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# Power to move: Accelerating the electric transport transition in sub-Saharan Africa

How governments, development partners, and private-sector stakeholders can build an enabling ecosystem for electric vehicles in the region.

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**Globally, the automotive future is looking increasingly electric**, due to growing regulatory moves, including forthcoming bans on sales of internal combustion engine (ICE) vehicles, shifting consumer behavior, and ongoing improvements in battery and charging technology. By 2035, the world's major automotive markets—the United States, European Union, and China—are expected to sell only electric vehicles (EVs), and by 2050, 80 percent of the world's vehicle sales are expected to be electric.[1] EVs are a critical component of achieving climate neutrality (in Europe, for example, the life-cycle emissions of an EV are around 65 to 85 percent lower than that of an ICE vehicle) and improving quality of life in cities by reducing air and noise pollution.

This article seeks to answer two questions: How will the trend toward electric mobility play out in sub-Saharan Africa? What are the opportunities and challenges associated with the region's electric transport future? [2]

Transport currently makes up 10 percent of Africa's total greenhouse gas (GHG) emissions, which is expected to increase in line with sub-Saharan Africa's expanding vehicle parc (Exhibit 1). [3] In the six countries that make up around 70 percent of sub-Saharan Africa's annual vehicle sales and 45 percent of the region's population (South Africa, Kenya, Rwanda, Uganda, Ethiopia, and Nigeria), the vehicle parc is expected to grow from 25 million vehicles today to an estimated 58 million by 2040, driven by urbanization and rising incomes. As its vehicle parc grows, the challenge for sub-Saharan Africa will be to push for more sustainable mobility and avoid the risk of becoming the dumping ground for the world's unwanted used ICE vehicles.

1 "Why the automotive future is electric," McKinsey, September 7, 2021.
2 For the purposes of this article, sub-Saharan Africa refers to all countries on the African continent except those in North Africa (Algeria, Egypt, Libya, Morocco, and Tunisia).
3 "Green Africa: A growth and resilience agenda for the continent," McKinsey, October 28, 2021.

Exhibit 1

## Sub-Saharan Africa's growing vehicle parc is dominated by used vehicles.

**Vehicles on the road in Ethiopia, Kenya, Nigeria, Rwanda, South Africa, and Uganda,** million

| | |
|---|---|
| 2022 | 25 |
| 2040 | 58 |

**Vehicle ownership,** number of vehicles per 1,000 people

| Ethiopia | Kenya | Nigeria | Developing Asia, Oceania, Middle East | Global |
|---|---|---|---|---|
| 2 | 17 | 25 | 79 | 180 |

**Vehicle life expectancy,[1]** years

| Cars[2] | Motorcycles |
|---|---|
| 15–20 | 2–5 |

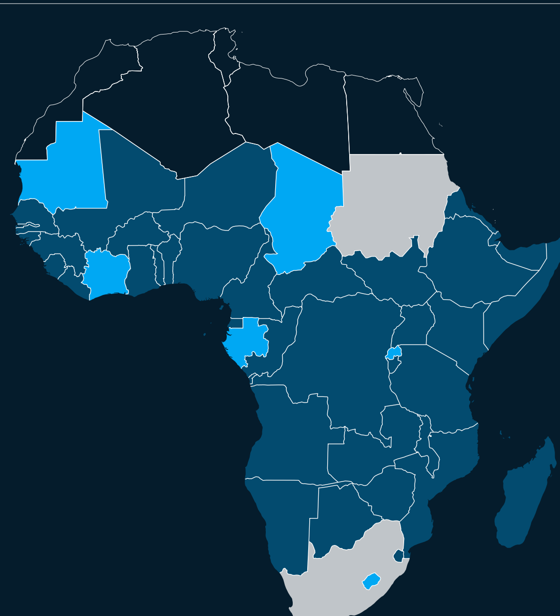
**Sub-Saharan Africa used-vehicle regulatory environment for light duty vehicles[3]**

**Good or very good**
7 countries ban import of used vehicles over 5 years old and/or have adopted at least a Euro 4 emissions standard for imports

**Weak or very weak**
39 countries allow imports of used vehicles of 6 years old or older and/or have adopted a Euro 3 emissions standard or lower for imports

**Banned**
3 countries have a complete restriction on used-vehicle imports

Not in-scope for this article



**40%**
of all used vehicles exported globally end up in Africa

**>80%**
of all four-wheeler vehicle imports[2] to sub-Saharan Africa are used

**$6,000–$10,000**
is the average price of a used passenger car in Kenya and Nigeria

Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by McKinsey & Company.
[1]Except for two-wheelers.
[2]Cars, minibuses, and light commercial vehicles; not including South Africa, where used-vehicle imports are banned.
[3]A light duty vehicle is a four-wheeler of less than 3.5 tons.
Source: IHS Markit consumer survey of ~1,000 vehicle owners in Nigeria and Kenya; *Global trade in used vehicles*, UN Environment Programme, October 26, 2020; McKinsey Center for Future Mobility

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Some governments in sub-Saharan Africa have started to announce electrification targets for vehicles and incentives for EV adoption—such as Rwanda's announced tax exemptions for EV sales. Moreover, a growing start-up ecosystem for EVs, focusing particularly on electric two-wheelers, is emerging in the region. McKinsey estimates that as of the end of 2021, there were more than 20 start-ups in the ecosystem, which combined raised over $25 million in funding that year.[4]

While momentum is building, sub-Saharan Africa faces some unique challenges in its electric mobility transition, including, in some cases, unreliable electricity supply, low vehicle affordability, and the dominance of used vehicles. Many countries have made significant strides toward improving electricity access (all six countries mentioned have urban-electricity-access rates above 70 percent and some more than 90 percent); however, electricity reliability remains an issue. A 2019 survey across 34 African countries found that fewer than half of those connected to the grid have reliable electricity.[5] In addition, the reported 2020 System Average Interruption Disruption Index (SAIDI) for sub-Saharan Africa was 39.30 versus 0.87 for OECD high-income countries.[6,7]

The second challenge is affordability, shaped by comparatively low household incomes, low availability of asset finance at affordable rates, and higher price points for EVs.

The third issue is the dominance of used vehicles on much of the continent (excluding a few countries such as South Africa, where used-vehicle imports are banned). In most sub-Saharan African countries, around 85 percent of all four-wheel vehicle sales are used vehicles.[8] This is driven by affordability challenges and weak regulation, with many countries allowing the import of vehicles over 15 years' old and with fairly low emissions standards. A 2020 United Nations Environment Programme (UNEP) report states that 40 out of 49 sub-Saharan Africa countries have weak or very weak used-vehicle regulations.[9] New EVs will therefore struggle to compete with old, low-cost ICE vehicles that are readily available in the region. And, given that 40 percent of all globally exported used vehicles end up in Africa, the continent runs the risk of becoming a dumping ground for used ICE vehicles while the rest of the world transitions to an electric transport future.[10]

In this article, we look at some of the challenges and opportunities associated with sub-Saharan Africa's electric transport journey, including some of the steps governments, development partners, and private-sector stakeholders can consider taking to build an enabling ecosystem for EVs in the region.

[4] Publicly announced funding only.
[5] "Prerequisite for progress: Accessible, reliable power still in short supply across Africa," Afrobarometer survey, December 5, 2019.
[6] Doing Business 2020, World Bank.
[7] SAIDI measures the total duration of customer interruptions of electricity supply over a year divided by the number of customers, such that a higher value is worse than a lower value. The SAIDI value for sub-Saharan Africa covers 20 countries.
[8] Global trade in used vehicles, UN Environment Programme, October 26, 2020.
[9] *Ibid.*
[10] *Ibid.*

## Common EV Terminology

***EVs* typically refer** to BEVs (battery electric vehicles) unless otherwise specified.

*Range anxiety* is the concern that a battery may lose charge while on the road without access to charging infrastructure.

*Parc* refers to the total stock of vehicles on the road.

*(EV) adoption rate* is the share of electric vehicles purchased in a year.

*Vehicle charging* is divided into three levels:

- *Level 1* charging uses a standard home power outlet and typically provides 5 to 8 kilometers (km) per hour of charging.
- *Level 2* charging requires specialized equipment, costing between $200 to $1,000, that can be installed at home, at the workplace, or in public locations and can charge 20 to 130 km per hour (depending on the equipment).
- *Level 3* (or DC fast charging) uses direct current (DC), costs tens of thousands of dollars per charger to install, and can charge 5 to 30 km per minute. This type of charger is typically for high-use commercial vehicles like buses or for highway driving where fast charging is required midoperation.

*Vans* (or light commercial vehicles) are less than 3.5 tons, including panel vans, utility vans, and pickups.

## Opportunities and challenges to EV adoption in sub-Saharan Africa

In assessing the opportunity for EV adoption in sub-Saharan Africa, we engaged more than 70 organizations, including local EV start-ups, vehicle assemblers and distributors, electricity-distribution companies, commercial fleet owners, minibus associations, regulators, and financiers, and surveyed nearly 1,000 vehicle owners in major markets. This article focuses primarily on two-wheelers, passenger cars, minibuses (14-seater vans, currently the predominant form of public transport in sub-Saharan Africa), and light commercial vehicles (vans), which together comprise most of the vehicle parc in sub-Saharan Africa (see sidebar "Large buses and trucks"). South Africa is not included in this analysis due to some key differences compared with the rest of the region, including its ban on used-vehicle imports, higher consumer income, and relatively small two-wheeler parc (less than 3 percent of the total vehicle parc, versus up to 50 percent in most other sub-Saharan African countries). However, many of the findings are likely still applicable in the overall South African context.

This article's findings indicate high awareness of EVs among drivers, a favorable total cost of ownership for EVs, and a growing use case for electric two-wheelers in particular, though up-front costs may stall the widespread uptake of EVs.

**Awareness of EVs is high among passenger-car owners.**
Over 90 percent of all vehicle owners surveyed in Nigeria and Kenya had heard of EVs, with most recognizing that the technology is sound and better for the environment. However, almost all stated "range anxiety" (see sidebar "Common EV terminology") and high up-front costs as their primary concerns.

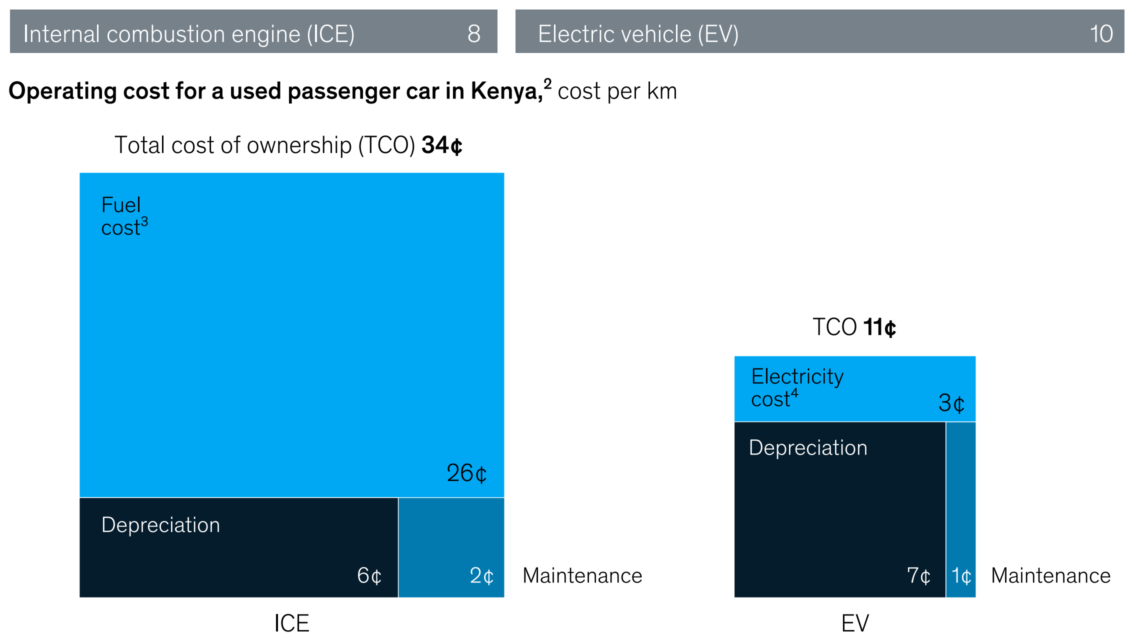
**The total cost of ownership is favorable, but up-front costs are currently prohibitive.**

The total cost of ownership (TCO) of EVs is more favorable than that of ICE vehicles, even in countries with fairly high electricity costs like Kenya, where the residential electricity tariff is over 20 cents per kilowatt-hour (Exhibit 2). These economics improve the more a vehicle is driven due to the lower operating costs, meaning that vehicles used for commercial purposes (such as minibuses, vans, and two-wheelers) are more favorable for early transition. Despite high awareness of EVs, few individuals we surveyed understood the benefits, with some commercial fleet owners and bus associations expressing surprise at the favorable lifetime economics of EVs.

Exhibit 2

## EVs are more affordable over their lifetime than ICE vehicles in Kenya.

**Estimated up-front price for a used passenger car in Kenya,**[1] $ thousand




[1]Projection made for used EVs based on expectation that they will follow depreciation curves similar to that of ICE vehicles.
[2]Based on Toyota Corolla equivalent and assuming ~23,000 km driven per year and a 7-year holding period with 0% residual value at the end of the period.
[3]Assuming 2021 fuel price.
[4]Assuming at-home charging (Level 1) and 2021 electricity pricing.
Source: McKinsey Center for Future Mobility

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## Large buses and trucks

**This McKinsey analysis** focuses on smaller vehicle classes. The technology and ecosystem for the electrification of large, long-haul trucks are still being developed globally and are unlikely to scale to sub-Saharan Africa in the next 20 years.

Large buses have a case for electrification, with China and the European Union both setting targets for their adoption (electric buses are already widespread in many Chinese cities).[i] However, as most large buses in sub-Saharan Africa are currently used for intercity transportation, often driving well above 100 km a day, they are, for now, unlikely candidates for electrification.

Minibuses remain the dominant form of urban public transportation. However, governments in sub-Saharan Africa are increasingly encouraging the use of large buses for urban public transport, which could impact the electrification potential and charging infrastructure required. For example, Kenya has stated that it will be encouraging the use of electric buses as part of the Nairobi Bus Rapid Transit system.[ii]

i "The European electric bus market is charging ahead, but how will it develop?," McKinsey, July 2, 2018.
ii Hilary Kimuyu, "Kenya: Nairobi BRT lane is for electric buses only, says PS Hinga," AllAfrica, June 9, 2021.

Nonetheless, up-front costs remain a barrier. While Exhibit 2 shows the projected comparison for a used ICE vehicle and electric car in 2030, the availability of EVs is currently limited to new vehicles, whereas most vehicles purchased in sub-Saharan Africa are low-cost used ICE vehicles. Surveyed passenger-car owners in Kenya and Nigeria estimate they spend between $6,000 and $10,000 to purchase a used ICE vehicle. Until used four-wheeler EVs become available at scale at similar prices—likely in the mid to late 2030s, it is unlikely they will be able to compete without incentives. In sub-Saharan Africa, this also impacts some commercial vehicle classes, such as vans, as these are often purchased used and owned by individuals or private associations who then hire them out. In Kenya, for example, nearly 50 percent of all vans are likely owned by individuals on a for-hire basis, which means that the ability to purchase an EV still relies on the owner's income and access to affordable financing.

**Driving behavior in Africa is suitable for EV adoption, with some exceptions.**
Understanding driving and parking behavior is critical to assessing the region's potential for EV adoption. Vehicle owners who tend to drive less than 100 kilometers (km) per day and park in a dedicated space at home or at work can typically use basic Level 1 or Level 2 EV charging (see sidebar "Common EV terminology"). Most personal car owners in sub-Saharan Africa fit these criteria, even when factoring in time spent in traffic, as EVs are very efficient in start-stop conditions.

The picture becomes more complex, however, for taxis, minibuses, and vans that are in frequent use and travel long distances every day. Vehicles that travel more than 100 km a day with limited stops would require fairly high-cost Level 3 DC fast-charging infrastructure along major routes or at commercial centers. Short routes for minibuses and vans that park overnight at a fixed station may be more suitable for early EV adoption, where a wall charger can be installed with comparatively limited investment.

**Emerging use case for electric two-wheeler adoption.**
Unlike all other vehicle segments assessed, two-wheelers (called *boda bodas* in much of East Africa and *okadas* in Nigeria) are predominantly purchased new in sub-Saharan Africa. More than nine in ten two-wheelers are purchased for commercial use as taxis or delivery services. Commercial use results

## Most four-wheelers purchased in sub-Saharan Africa are low-cost used ICE vehicles. Until used four-wheeler EVs become available at scale at similar prices–likely in the mid to late 2030s–it is unlikely they will be able to compete without incentives.

in a higher average distance traveled per vehicle, which improves the TCO of the electric two-wheeler versus the ICE two-wheeler. This also results in a fairly high fleet turnover, with an urban owner in Kenya and Nigeria purchasing a new two-wheeler every two to three years, on average. And because electric two-wheelers have a small battery, they can be charged via a mini-grid, making them suitable for use in locations with low access to reliable electricity-grid infrastructure. They can also benefit from a battery-swap model, in which a depleted battery is replaced with a fully charged battery from a designated "swap station" in just a few minutes.

These factors strengthen the case for more widespread adoption of electric two-wheelers in sub-Saharan Africa, following the trend seen in Asia.[11] A number of start-ups are already investing in the region's nascent electric two-wheeler space to design vehicles at a cost and durability suitable for the local market. For example, Opibus in Kenya is investing in local R&D and assembly to build an electric motorcycle tailored to the needs of *boda boda* drivers who demand a high-durability vehicle that can go up to 130 km per day at a comparable cost to an ICE two-wheeler. Companies such as Ampersand in Rwanda are also developing a network of battery-swapping stations to enable two-wheeler drivers to exchange depleted batteries for fully charged batteries on the go.

Even with this emerging use case, there are still challenges to overcome. Issues include the higher up-front price point for electric two-wheelers versus ICE two-wheelers (estimated at $1,700 to $1,800 in mid-2021 versus $1,300 in Kenya), unknown battery lifetime data given that motorcycles in sub-Saharan Africa go much longer daily distances than those in Asia, and the high cost of battery swapping.

Despite these challenges, the TCO for electric two-wheelers is favorable. Even with a higher up-front cost—and assuming no residual value—the electric two-wheeler is 25 percent cheaper over a five-year life cycle compared with an ICE two-wheeler due to fuel and maintenance savings. Moreover, initial driver feedback on electric two-wheelers in sub-Saharan Africa has been very positive. A recent pilot by the UK Aid–funded Manufacturing Africa program involving a side-by-side test of 20 drivers using electric two-wheelers and 20 drivers using ICE two-wheelers found that more than 90 percent of the electric two-wheeler drivers felt they performed as well, if not better, than the ICE two-wheeler. All of the participating drivers indicated that they are likely or very likely to purchase an electric two-wheeler as their next vehicle. This combination of local companies investing to solve the challenges to adoption and positive consumer perception suggests high potential for electric two-wheelers in the region.

[11] Patrick Hertzke, Jitesh Khanna, Bhavesh Mittal, and Felix Richter, "Global emergence of electrified small-format mobility," McKinsey, October 6, 2020.

## Mixed potential for electric vehicles in sub-Saharan Africa

Based on these findings, McKinsey mapped different vehicle segments across a number of criteria to determine their feasibility for EV adoption in sub-Saharan Africa (Exhibit 3). This mapping is based on the situation today; as more used EVs become available post-2030 and technologies evolve, this assessment may evolve too.

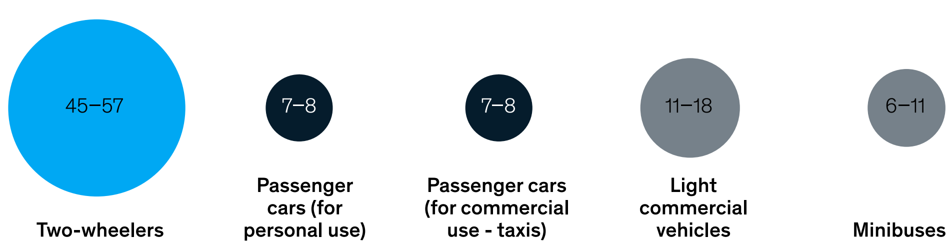
Exhibit 3

### Electric two-wheelers are currently the most feasible vehicle segment for adoption in sub-Saharan Africa.

**Feasibility of electric-vehicle adoption in sub-Saharan Africa** — High, Medium, Low

| | Two-wheelers | Passenger cars (for personal use) | Passenger cars (for commercial use - taxis) | Light commercial vehicles | Minibuses |
|---|---|---|---|---|---|
| **Primary use** (commercial or personal) | *90% of all two-wheelers are for commercial use, traveling 90–130 km per day* | *Personal use, traveling 20–40 km per day* | *Commercial use (taxis), traveling up to 100 km per day* | *Commercial use, traveling over 100 km per day* | *Commercial use, traveling over 100 km per day* |
| **Charging infrastructure required** | *Battery swap stations or Level 1 at-home charging* | *Level 1 at-home charging sufficient in most cases* | *For some drivers and routes (traveling less than 100 km per day), Level 1 or 2 charging is sufficient DC fast charging required for full coverage* | | |
| **Ability to charge** | *Drivers have time to make battery swaps, charge at home, or publicly charge* | *Most owners have access to electricity at home and are able to charge overnight* | *Able to charge overnight; limited time to charge during the day, which is required for going longer daily distances* | | |
| **Up-front cost of EV[1]/ICE[2]** | *Current models are 30% more expensive, but R&D expected to bring down cost* | *Approximately 20–30% more expensive for new vehicles Used EVs not yet available so unable to compete with used ICE vehicles on purchase price* | | | |
| **TCO[3] EV/ICE** | *More favorable for EVs, even in countries with high electricity costs* | | | | |
| **Buy used/new** | *Mostly new* | *Mostly used (>80% of all sales)* | | *New and used* | *Mostly used* |
| **Overall assessment** | | | | | |

**Sub-Saharan Africa's estimated vehicles on the road by 2040,[4] % share**




[1]Electric vehicle.
[2]Internal combustion engine.
[3]Total cost of ownership.
[4]Excluding South Africa; percent of total vehicles on the road. Range represents the base versus accelerated case.
Source: McKinsey analysis

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Using this analysis, two potential scenarios emerge for EV adoption in sub-Saharan Africa:

- *Base-case scenario, primarily driven by as-is market conditions.* Under this scenario, regulatory intervention to encourage the EV transition is limited; adoption is driven by EV affordability and availability. Vehicle segments that are dominated by used vehicles do not transition at any significant level until after 2035, when used EVs start to become available at sufficient scale to compete with used ICE vehicles in terms of affordability. Corporate-owned fleets (estimated at around half of all vans) are expected to switch to EVs faster, driven by companies' sustainability commitments and the benefits of EV's lower operating costs. Given the existing momentum in the electric two-wheeler segment, this segment is expected to grow dramatically, in line with the trend in Asia, given favorable TCO and high fleet turnover. This scenario also factors in the current electricity reliability issues in each country (for example, in Nigeria, low reliability means lower adoption rates) but assumes that investments will continue to improve reliability over time.

- *Accelerated case scenario, with EV market actively shaped by stakeholders.* Under this scenario, multiple interventions lead to accelerated adoption. For example, governments put in place regulations and incentives to encourage adoption, such as those seen in other countries, including ICE vehicle sales bans and tax exemptions for EVs. This accelerates adoption across all vehicle segments but could have greater impact on minibus and van segments in particular, where owners are more "TCO conscious" and also potentially more likely to face targeted incentives or regulations, such as mandates for all public transport to be electric within a certain timeframe. This is the case in countries such as Norway, where 75 percent of long-distance buses must be zero-emission by 2030.[12] This scenario assumes government or private actors invest significantly in the electricity system, improving overall electricity reliability and installing fast-charging infrastructure for taxis, minibuses, and vans.

In both scenarios, this analysis indicates that two-wheelers will electrify fastest, with electric two-wheeler sales rising to 50 to 70 percent of all sales by 2040 (Exhibit 4). In Kenya and Nigeria alone—two of the largest two-wheeler markets in sub-Saharan Africa—this would translate into three million to four million electric two-wheeler sales per year by 2040.

**In the electric two-wheelers segment, there is already an emerging use case today, and this segment is expected to grow dramatically, in line with the trend in Asia, given favorable TCO and high fleet turnover.**

[12] Norwegian National Transport Plan, 2022-2033.

Vans and minibuses would likely electrify next, but they have greater variability in the base and accelerated cases due to the potential of targeted regulation, with approximately 20 percent and 25 percent sales adoption by 2040 in the base case, respectively, and around 35 percent and 45 percent in the accelerated case.

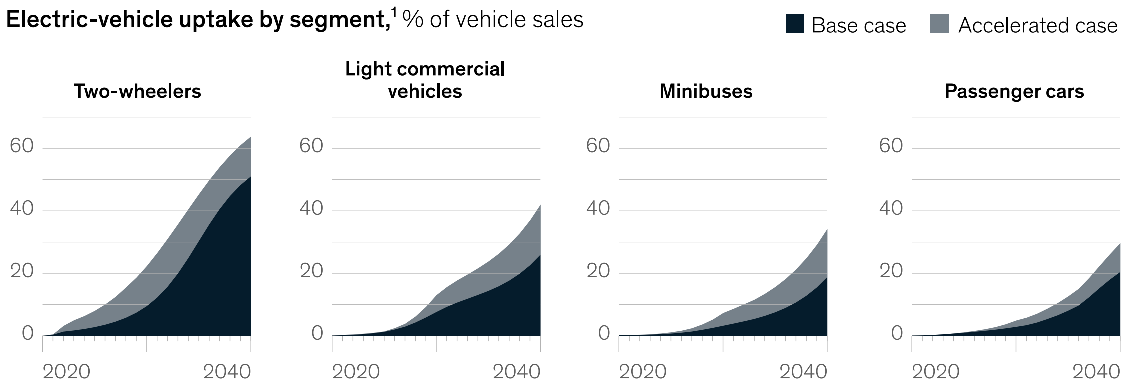
Electrification of passenger cars would likely be slowest, due to the expected supply constraints of used EVs in Africa before 2030. In the base case, around one in five passenger cars will be electric by 2040, and in the accelerated case, nearly one in three, based on stricter import regulation on used cars or incentives for EV adoption such as tax exemptions. This equates to a roughly ten-year "lag" behind the expected adoption trend in the European Union.

In aggregate, across all vehicle segments, these scenarios could result in a 20 to 25 percent annual carbon emissions reduction in 2040, assuming the current electricity-generation mix.[13]

Exhibit 4

## Electric-vehicle adoption in sub-Saharan Africa is expected to be highest for two-wheelers, but other segments can grow significantly in an accelerated case.

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




[1]In 5 markets (Ethiopia, Kenya, Nigeria, Rwanda, and Uganda), which make up ~60% of all vehicle sales in sub-Saharan Africa, excluding South Africa.
Source: McKinsey Center for Future Mobility analysis, 2021

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[13] Based on analysis of Kenya, Nigeria, Ethiopia, Uganda, and Rwanda, which make up approximately 50 percent of all vehicle sales in sub-Saharan Africa (excluding South Africa). Reduction is based on what 2040 tailpipe emissions would have been without EVs versus with EVs.

The curves in Exhibit 4 represent an average across five countries that make up 60 percent of all vehicle sales in sub-Saharan Africa, excluding South Africa. Some countries, such as Rwanda and Kenya, are expected to transition faster, with EVs accounting for 60 to 75 percent of all two-wheeler sales by 2040. This is due to a range of factors, such as stronger regulation on the age of used-vehicle imports in Kenya, incentives for EV adoption in Rwanda, comparatively better electricity reliability in both countries, and the growing presence of EV start-ups.

EVs are an evolving technology, and this analysis makes several assumptions on unknown factors, including competition with alternative fuels (see sidebar "Alternative fuels"). One critical unknown is how long batteries will last and whether they will be suitable for the 300,000 km lifetime mileage often seen in Africa. Two test cases of the Tesla Model S and Nissan Leaf have shown these vehicles going over 150,000 km with at least 80 percent of the original battery capacity retained.[14] Based on these results and the ongoing investments in battery technology, this analysis assumes that batteries will indeed last for many miles. We further assume that used EVs will follow similar depreciation curves and export trends as seen for ICE vehicles. For example, countries will not seek to retain used EVs in their home markets to recycle batteries, as the value of an exported EV is higher than that of a recycled battery, meaning it makes more economic sense to export the used EV.

Due to the challenges mentioned, sub-Saharan Africa's EV adoption curves are still slower than those expected globally. For example, by 2040 90 percent of all two-wheeler sales are expected to be electric, driven by growing demand in India, China, and Southeast Asia, as are nearly 70 percent of all car sales. Nonetheless, even if the adoption rates are lower, the difference between the base case and accelerated case is significant in sub-Saharan countries, with the accelerated case translating to more than double the number of EVs on the road by 2030 and 30 percent more by 2040.

**One critical unknown is how long batteries will last and whether they will be suitable for the 300,000 km lifetime mileage often seen in Africa.**

[14] Based on consumer surveys run by Plug In America and Consumer Reports.

## Alternative Fuels

**Some countries and private** companies in sub-Saharan Africa are exploring "cleaner" fossil fuels as a stepping-stone to lowering carbon emissions from transport, including liquefied petroleum gas (LPG), also called autogas or compressed natural gas (CNG). Both fuels can drive a 10 to 15 percent reduction in tailpipe carbon emissions compared with petrol.[i] This is compared with at least 40 percent reduction (and up to 100 percent) for EVs, even in countries with a high use of fossil fuels in electricity generation. LPG and CNG should thus be viewed only as transition fuels on the journey to zero-emission transport.

Conversion to autogas requires a comparatively low-cost upgrade to an existing petrol engine, at a cost that can be recovered in less than one year for commercial vehicles traveling long distances. Many countries are already making investments in LPG terminal and distribution infrastructure to support its use as a clean cooking fuel. This infrastructure could be cross-leveraged to support autogas for transport as an intermediate step for some vehicle segments. In particular, conversion to autogas can be relatively low cost for commercial vehicles like taxis, heavy vehicles like large buses, and even large long-haul trucks—segments that will require significant infrastructure investment to support electrification due to their high daily mileage.

CNG, on the other hand, has a weaker investment case. Unlike LPG, its primary use would be for road transport. This would require building dedicated high-cost infrastructure (including port and inland terminals, bulk storage, and distribution and retail networks) for a fuel that is at best a stepping-stone toward cleaner transport at a time when the global trend is toward electrification, with ICE vehicles being phased out by many manufacturers. The investment might be better directed toward strengthening and decarbonizing the electricity grid and making EV charging more accessible.

Another fuel option is hydrogen, which can have zero to minimal carbon emissions if using green or blue production methods. However, according to the Hydrogen Council, the costs of hydrogen production currently make it economically viable only for heavier road-transportation applications such as large trucks.[ii]

i Ross Ryskamp, Emissions and performance of liquefied petroleum gas as a transportation fuel: A review, World LPG Association, October 3, 2017.
ii Hydrogen Insights: A perspective on hydrogen investment, market development and cost competitiveness, Hydrogen Council, February 17, 2021.

## Building an enabling ecosystem

Governments, development partners, and private stakeholders can consider working together to build the ecosystem required to help EVs scale in sub-Saharan Africa and push toward the accelerated growth case.

Four primary categories of enablers could be considered:

- scaling electricity and charging infrastructure
- innovating local production and supply chains
- considering regulatory mechanisms
- financing assets, assemblers, and infrastructure

### Scaling electricity and charging infrastructure

Stable electricity supply and charging infrastructure will need to be built ahead of demand to mitigate the range anxiety that may hinder consumers from adopting EVs.

Electricity system developers and operators will need to plan ahead to build the infrastructure for EVs. This includes improving electricity access and reliability, while also planning for increased domestic consumption at off-peak times, since vehicles are likely to be charging overnight. In the case of electric two-wheelers, charging is also possible via mini-grids, making these vehicles a core solution in areas with poor grid access or reliability.

Companies can also proactively invest in charging infrastructure, including partnerships with large retail actors to set up public charging stations. For example, many minibuses in Kenya park overnight at petrol stations so setting up charging in these locations could enable an electric transition for minibuses. Partnerships with shared-mobility providers could also help with charging-network optimization. This is being seen in Asia, where Gojek (a ride-hailing company) and Gogoro (an electric two-wheeler company) are partnering in Indonesia to set up battery- swapping stations in high-use locations.[15]

In addition to charging, electric two-wheelers will likely need to be supported by a network of battery-swapping stations, as the long daily distances traveled by many commercial two-wheelers mean they might need to swap "on the go." The creation of a common battery standard would significantly help in the development of the sector, as it would allow for the creation of a common battery-swapping "utility" that would bring down the amount of battery inventory required for each company. This initiative is already being pursued globally through the swappable battery consortium formed in 2021 by Piaggio, KTM, Honda, and Yamaha.[16]

**Innovating local production and supply chains**

EV companies could consider investing in homegrown-product innovation to design or tailor EVs for local needs and conditions. As mentioned, two-wheelers in sub-Saharan Africa tend to travel much longer daily distances compared with those in Asia (up to 130 km in Kenya versus an estimated 40 to 50 km in Asia). Developing an electric two-wheeler that is both durable and capable of carrying a spare battery may be required to meet the needs of the sub-Saharan African two-wheeler driver. Stakeholders can also invest in retrofitting existing ICE vehicles with electric powertrains. This would likely be the most economically feasible alternative for larger vehicles that go long distances, such as vans or minibuses, as the lifetime cost trade-off of an electric versus an ICE powertrain is favorable over a shorter timeframe.

Local vehicle assemblers may also invest in national and regional supply chains by manufacturing some parts locally. Going even further upstream, and as discussed in McKinsey's Green Africa report, sub-Saharan Africa has many of the raw materials needed to develop a supply chain for at least the attractive cathode segment of batteries used in EVs.

**Considering regulatory mechanisms**

As seen in other countries, regulatory mechanisms can be a significant driver for EV adoption. Globally, countries have adopted a range of approaches, including hard targets such as banning sales of ICE vehicles within certain timeframes or setting emissions standards or fiscal incentives such as tax exemptions for EV sales or subsidies for charging infrastructure. These can also include soft incentives such as reduced registration times for EVs or allowing free parking for EV drivers (Exhibit 5).

[15] "Gojek and Gogoro announce strategic partnership to electrify two wheel transportation in Indonesia," Gogoro press release, November 2, 2021.

[16] "Honda signs a letter of intent with KTM, Piaggio and Yamaha Motor for the creation of a swappable batteries consortium for motorcycles and light electric vehicles," Honda press release, March 1, 2021.

Exhibit 5

## Countries globally have adopted a range of regulatory mechanisms to accelerate EV adoption.

### Examples of electric-vehicle (EV) regulatory mechanisms deployed by country

#### USE OF TARGETS

**Electrification targets for publicly procured vehicles** (China)

**Consumption and emission targets:** Fuel-consumption targets for new or imported cars; European emission standards as prerequisite for new or imported internal combustion (ICE) vehicles (Norway)

**Banning ICE vehicle sales from a certain year onward** (Norway, China)

#### USE OF TAXES, TARIFFS, AND FINANCIAL INCENTIVES

**Tax exemptions or reductions for EVs,** including on import duties or VAT (India, China)

**Exemptions from charges:** free parking, exemptions from tolls, waiving permit and registration fees (Norway, China)

**Subsidies** for new EV purchases or for charging infrastructure (India)

**Usage-based taxes for ICE:** eg, malus tax for ICE vehicles or higher fuel taxes to make EVs more cost attractive (Norway)

**Zero-emission-vehicle credit system:** manufacturers required to produce a certain percentage of zero-emission vehicles based on a credit system; credits can be traded (multiple states in the US)

**Vehicle swapping:** turnover schemes to encourage ICE owners to trade in their vehicles in exchange for a discount on EVs (Singapore, State of California)

#### PERKS AND BENEFITS

**Decreased processing time for registrations and license plates** (China)

**Access to high-occupancy vehicle lanes, bus lanes, or Green Zones** (Norway)

Source: McKinsey analysis

McKinsey & Company

**Financing assets, assemblers, and infrastructure**
Four broad types of financing would help to accelerate the transition, including asset financing, financing for EV importers and assemblers, financing for charging infrastructure (for example, battery-swapping stations for electric two-wheelers, installation of Level 1 and Level 2 public charging points), and infrastructure financing for electricity grid and mini-grid development. This will require some innovation in financing models, including credit guarantees to derisk lending. Take asset financing, for example. Formal asset financing is an established model in some countries, such as Kenya, where an estimated 90 percent of two-wheelers are financed through specialized players. Other countries rely on more informal models, such as Nigeria, where around 30 percent of two-wheelers are financed via *okada* associations and the remainder through informal borrowing from friends and family. The unknown depreciation curves and technology life cycles of EVs mean that asset financiers might be reluctant to finance them. Derisking models such as credit guarantees might be required to encourage asset financing for EVs. For vehicles such as vans or minibuses, lease-to-own models for retrofitted electric powertrains could also be explored.

Innovative financing models, such as carbon credits for charging infrastructure, are already being launched globally. The world's first validated and registered carbon offset program for EV chargers, with plans to finance 3,500 fast-chargers in the United States, was announced in 2020 by SCS Global Services, Electrify America, and Verra.[17]

Sub-Saharan Africa faces many unique challenges in the electrification of transport, but it is critical that the continent is not left behind as the rest of the world transitions. Failure to create an enabling ecosystem for electric transport could see the region becoming a dumping ground for old ICE vehicles, setting back the continent's carbon-emission-reduction goals as the vehicle parc continues to grow in the decades ahead.

The automotive future may be electric, but in sub-Saharan Africa, private-sector stakeholders, development partners, and governments may need to consider collaborative measures to accelerate the EV transition, or Africa may find itself stuck in the slow lane.

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[17] "World's first validated and registered carbon offset project for electric vehicle chargers announced by SCS Global Services, Electrify America and Verra," SCS Global Services, July 22, 2020.