

### Growing electric vehicle use or sales

EVs in use  
<1,000

Although there are few EVs in use, Egypt's vehicle market is growing, with domestic (e.g. El Nasr) and international (e.g. BMW) players moving into the EV space

### Increasing installation of charging points

Charging points  
<100

Public charging infrastructure is scarce, but is set to scale rapidly – the government plans to support the rollout of 1,000-3,000 charging points in the 1-2 years

### Increasing funding for mobility players

\$120 Million of funding for mobility in 2021

There are now 36 unique investors in Egypt's mobility space who invested a total of \$120 million in 2021 and have enabled e-mobility start-ups (e.g. Rabbit) to gain traction

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness



**RWANDA** is currently one of the largest EV markets in the region, but its small domestic and export markets may limit its future growth

## Potential of the market to grow sustainably over the long term

Rwanda has a clear focus on developing its domestic EV industry. However, the limited size of its ICE market and constrained capacity of its energy infrastructure may stunt the growth of its e-mobility ecosystem in the long-term

### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~200,000

Vehicle exports  
\$15 million

Rwanda has a small domestic vehicle market – low levels of vehicle ownership mean the number that will need replacement by EVs within the next few years is limited

### Sufficient energy infrastructure and fuel prices to encourage EV use

38% Energy access

2.4 Outages a month

Although Rwanda's supply is relatively reliable, low levels of energy access and capacity are an obstacle to EV transition – low energy coverage may limit the potential EV market size and restrict the rollout of charging stations to connected regions

164 kWh Production per capita with access

-5% relative to the world average petrol price<sup>1</sup>

### Sufficient access to inputs to enable EV production/maintenance at scale

5,000 Units Maximum vehicle production per annum, since 2010

Rwanda has limited vehicle manufacturing capacity, but is focused on increasing EV production capacity – while the first vehicle manufacturing plant in the country was only created in 2018, the number of dedicated EV assembly plants is growing

## Current and future growth of market

Rwanda's EV market is one of the most developed in the region, with a high number of EVs and a clear pathway towards an extensive charging network

### Growing electric vehicle use or sales

EVs in use  
<10,000

Rwanda has one of the largest EV markets on the continent, and growth remains high due to a government focus on boosting EV manufacturing and incentivizing EV use

### Increasing installation of charging points

Charging points  
<100

Public charging infrastructure is scarce, but faces a favorable growth environment – electricity tariff caps, tax exemptions, and rent-free public land will aid the rapid rollout of charging infrastructure across

### Increasing funding for mobility players

\$13 Million of funding for mobility in 2021

There are now 22 unique investors in Rwanda's mobility space who invested a total of \$13 million in 2021

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness



**UGANDA'S** ecosystem includes players that are looking to scale rapidly, but may lack the infrastructure and consumer base to enable long term growth

### Potential of the market to grow sustainably over the long term

Although Uganda is investing in mobility, the limited size of its ICE market and low capacity and coverage of its energy infrastructure may limit the growth of its e-mobility ecosystem in the long-term

#### Access to domestic & foreign markets that enable EV ecosystems to grow

Vehicle stock  
~2 million

Vehicle exports  
\$48 million

Uganda has relatively small domestic and foreign markets – the existing vehicle stock is low relative to the size of the population, while exports are limited by a nascent trade network

#### Sufficient energy infrastructure and fuel prices to encourage EV use

41% Energy  
access

6.3 Outages  
a month

266 kWh  
Production per  
capita with  
access

+4% relative to  
the world average  
petrol price<sup>1</sup>

Highly intermittent electricity and low levels of energy access present an obstacle to Uganda's EV transition – while petrol prices are high, low energy coverage may limit the size of the EV market while frequent power outages may create range anxiety

#### Sufficient access to inputs to enable EV production/maintenance at scale

<5,000 Units Maximum vehicle  
production per annum, since 2010

Uganda's vehicle manufacturing capacity is low but is said to be a government priority, which has made \$40 million available to Kiira motors and plans to expand production to 60,000 vehicles by 2040. EV batteries are a focus for Makerere University, but there are no state plans for battery production

### Current and future growth of market

Although the provision of EVs is set to rise, Uganda's e-mobility ecosystem may experience uneven growth due to limited planning for, and investment in, EV charging

#### Growing electric vehicle use or sales

EVs in use  
<1,000

While there are few EVs in use, private and state-owned players are looking to scale – Kiira Motors aims to produce ~900 e-buses annually by 2025 and Zembo recently received VC funding to scale

#### Increasing installation of charging points

Charging points  
<100

Public charging infrastructure is scarce and there are no public plans for rollout at scale – private players are forced develop their own infrastructure invested (e.g., Zembo have invested in ~20 charging stations)

#### Increasing funding for mobility players

\$23 Million of funding  
for mobility in 2021

There are now 36 unique investors in Uganda's mobility space who invested a total of \$23 million in 2021

1. Assessed based on difference in domestic and global average fuel price

Key: ● = High attractiveness, based on evidence of condition for growth or present/future growth outlook; ● = Medium attractiveness; ● = Low attractiveness

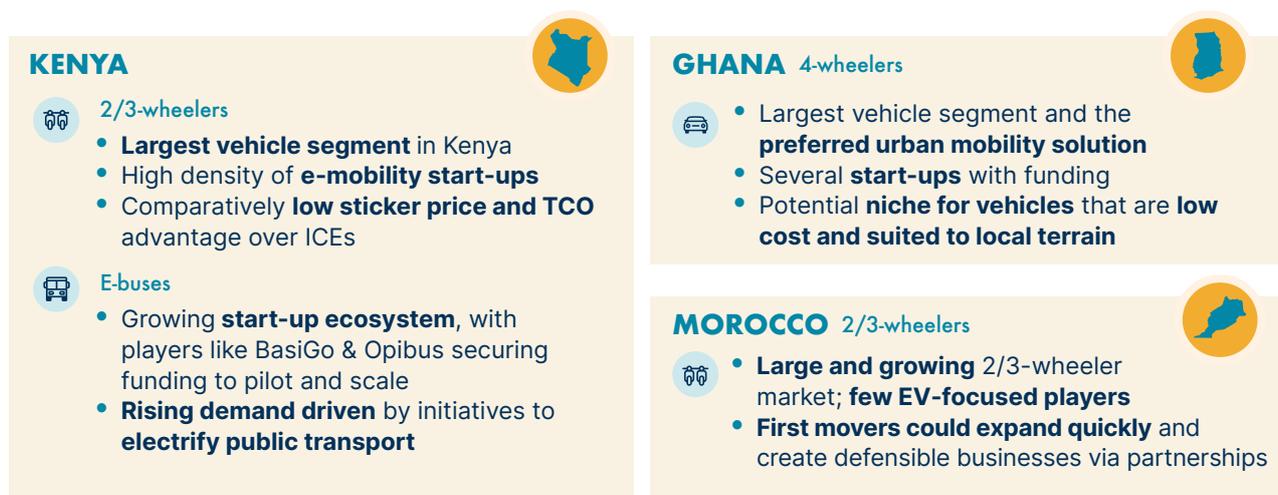
# PROMISING MARKET SEGMENTS: OPPORTUNITIES AND INVESTMENT CONSIDERATIONS

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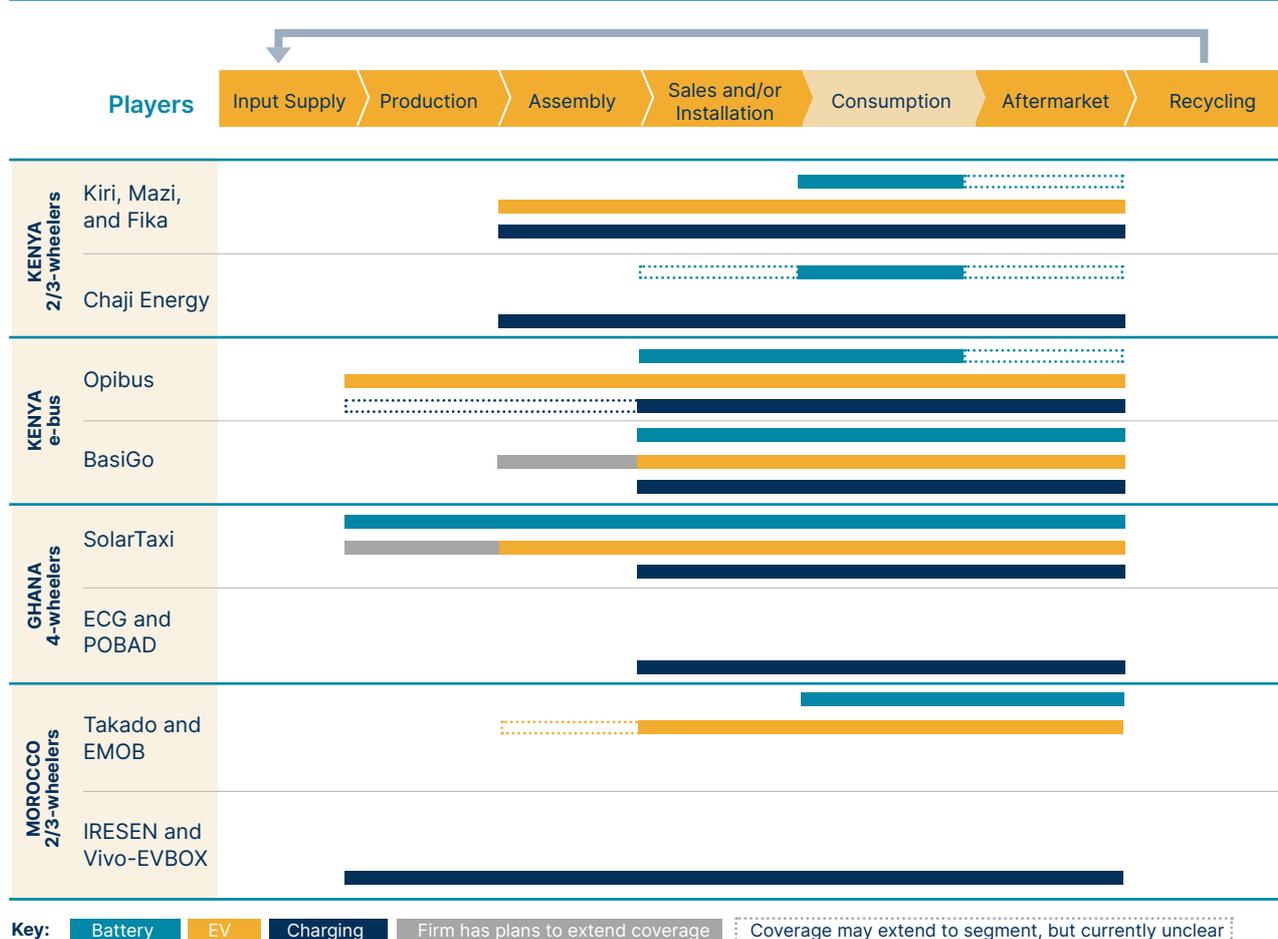
A number of market segments across Kenya, Ghana, Morocco, Egypt, Rwanda and Uganda present promising opportunities for investment in the e-mobility space – this report specifically dives into four of them.<sup>1</sup>

Figure 10: Selected promising market segments in highest potential countries and rationale for select<sup>1</sup>



Across these markets, players tend to use a variety of business models to expand the size of their market and cover all three e-mobility value chains. Many firms in the region use multiple business models to grow the size of their serviceable market, and also work across the EV, battery, and charging value chains (e.g., EV players set up swap stations). For example, SolarTaxi and Opibus aim to build defensible models by extending value chain coverage, entering multiple vehicle segments, and creating diverse revenue streams.

Figure 11: Value chain coverage of selected players in deep dive markets



1. These segments were chosen through analysis of the ecosystem's attractiveness from a supply-side (e.g., what types of vehicles could the country's infrastructure realistically support in the medium term, where are existing e-mobility manufacturers focusing their efforts, etc.) and demand-side (e.g., what types of vehicles are in demand in the ICE space or have shown some signs of traction in the e-mobility market) perspective, as well as an investor's potential additionality. 2. For the purposes of this report, these market segments were selected within countries that displayed the most conditions for long term growth as well as immediate investment opportunities (nascent/emerging ecosystem), but that is not to say that other promising segments are not present in other marke



## KENYA'S 2/3-WHEELER MARKET

Kenya's 2/3-wheeler market is large and diverse, with battery swapping, and pay per use charging models driving growth and presenting first-mover opportunities. Agile charging models (pay per use, battery swapping) will likely drive market growth, given the lack of public charging stations. As most players are still piloting products, first mover opportunities are available to investors, particularly those able to provide grant funding and technical assistance. Infrastructure finance can also help establish interoperable charging infrastructure and monetary / non-monetary incentives for EV use, required to drive growth.

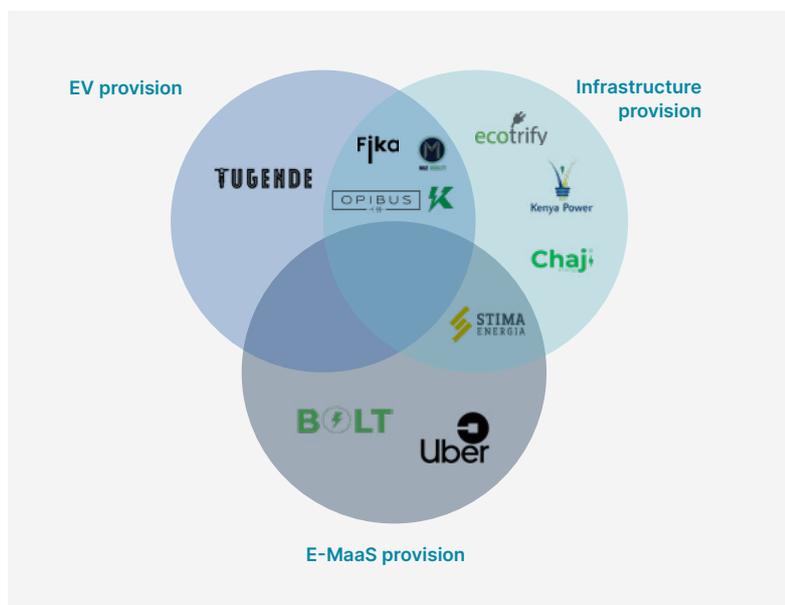
The segment presents compelling conditions:

- **Market dynamics:** Kenya has the largest e-mobility start-up ecosystem in Africa, with over 50 start-ups, most of which are in the 2/3-wheeler space. There are scaling opportunities for nascent players in 2/3-wheeler space, given there are under 1,000 e-motorcycles in Kenya of a fleet larger than 1.5 million.
- **Investment ecosystem:** There is a diverse set of mobility-focused investors, with 60 unique players and \$26 million invested in 2021. Investors appear confident in e-mobility, investing in four players in 2021 alone (e.g., Opibus secured Sub-Saharan Africa's largest ever e-mobility investment, worth \$7.5 million).
- **Policy environment:** Kenya also has a range of pro-EV policies, including excise duties on EVs that halved from 20% to 10%, while ICE duties remain at 20%. In addition, the Ministry of Energy aims for 5% EVs among new registrations by 2025, but is yet to implement EV policy framework.

In terms of risks, the high cost of battery swap stations slows expansion and could result in duplicative investment, reducing the ability to scale and incentivizing incompatibility across brands to create captive consumer base. This could be mitigated by supporting the initial rollout of battery swapping stations and/or charging points to address range anxiety, and rolling out pay per use charging models, which are cheaper than swap stations.

Figure 12: Snapshot of ecosystem actors in the Kenya 2/3-wheeler market

### MARKET PLAYERS



### INVESTORS



### POLICY MAKERS





## KENYA'S E-BUS MARKET

Kenya's e-bus market is emerging, with two local players recently securing high-profile funding rounds, and pay-as-you-drive and retrofitting models driving growth. Demand for e-buses is expected to rise, fueled by the size of the bus market and government commitment for e-buses in Nairobi's new bus-rapid transit (BRT) system. Two innovative players (BasiGo and Opibus) recently secured high-profile funding rounds to pilot and scale operations, offering investment opportunities for (concessional) capital that enables scale-up. Momentum can be enhanced by market shaping actions to support the growth of local manufacturing via tax policies (e.g., to limit imports).

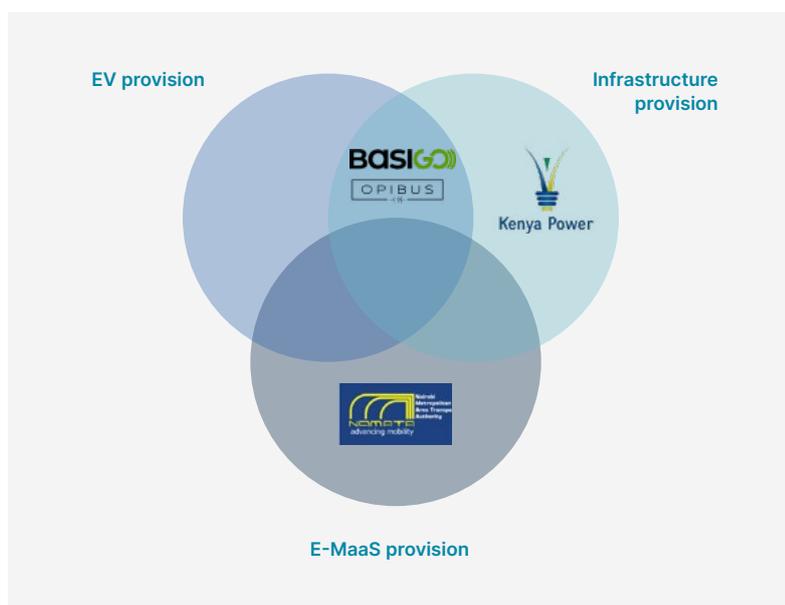
The segment also presents a nascent investment case that could quickly become compelling:

- **Market dynamics:** Buses form a large portion of public transport in Kenya, with around 1,500 buses bought annually in Nairobi. They make up 40% of commuter trips. E-buses are attractive, given that their TCO is lower than for ICEs and infrastructure can be strategically placed for overnight charge.
- **Investment ecosystem:** Investors appear confident in Kenya's e-bus sector, investing in two players (Opibus & BasiGo) in 2021. This is complemented by the diverse set of mobility-focused investors as outlined in the previous section.
- **Policy environment:** Adding to pro-EV policies outlined earlier in this report, the Kenyan government is directly supporting the rollout of e-buses, and Nairobi's new BRT system is set to only use electric and hybrid buses.

There are two important risks for this segment that must be mitigated. Firstly, sticker prices remain substantially higher for e-buses (approximately \$110,000) than for ICE buses (approximately \$60,000) in Kenya. Building on existing excise duties that favor electric vehicles, this risk could be further mitigated through the implementation of other policies that reduce up-front costs, such as import duty reductions and grace periods to import taxes for e-buses while local assembly is established. Secondly, e-buses have long cash-to-cash cycles and companies realize revenue over a five-year period from bus purchase with current pay as you drive schemes. Patient capital that suits the characteristics of the emerging business models could enable them to scale and build adequate cash flow cycles as they grow.

Figure 13: Snapshot of ecosystem actors in the Kenya e-bus market

### MARKET PLAYERS



### INVESTORS



### POLICY MAKERS



## GHANA'S 4-WHEELER MARKET

Ghana's 4-wheeler market is large and growing, with highest potential for EV manufacturers providing vehicles suited to the local terrain and cost preferences. Pro-EV policies favoring 4-wheelers and rapidly growing vehicle production capacity present growth capital opportunities, likely combined with convertible grants and technical assistance to refine business models and improve unit economics of local EV providers. Supported by the government, the rollout of interoperable charging infrastructure at scale also presents potential opportunities for infrastructure finance.

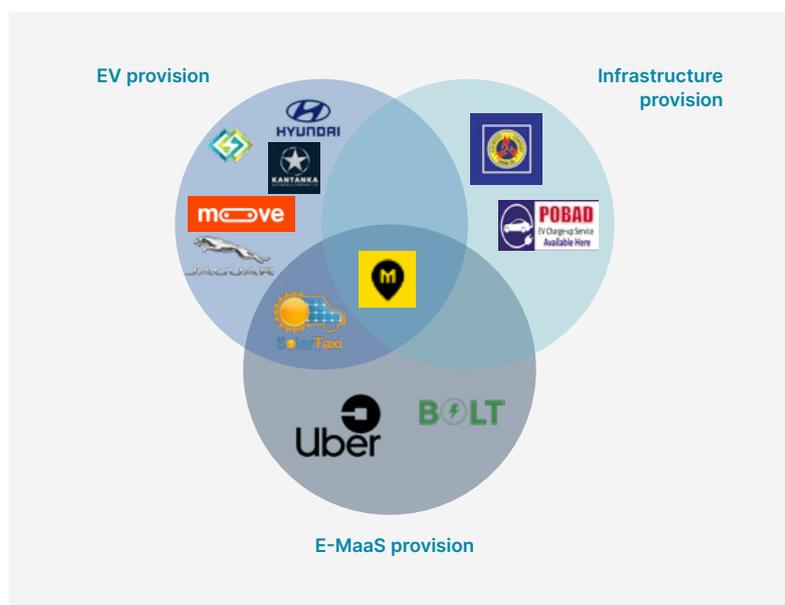
The segment also presents an appealing investment case:

- **Market dynamics:** Ghana has one of the largest EV markets in Africa, with 5,000 EVs imported between 2017 and 2020. The domestic supply of EVs is likely to grow rapidly, given that Ghana's automotive industry is one of the fastest growing in the world and current production capacity is over 300,000 vehicles per year.
- **Investment ecosystem:** Ghana has a diverse set of 37 unique mobility-focused investors, who invested \$66 million in 2021. Concessional investors also see potential in the market, with the example of Mastercard Foundation providing seed funding for Ghanaian enterprise SolarTaxi in 2019.
- **Policy environment:** In terms of pro-EV policies, EV custom duties have been halved and plans are in place to fully remove them. The Ghanaian government supports the sector's growth, and Ghana's electricity company has plans to install 200 charging stations across the country in partnership with a private sector company, POBAD International.

Risks to the 4-wheeler market in Ghana revolve around sticker prices and entry of global manufacturers. High sticker prices may limit the addressable market by putting 4-wheelers out of reach for a large proportion of domestic users, while the entry of international vehicle manufacturers could take market share from start-ups. Asset financing could help mitigate the sticker price risk by reducing upfront costs for EVs. At the same time, supporting Ghanaian players to focus on specialized vehicle models tailored to local terrain conditions could limit the competitive advantage of international players whose models may be unsuitable to Ghana's road conditions.

Figure 14: Snapshot of ecosystem actors in the Ghana 4-wheeler market

### MARKET PLAYERS



### INVESTORS



### POLICY MAKERS





## MOROCCO'S 2/3-WHEELER MARKET

Morocco's 2/3-wheeler market only has a few EV-players, offering sizeable opportunities for first movers with defensible business models. Driven by pro-EV policies, the 2/3-wheeler market is set to double by 2026. With only a few EV-focused players active so far, there may be seed funding and growth capital opportunities that enable first movers to scale quickly and grow their market shares significantly. An ambitious national plan for e-mobility also provides infrastructure finance opportunities to support charging network rollout with a focus on interoperability.

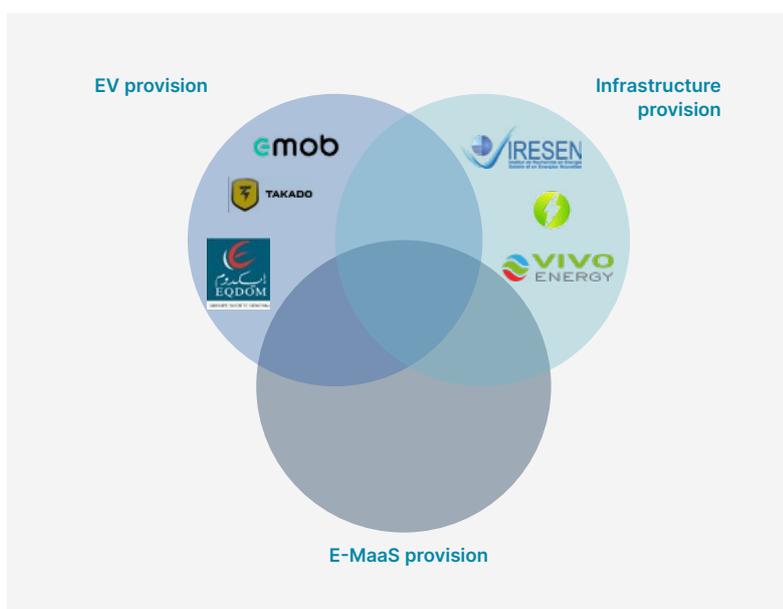
The segment presents an attractive proposition for investors willing to move into nascent markets:

- Market dynamics:** The 2/3-wheeler market in Morocco is large and growing. Between 2017 and 2020, a total of 280,000 2-wheelers were registered in the country, and sales are expected to double by 2026. Few players are focused on electric 2/3-wheelers, although there are a variety of available products offered by original equipment manufacturers (OEMs). In addition, electric 2-wheelers are competitive with ICE alternatives on a TCO basis.
- Investment ecosystem:** There is a relatively small but diverse set of mobility-focused investors in Morocco, with 15 unique investors and \$30 million invested in 2021. This presents an opportunity for other players to enter the investment space, as the e-mobility sector.
- Policy environment:** There is promising movement in terms of pro-EV policies. EV customs duties have been removed, and VAT has been halved from 20% to 10%. In addition, a National Plan for Electric Mobility is under development and will likely fund the rollout of a public charging network.

Risks to the 2/3-wheeler market in Morocco are similar to those present in the 4-wheeler market in Ghana. High price sensitivity makes sticker price parity essential, given that the majority of sales are of low-cost 2-wheelers. At the same time, major automakers are entering the domestic EV market, putting local start-ups out of business. Policies that reduce up-front costs relative to ICEs (e.g., point of purchase subsidies) together with a focus on value chain segments that are less vulnerable to OEM entry (e.g., low-cost assembly and distribution at a smaller scale) offer important avenues to mitigate existing risks.

Figure 15: Snapshot of ecosystem actors in the Morocco 2/3-wheeler market

### MARKET PLAYERS



### INVESTORS



### POLICY MAKERS



# E-MOBILITY BUSINESS MODEL SNAPSHOTS

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The most robust e-mobility enterprises have actively expanded across the EV, battery, and charging value chains. This enables them to grow the size of their serviceable markets, reduce cost to serve, and increase the defensibility of their business models. The figure below shows how different business models are relevant across value chains and vehicle segments.

Figure 16: Overview of selected business models relevant across Africa and the Middle East

Ecosystem		Model <sup>1</sup>	Description	Relevance to regional markets	Relevance by vehicle segment and infrastructure readiness			
Decreasing complexity of EV provision models	E-Mass	Ride hailing & sharing	Users pay a personal or shared driver to transport them from point A to B	Drives early adoption, incentivized by EVs' lower TCO compared to ICEs – e-MaaS providers stimulate demand by purchasing vehicles, introducing their customers to EVs, and lobbying policymakers	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant
		EV provision	Pay by use charging	Users pay for the volume of power they use (sometimes rolled out by EV providers)	Improving the coverage, quality, and volume of available charging infrastructure can add to demand for EVs, shaping perceptions of EVs' range of travel and thereby speeding market growth	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant
	Battery swapping		Users purchase EV without a battery and lease batteries from charging stations	Enables growth in 2/3-wheeler markets with minimal charging infrastructure – allows EV providers to lower sticker prices, create additional revenue streams, and sell EVs despite a lack of public charging infrastructure	Feasible and highly relevant	Feasible and highly relevant	Not technically possible	Not technically possible
	PayGo (lease to own)		Users pay a deposit, plus a regular fee until they own the vehicle	Expands access in markets where large populations cannot afford, or are put off by, EVs' upfront costs – given the sum of repayment, maintenance, and refueling costs are less than ICE running costs, users are incentivized to switch	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant
	Rental (pay per use)		Users pay for access to a vehicle for a specific length of time or mileage	Enables users to access EVs as and when needed, without high upfront costs or the liabilities associated with ownership (e.g. purchase, maintenance, and repair costs)	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant	Feasible and highly relevant
	Retro-fitting		Users pay a one-off fee to have an ICE converted into an EV	Allows small-scale conversion, but may not be economically viable for smaller vehicles – the process is complex and must be customized to the relevant vehicle as key components (e.g. drivetrain) need to be replaced	Feasible and highly relevant	Unlikely to be economically possible	Unlikely to be economically possible	Unlikely to be economically possible
	Full price retail	Users pay the full price of the product upfront	Unlikely to drive significant sales in most markets – limits addressable market to users who can afford the sticker price, but is feasible in higher income markets (e.g. South Africa) and has the benefit of shortening cash cycles	Feasible and highly relevant	Most consumers cannot afford to pay full product upfront	Most consumers cannot afford to pay full product upfront	Most consumers cannot afford to pay full product upfront	

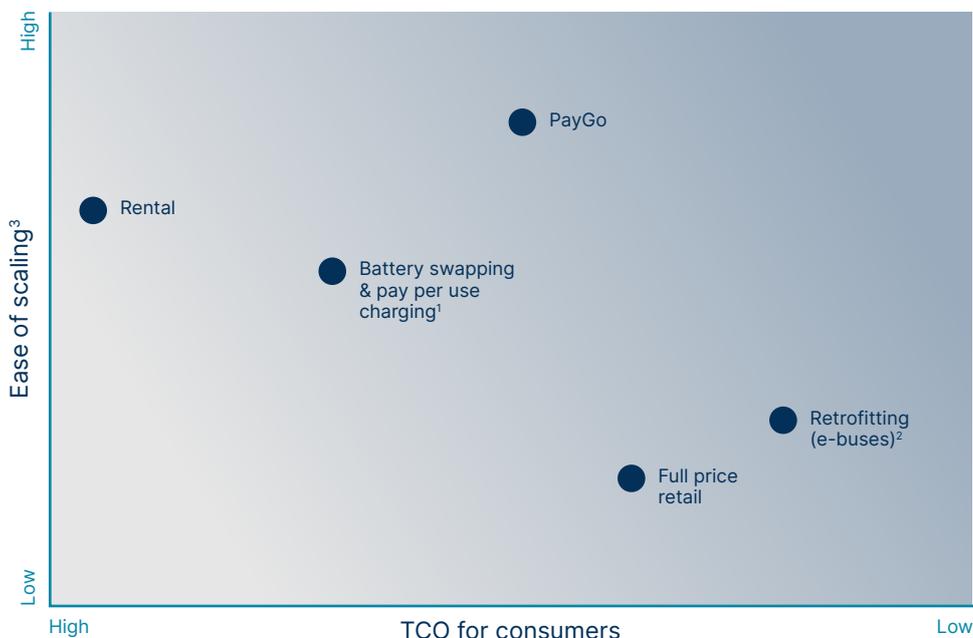
Key: ■ = Model is feasible and highly relevant to the vehicle segment or in a market with minimal charging infrastructure;  
■ = Model is feasible or somewhat relevant;  
■ = Model is either not feasible or relevant.

1. Represents common models rather than an exhaustive list.

**Promising models also have relative ease of scaling and low TCO for consumers.** For instance, pay-as-you-go (PayGo) models increase affordability, reduce sticker price, and quickly enable high sales, and their relatively low CAPEX keeps costs below models like battery swapping. Similarly, models focused on battery swapping and pay per use charging are essential to enabling e-mobility scale in markets that lack charging points, even if CAPEX costs end up being passed onto the consumer. Retrofitting models, particularly relevant for e-buses, convert ICEs to EVs at a cost that is lower than the price of a new EV. However, the scale can be limited by the need to customize the retrofitting process to each individual vehicle model.

**Models with limited ease of scaling or higher TCO for consumers may be more challenging to deploy, but still offer potential.** Rental models require higher CAPEX than PayGo models, but are relatively easy to setup and have a low cost per use, which can enable rapid adoption. However, users continually pay for access and never own the EV, making the TCO for consumers higher in the long run. Finally, business models that offer full price retail EVs are hard to scale as most users cannot afford the upfront price, even if TCO is lower on the whole, given that the product is sold at retail price with no added interest.

Figure 17: Models for EV provision, by ease of scaling and TCO for consumers



**The potential of individual players can be assessed against three criteria** which affect their scalability and attractiveness for commercial investment. First, players should operate in attractive markets, which have a large and growing addressable market and limited regulatory barriers. Second, players should display competitive strength through a strong value proposition versus existing (or potential) alternatives and a defensible business model that can remain relevant even in the face of replication or new entrants. Third, players should have viable economics, both in terms of unit economics and of demonstrating a viable path to achieving economies of scale.

The following pages profile selected enterprises following some of the business models outlined in this report.

1. Pay per use charging rolled out by EV providers to enable customers to use EV offering; 2. Retrofitting is more viable in the bus segment because vehicle values are higher, and the stock is concentrated in a few models (buses are often imported in fleets). As a result, the returns are sufficient to justify designing the customized process and, once designed, it can be repeated multiple times. 3. Ease of scaling is defined as the model's capacity to cost-effectively increase EV provision as demand grows

## BUSINESS MODEL SNAPSHOTS



**Tugende is a leading player in asset financing**, recently secured a total Series A round of \$9.9 M, and is expanding its offer to include electric 2-wheelers

## Company overview

Description	Tugende is a lease-to-own finance solution that increases access to relevant mobility solutions (e.g., motorcycles). It combines insurance, tracking, and service bundles to provide a holistic solution
Countries	Kenya and Uganda
User profiles	Households and taxi operators
Mobility model	PayGo (lease to town)
Offering overview	<p>Asset financing for ICEs</p>  <p>Special hire taxis Boat engines Matatus</p> <p>Asset financing for EVs</p>  <p>Boda-bodas</p>

## Potential forms of support

Type of capital	<ul style="list-style-type: none"> <li>Local currency facilities to provide loans without excessive currency risk</li> </ul>
Technical assistance	<ul style="list-style-type: none"> <li>Technical assistance to establish partnerships with key EV players to expand market opportunities</li> </ul>
Additional market shaping efforts / support	<ul style="list-style-type: none"> <li>Informational events and campaigns to raise awareness of the financing options available for purchasing EVs</li> </ul>



**BasiGo has recently secured \$4.3 M in seed funding** and aims to supply e-buses in Kenya through a 'pay as you drive' model reducing upfront costs to operators

## Company overview

Description	BasiGo is an e-mobility start-up that aims to provide public transport bus owners with a cost-effective electric alternative to diesel. It has established a partnership with major Chinese manufacturer BYD to produce e-buses and plans to assemble these in Kenya
Countries	Kenya
User profiles	Bus operators
Mobility model	Pay as you drive (lease fee for battery on a per km basis)
Offering overview	<p>Electric bus</p>  <p>K6 electric bus</p>

## Potential forms of support

Type of capital	<ul style="list-style-type: none"> <li>Patient capital (equity investment and debt) that accounts for the long cash-to-cash cycles inherent in the business model</li> <li>Guarantees to enable local asset financing by reducing risk to local banking institutions</li> </ul>
Technical assistance	<ul style="list-style-type: none"> <li>Technical assistance to help refine their business model (e.g. sustainable battery input supply)</li> </ul>
Additional market shaping efforts / support	<ul style="list-style-type: none"> <li>Technical assistance to identify high-impact enabling environment reforms (e.g., reductions in import duties; grace period to import buses tax-free while local assembly is established)</li> </ul>



**SolarTaxi** focuses on manufacturing batteries and 2-wheelers, importing 4-wheelers, and e-delivery with support from MasterCard Foundation and Siemens Stiftung

### Company overview

<b>Description</b>	SolarTaxi produces and imports EVs. These are then sold directly or through a deposit plus monthly payments. SolarTaxi also has a battery lab in which it produces lithium-ion batteries (LIBs)
<b>Countries</b>	Ghana
<b>User profiles</b>	Households, taxi operators, & delivery fleets
<b>Mobility model</b>	Direct sales & PayGo
<b>Offering overview</b>	<p><b>Electric 2-wheelers</b></p>   <p>Electric delivery bike      EDV with solar panel</p> <p><b>Imported electric 4 wheelers</b></p>    <p>ER - 30      Renault KZ-E      Xpeng G3 520i</p>

### Potential forms of support

<b>Type of capital</b>	<ul style="list-style-type: none"> <li>Equity investment to enable scale-up of operations and improve unit economics, protecting against potential OEM competition</li> <li>Convertible grants to enable testing of different models for li-ion batteries and identify most cost-effective approach</li> </ul>
<b>Technical assistance</b>	<ul style="list-style-type: none"> <li>Develop network platforms, connecting SolarTaxi to relevant investors and financiers</li> </ul>
<b>Additional market shaping efforts / support</b>	<ul style="list-style-type: none"> <li>Infrastructure finance to develop the charging infrastructure across Ghana</li> <li>Technical assistance to asset financing firms to enter EV market and broaden addressable market</li> </ul>



**Takado** has adopted a partnership model, applying its branding to 2-wheelers from Chinese manufacturer Sunra and providing consumer finance through Eqdom

### Company overview

<b>Description</b>	Takado distributes and applies its branding to scooters produced by Sunra (Chinese manufacturer). Its offering also includes access to finance, which is provided through a partnership with Eqdom (second largest consumer finance company in Morocco)
<b>Countries</b>	Morocco
<b>User profiles</b>	Households, taxi operators, & delivery fleets
<b>Mobility model</b>	Direct sales (and PayGo through partnership)
<b>Offering overview</b>	<p><b>Electric 2-wheelers</b></p>   <p>Electric bike (E-sporty)      Electric delivery bike (E-delivery)</p>

### Potential forms of support

<b>Type of capital</b>	<ul style="list-style-type: none"> <li>Equity investment to enable growth and increase market share in EV sector</li> </ul>
<b>Technical assistance</b>	<ul style="list-style-type: none"> <li>Technical assistance to help refine defensible business model (e.g. identify opportunities and niche plays that complement OEM offering)</li> </ul>
<b>Additional market shaping efforts / support</b>	<ul style="list-style-type: none"> <li>Promotion campaigns to raise awareness of the benefits of EVs</li> </ul>



**“INNOVATIVE BUSINESS**

**MODELS ARE GIVING**

**NEW CONSUMER GROUPS**

**ACCESS TO E-MOBILITY”**



# LOOKING TO THE FUTURE

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Looking to the future, market shaping efforts could strengthen e-mobility ecosystems and enable growth in promising geographies, vehicle segments, and innovations. These are not limited to those presented in this report. Rural e-mobility business models could present a future opportunity. Additional segments such as micro-mobility and boats also have electrification potential. Finally, innovations in the EV space – including battery storage, common charging standards, and carbon credits for financing – could enhance the viability of e-mobility business models across Africa and the Middle East.



## Rural e-mobility

Currently, 500 million Africans still experience poor rural mobility\* which has an adverse effect on economic development, health, and education. Rural households struggle to find mobility solutions that are affordable and appropriate in meeting their needs. In parallel, most rural mobility players struggle to achieve scale while improving the accessibility, safety, efficiency, or sustainability of transport solutions. Rural e-mobility start-ups are often hindered by thin margins, inconsistent demand, and low levels of defensibility, as well as poor transport and energy infrastructure.

Market shaping could play an important role in developing this market. Actors can fund market studies to create an evidence base for investors and entrepreneurs to identify opportunities and refine business models. Supporting incubators/accelerators to build and refine rural mobility models can also help to prepare the ecosystem for commercial investment. Grant funding or concessional capital can further catalyze ecosystem growth, by de-risking innovation and business model development. Finally, building industry platforms that connect decision-makers, innovators, financiers, and suppliers can encourage shared learning and the creation of a more conducive policy environment.



## Micro-mobility and boats

Micro mobility offers a large and growing market, as the sector is forecast to grow at a CAGR of ~13% in the next 5 years. There is a favorable policy environment, with cities like Nairobi and Kigali creating cycle lanes to ease congestion. Complementing this picture, there are few players relative to the size of the market, offering an opportunity for new entrants. Business models must reduce or spread costs to ensure that micro-mobility is competitive to walking as the alternative. In addition clear communication on the benefits of micro-mobility can overcome cultural barriers (e.g., often seen as less desirable). Market shaping efforts can thus focus on investing in and advocating for e-MaaS models that allow consumers to avoid purchase costs and use micro-mobility on demand, and supporting promotional campaigns that raise awareness of the benefits of micro-mobility and target cultural barriers.

Electric boats have favorable economics, given the low TCO and a cost to run 25% lower than for ICE alternatives. Given that fishers typically use boats at night, batteries can be charged during the day with solar power and thus result in no significant charging bottlenecks. In addition, e-boats avoid oil contamination – thus reducing water pollution – and lower CO2 emissions. To scale this segment, business models must offer affordable electric motors to create an addressable market. Market shaping efforts can be directed at strengthening links to asset finance providers (e.g., PayGo models) that can broaden access to electric motors for fishers. Building greater awareness of e-boats is also important to drive early adoption, given that entire crews must trust the technology before switching. Concessional capital or grants can help increase access to finance that enables start-ups to offer free trial periods, as fishers who use e-boats report high satisfaction with reliability, speed, and cost. Finally, additional efforts such as market studies and awareness campaigns can ensure the benefits of e-boats are well understood.

\*Poor rural mobility is defined using the World Bank's Rural Access Index (RAI). It measures the percentage of the population that live within 2km of a quality road.



## Business model innovations

At present, three main business model innovations could drive longer term growth of the e-mobility sector in Africa and the Middle East: (1) batteries for energy storage; (2) the development of common charging standards; and (3) the exploration of carbon credits.



### Battery as an energy storage solution

Supplying the grid with stored energy from unutilized batteries at swap stations could create an extra revenue source for firms, and generate wider benefits by helping to stabilize the grid. Revenue potential would depend on utilization rates at stations, but estimates suggest this could increase revenues by up to 50%. In developing these models, viability must be considered and depends on batteries maintaining storage capacity despite frequent charging and selling. Market research on the viability and revenue potential of energy storage solution models, coupled with technical assistance (e.g., support to EV players in developing the business model) and investments in battery technology to improve durability of storage capacity are market shaping efforts that, if deployed in tandem, could significantly accelerate the development of batteries as an energy storage solution.



### Common charging standards

Common charging standards are a critical component of efficient e-mobility ecosystems. Infrastructure interoperability allows charging of an EV independently of the charging provider, which supports the rollout of a comprehensive charging network. However, current incentive structures drive EV providers to make charging and swapping infrastructure incompatible across brands in order to create a captive consumer base. This results in duplicative over-investment across the ecosystem and in reduced consumer choice. Market shaping can play an important role in addressing these barriers. Industry engagement initiatives that bring EV players together can enable agreements to make infrastructure inter operable, and the establishment of industry associations can improve lobbying for regulations on interoperability. Additionally, technical assistance can be deployed to support regulators on designing optimal common charging standards designed to the nuances of each market.



### Carbon Credits

Carbon credits are a potential source of additional revenue for EV providers that is currently underexplored. Carbon credits require an independent assessment of the emissions reduced from using an EV relative to the ICE alternative. These reductions can in turn be monetized and sold in carbon markets (e.g., to airlines offsetting their emissions), generating wider impact by more accurately pricing the benefits of emission reductions in society. However, estimating reductions can be challenging as the mix of energy sources can change as demand varies. Market research on the potential of EVs to reduce emissions can help build the evidence base needed to justify a carbon credit approach, and industry-wide initiatives can be directed at raising awareness of the potential of carbon credits among EV players.

# ANNEX

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## Globally, demand for mobility solutions is increasing rapidly and is predicted to continue growing between 2022 and 2050

Demand for mobility solutions has increased substantially in the last decade, with a slight slump due to the COVID pandemic

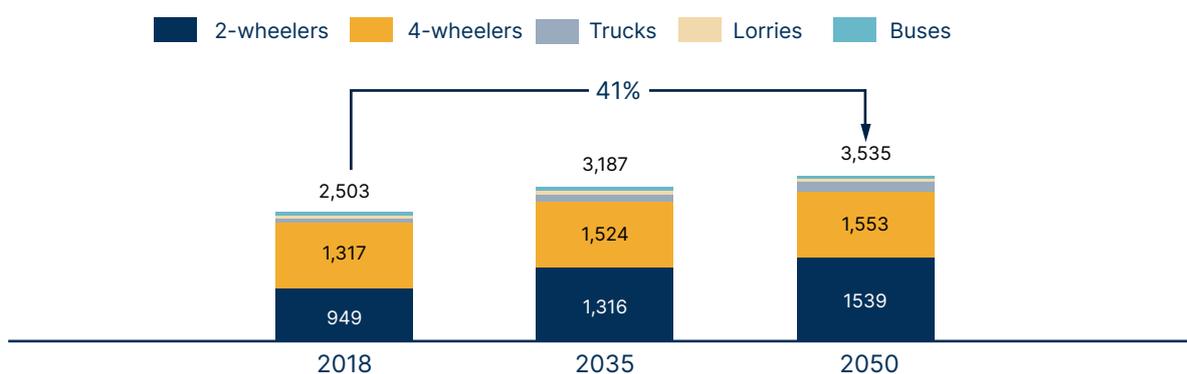
Global car sales, 2010-2020 (million units)<sup>1</sup>



- The global appetite for private cars has increased by 26% (18 million units) between 2010 and 2019
- This growth has been driven by a range of factors, including economic recovery, population growth, the rise of a consumer middle class, increasing urbanization, and demographic trends
- Between 2019 and 2020, global car sales fell by ~15%, due to the impact of COVID

## Projections point to this growth continuing, with opportunities in all vehicle segments and significant 2-wheeler sales

Global vehicle stock by type, 2018-2050 (million units)<sup>2</sup>

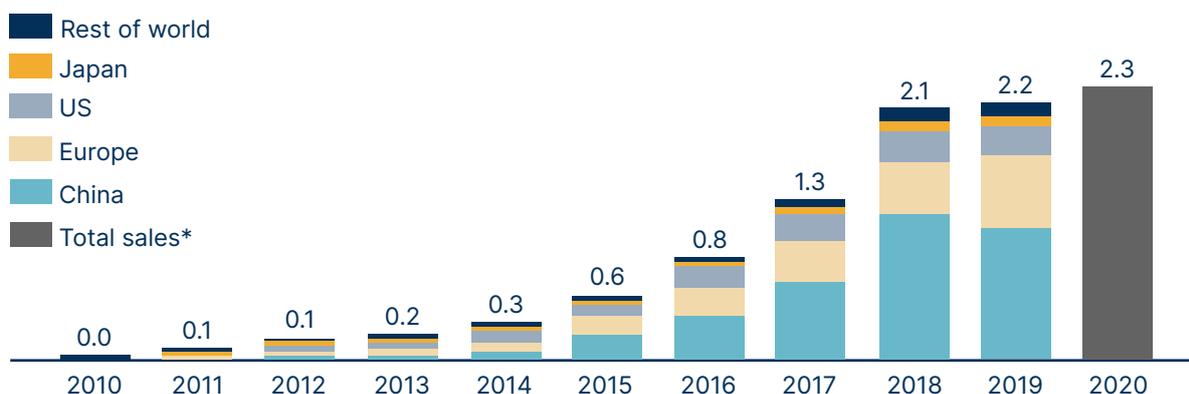


- Global vehicle stocks are expected to rise by 41%, to 3.5 billion in 2050
- The 2-wheeler stock is predicted to grow faster than the currently dominant 4-wheeler stock (CAGR 1.52% vs. 0.52%) to achieve volume parity by 2050
- Stock growth is expected to be highest in the larger, typically private, vehicle segments – while trucks are set to grow at a CAGR of 2.1% and lorries at 1.8%, other segments have a projected CAGR of 0.5-1.5%

## The proportion of global demand met by e-mobility solutions is expanding quickly, with EVs set to dominate sales by 2035

### EVs' share of global sales is increasing rapidly, with promising signs of growth in emerging markets

Global EV sales by market, 2010-2020 (million units)<sup>1</sup>

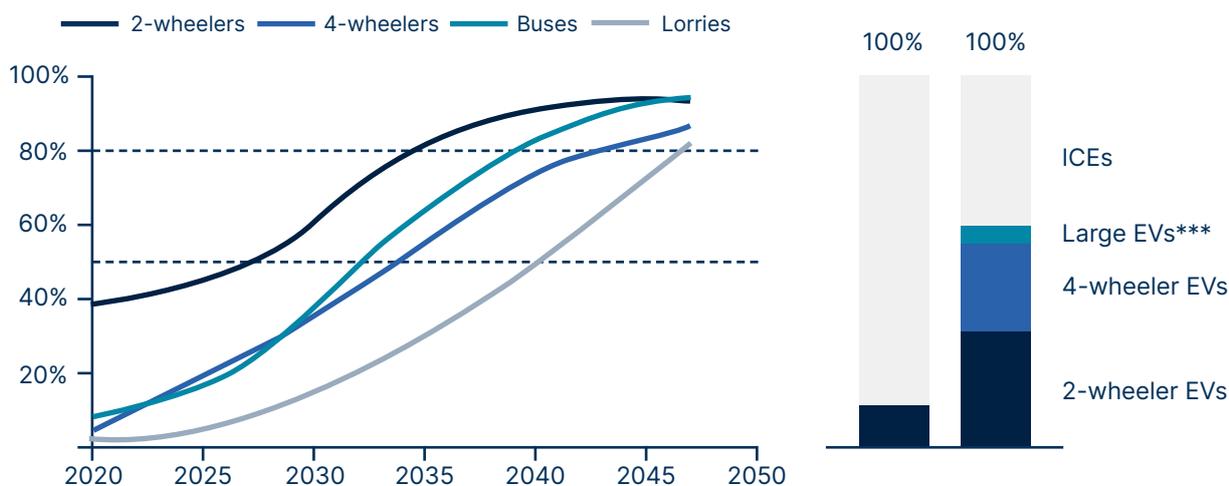


- In 2-wheeler markets, EVs account for ~40% of global sales (18 million)
- Sales of electric 4-wheelers quadrupled between 2015-2020, reaching ~2 million units and increasing EVs' market share from ~1% to ~3%
- There are promising signs of growth in emerging markets – 80% of global 2-wheeler sales took place in Asia in 2020 and 4-wheeler sales in non-established markets\*\* increased 10-fold between 2015 and 2019, amounting to 5% of the global market in 2019

## The pace of growth is set to increase for all vehicle segments, transforming vehicle stocks to be 57% electric by 2050

Left: EVs as a % of global vehicle sales by segment, 2020-2050 (%)

Right: EVs as a % of global vehicle stock by segment, 2018 vs. 2050 (%)<sup>2</sup>



- Global vehicle stocks will transform to being 57% electric by 2050 (from 11% in 2018)
- This transformation will primarily be driven by 4-wheelers (853 million additional units) and 2-wheelers (722 million additional units)
- Projections indicate that >50% of sales in all vehicle segments will be electric by 2035 and >80% by 2050

\* 'Total sales' is used in 2020 because disaggregated data by market is not available; \*\* Markets beyond China, Europe, US, and Japan; \*\*\* 'Large EVs' includes trucks, lorries, and buses;

## Global trends are enhancing EVs' monetary and non-monetary advantages (over ICEs) and removing limitations on supply

		Removes limitations on the supply of EVs or chargers	Erodes non-monetary constraints on demand	Reduces TCO and/or sticker price
		(e.g. infrastructure coverage, battery availability, etc.)	(e.g. range anxiety, lack of consumer awareness, poor product suitability, etc.)	(e.g. purchase costs, running costs, end-of-life costs, etc.)
Level	Trend			
Company	1. <b>Innovative business models</b> are giving new consumer groups access to e-mobility and easing infrastructure constraints.			
Sector	2. <b>An increase in the number of EV producers</b> is expanding consumer choice and improving products' adaptation to the market			
	3. <b>Improving battery performance</b> is ensuring that EVs have a TCO that is notably lower and falling faster than that of ICE equivalents			
	4. <b>Falling battery costs</b> are reducing EVs' sticker price, closing the price gap on ICE vehicles			
Ecosystem	5. <b>Improvements in infrastructure readiness</b> are likely to reduce consumers' range anxiety and remove limits to growth			
	6. <b>E-mobility friendly policies</b> are providing monetary and non-monetary incentives to use e-mobility and limiting the market for ICEs			

Please note: Ticks are given based on the trend's current contribution (i.e., a trend's potential future contribution is not assessed). For example, while improvements in infrastructure readiness could lower the cost of charging in the future, desk research found little evidence that this is currently the case.

## Most LMICs in the region do not have the volume of funding available to China and India, but tested policies and innovative private sector models are filling the gap



### Fossil fuel subsidies

#### LMICs in Africa and the Middle East are increasingly looking to phase out petrol subsidies, while subsidizing EV charging points:

- Many high potential e-mobility markets in Africa have petrol prices that are close to the world average (e.g. prices in Ghana, Kenya, Rwanda, Uganda, and South Africa are within +/-15% of the global average)<sup>1</sup>
- Countries that heavily subsidise prices are considering changes (e.g. Nigeria's government considered eliminating fuel subsidies in 2020 and Egypt's fuel subsidies dropped by 45% in the first half of FY2020/2021)<sup>2</sup>

#### Increasing oil prices due to the current energy crisis are also increasing EVs' TCO advantage



### EVs' high sticker prices

#### LMICs in the region are taking on a range of measures that encourage purchase price parity:

- Egypt has waved customs duties for EVs, applied point of purchase subsidies worth up to \$3,000 per EV, and implemented a 1-year age limit on imported ICEs
- Similarly, countries like Rwanda and Morocco have reduced customs duties for EVs, and the latter has halved VAT for EVs

#### Innovative business models are also enabling sticker price parity:

- Companies like BasiGo sell EVs at the same price as comparable ICEs, collecting the outstanding value of the EV through PayGo payments – given EVs' running costs are substantially cheaper than those of ICEs, consumers still benefit from a lower TCO



### Availability of charging

#### Although most LMICs do not have the volume of funding of China and India, the public sector is still driving the rollout of charging stations:

- Egypt aims to rollout ~3,000 charging points by 2024
- By the end of 2022, Morocco aims to establish a production line capable of producing 5,000 charging stations per year
- Kenya, Rwanda, Ghana, and Uganda are all piloting and incentivizing rollout

#### Private players are also leading the charge in many countries, through battery swapping business models:

- Players like Ampersand & Zembo have used the additional revenue from battery swapping to fund the rollout of charging stations



### Consumer perceptions

#### Several states are launching campaigns that raise awareness of EVs' existence, reliability, and lower TCO:

- Rwanda has partnered with the Global Green Growth Institute (GGGI) to increase outreach and raise awareness of the potential of e-buses
- Uganda's government has partnered with Makerere University to publicise the production and utility of EVs produced by Kiira Motors
- In Morocco, city-level authorities (e.g. in Casablanca) are promoting EVs through public information and awareness campaigns

# ANNEX

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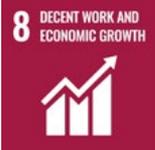
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## E-mobility can support progress towards a range of Sustainable Development Goals (SDGs) beyond SDGs 3 and 13

	SDG	Link to e-mobility	Target Description
PROVEN LINKS		<b>Target 11.2:</b> Provide access to safe, affordable, accessible, and sustainable transport systems for all... with special attention to women, children, persons with disabilities, older persons	<ul style="list-style-type: none"> <li>• EVs have a lower TCO which can make transport solutions more affordable (e.g., e-MaaS providers can provide more affordable transport options due to a lower cost base)</li> <li>• E-MaaS solutions are often designed with innovations that improve gender equity in access to transport (e.g., 'dial-a-ride' services that enable direct transit from point A to point B)</li> </ul>
		<b>Target 9.4:</b> Upgrade infrastructure... to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes	<ul style="list-style-type: none"> <li>• EVs provide a sustainable alternative to ICEs, especially in countries where most energy production is renewable (e.g., Kenya)</li> <li>• EVs also have the potential to significantly reduce noise pollution in urban areas, linked to improved quality of life and health outcomes</li> </ul>
POTENTIAL LINKS		<b>Target 8.3:</b> Promote productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises	<ul style="list-style-type: none"> <li>• E-mobility could potentially create a range of skilled and labor-intensive jobs across the value chain – raw material extraction and processing, vehicle assembly, and aftermarket services (e.g., repairs) could create jobs</li> <li>• Several countries (e.g., Egypt, Kenya, South Africa, DRC) are already looking to increase the proportion of EV parts that can be produced domestically</li> </ul>
		<b>Target 1.4:</b> Ensure that all... have equal rights to economic resources, as well as access to basic services	<ul style="list-style-type: none"> <li>• More accessible and affordable transport options could potentially support the alleviation of poverty by increasing economic linkages and enhancing access to job opportunities</li> </ul>

## Investment in e-mobility also offers the chance to enhance gender equity in the delivery and consumption of mobility solutions

	Existing barrier(s)	Potential e-mobility contribution(s)
<p><i>Criteria</i></p> <p><b>1. Entrepreneurship</b></p> <p><i>Metric</i></p> <p>1A. Share of women ownership is 51%</p> <p>OR</p> <p>1B. Firm founded by a woman</p>	<p><b>Female-founded or -led businesses receive a very small proportion of African VC funding</b></p> <ul style="list-style-type: none"> <li>- Female-founded start-ups received only 16% of all technology-focused VC equity funding in Africa in 2021</li> <li>- Male-only leadership teams secured 75-85% of all technology-focused VC deals in some of the region's largest markets (Nigeria, South Africa, Egypt and Kenya)</li> </ul>	<p><b>Investors could unlock returns by funding companies with diverse leadership</b></p> <ul style="list-style-type: none"> <li>- Diversity introduces varied perspectives, which can help mitigate risks, foster innovation, and avoid group-think</li> <li>- African firms in the top quartile for women's representation on the Board achieved margins 20% higher than the industry average; firms in the bottom quartile had margins that were 17% lower than average</li> </ul>
<p><i>Criteria</i></p> <p><b>2. Leadership</b></p> <p><i>Metric</i></p> <p>2A. Share of women in senior mgmt. is 30%</p> <p>OR</p> <p>2B. Share of women on the board or IC is 30%</p>		
<p><i>Criteria</i></p> <p><b>3. Employment</b></p> <p><i>Metric</i></p> <p>3A. Share of women in workforce is 30-50%</p> <p>AND</p> <p>3B. One "quality" indicator beyond compliance</p>	<p><b>Women are less able to access jobs in mobility</b> – in LMICs, women hold just 5-15% of jobs in the mobility sector</p> <p><b>Workplaces are not designed to serve the needs of female and male employees equally</b> (e.g. female drivers lack access to security systems that protect against the threat of violence)</p>	<p><b>Gender-focused funding conditions and technical assistance</b> could improve gender equity in e-mobility companies, providing the incentive and guidance (e.g. around appropriate recruiting and retention strategies) to increase the proportion of women in the workforce</p>
<p><i>Criteria</i></p> <p><b>4. Consumption</b></p> <p><i>Metric</i></p> <p>4. Product or service benefits women specifically or disproportionately</p>	<p><b>Women's needs often differ from men's</b> – in Nairobi, women's trips tend to be more frequent, shorter, and more affected by safety and cost</p> <p><b>Current mobility systems exacerbate time-poverty for women</b> (e.g. women in Ghana spend ~12x more time in transit than men)</p>	<p><b>E-mobility can be designed around women's needs</b> – as a new sector, e-mobility could gain traction by improving safety and designing subscription e-MaaS models that enable short and regular use</p> <p><b>Features of e-mobility cater to women's needs.</b> Women tend to have less disposable income. The lower TCO of EVs can make mobility more affordable</p>

## Realizing e-mobility's potential contribution to the SDGs and 2X Challenge will require a variety of obstacles to be mitigated

### Challenges capable of undermining e-mobility's contribution to the SDGs

Challenge	Description	Emerging mitigation mechanisms
<p>SDGs</p>   <p><b>Battery production has substantial environmental and social costs</b></p>	<p><b>Mining raw materials for LIBs is emission-intensive</b> – ~10% of the lifecycle emissions of an EV come from mining raw materials.</p> <p><b>A large proportion of batteries are not recycled and contribute to chemical waste when dumped</b> – currently ~95% of LIBs in the US are not recycled.</p> <p><b>Battery production has a human cost</b> – ~15% global cobalt comes from mines in the DRC with a history of child labor.</p>	<p><b>Battery recycling can cost less than mining</b> when scaled; recycling is expected to reach scale in ~20 years, though rising scarcity may bring this closer</p> <p><b>Batteries can be reused to keep them from landfills</b> – after 10 years, EV batteries still have 80% capacity and can be used for energy storage</p> <p><b>Reformulated 'cobalt-free' LIBs would have lower social impact and cost less</b> (e.g. cobalt can be replaced by manganese that is cheap and plentiful).</p>
<p>SDG</p>  <p><b>EVs' electricity needs could strain already stretched energy grid</b></p>	<p><b>The additional power required to charge EVs may put a strain on energy infrastructure capacity</b> – high income countries with relatively advanced EV markets (e.g. UK) are already creating contingency plans to avoid energy shortages and power cuts</p>	<p><b>Varying electricity tariffs by time of use</b> – cheaper electricity rates in off-peak periods can up to halve the load that EVs place on the grid</p> <p><b>In the future, EVs could also provide a means of energy storage</b>, discharging energy back to the grid at times of peak demand</p>
<p>SDG</p>  <p><b>EV emissions vary according to how clean their energy source is</b></p>	<p><b>EVs' emissions depend on the power source used</b> – EVs charged using 100% coal-powered energy can produce more emissions than an ICE</p> <p>Increasing energy prices will make coal more viable – the current energy crisis is pushing energy prices high enough to make coal attractive again</p>	<p><b>Renewable capacity is set to more than double</b> in Africa and the Middle East (from 30 to 65GW by 2026)</p> <p><b>This increase in capacity has been driven by significant flows of international finance</b> – Sub-Saharan Africa received nearly \$4 billion in international finance for clean energy in 2018 alone</p>

# ANNEX

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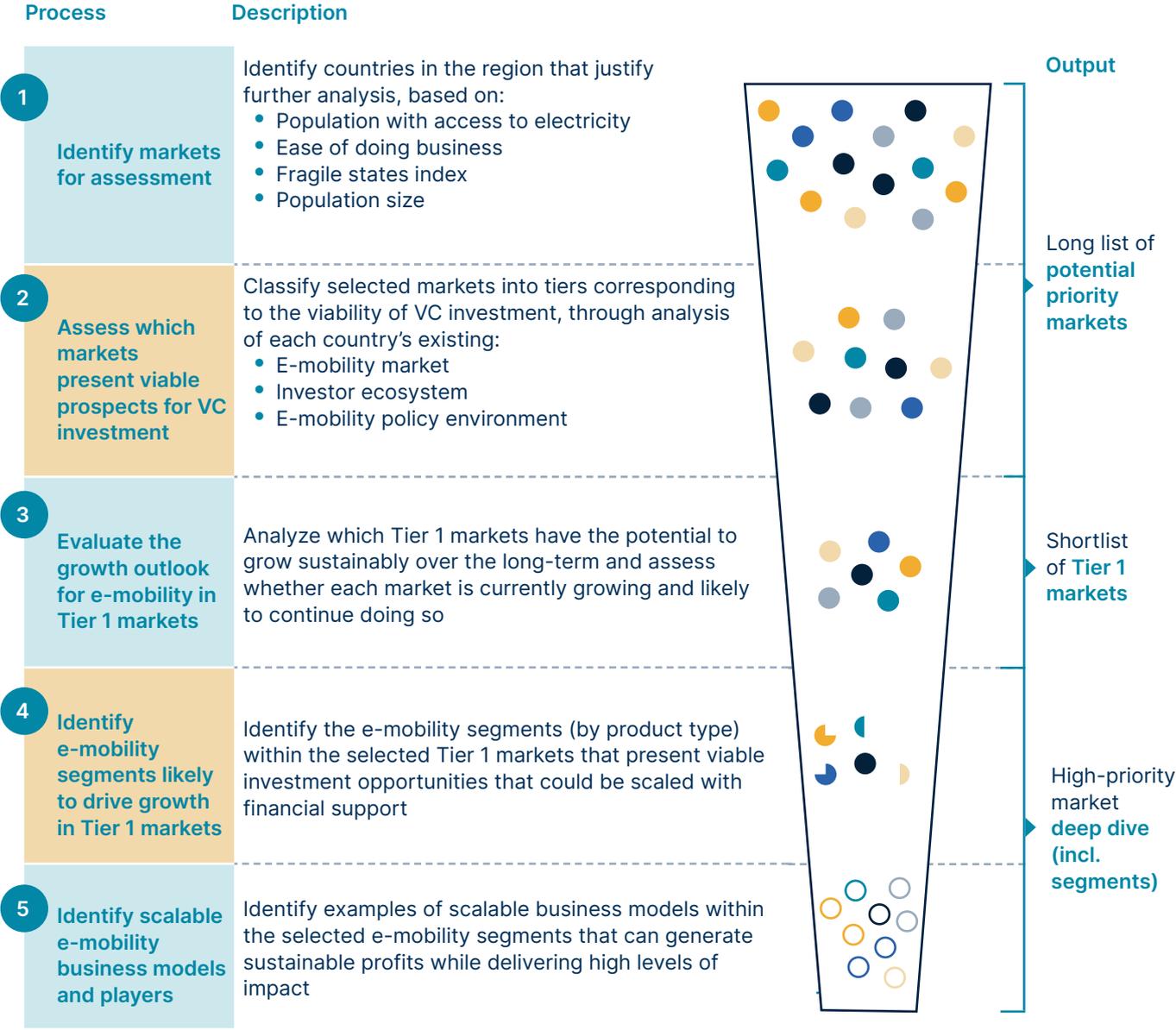
Global trends

Impact case

› Country assessment process



# A staged assessment can help identify the markets in Africa and the Middle East that present the best opportunities for e-mobility investment



Legend: ● = Country or market; ◐ = E-mobility market segment (e.g. 2 wheelers in urban areas); ○ = Scalable business model and players

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