NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

NTU-SBF Centre for African Studies
Nanyang Business School

Africa Current Issues

Electric vehicles: An ironic African opportunity?

Vol. 2021 - 47

Electric vehicles: An ironic African opportunity?

Introduction

Rising sales of fossil-fuel cars add to the air and noise pollution that now approaches dangerous levels in many of Africa's overpopulated cities. This trend makes a strong case for cleaner and quieter mobility options. [1] Electric vehicles (EVs) are more environment-friendly than internal combustion engine vehicles (ICEVs). [2] While EVs may cost more to acquire, they are less expensive to operate and maintain. [3]

How viable are EVs in Africa, especially in countries that lack a reliable electricity supply? Is this constraint significant? Sub-Saharan Africa's total power generation capacity is less than that of South Korea. [4] In South Africa, which provides most of the continent's generation capacity, the electricity supply is increasingly unreliable due to ageing infrastructure and mismanagement. An absence of charging infrastructure and the lack of policies to encourage EV adoption constrain EV growth across the continent.

Despite these barriers, EVs are already being assembled or imported in a few African countries. Roughly a thousand electric cars ply South African roads. In Kenya, one taxi company operates an all-electric fleet. South Korean automaker Hyundai now sells electric vehicles in Nigeria. While these trends suggest EVs may become viable on the continent, achieving scale may take a while. While government policies will be a crucial success factor, the private sector will play a decisive role in driving EV adoption and use. This article explores these issues in greater detail.

A Primer on EV Economics

The economic forces that drive the adoption of electric vehicles (EV) vary from those powered by internal combustion engines (ICE). First, even though both share the same road networks, they depend on different sources of energy. The mass-produced ICE engine is nearing the end of a century-long learning curve that began with Ford's Model T. In contrast, the battery pack and digitally controlled motors at the heart of the EV are in the early stages. Both the price and performance of batteries and controllers are improving rapidly. The average price of a vehicle battery pack fell by 87% between 2010 and 2019. VW recently set a range record of 531km on an ID.3 test drive. [5]

Nissan's zippy and relatively affordable Leaf earned an early lead in the EV market. The Leaf was the best-selling electric car from 2011 to 2014. However, Nissan failed to provide a robust fast-charging network. This gap forced buyers to rely on a small number of third-party fast-charging stations or slow home chargers. [6] Tesla deployed a new charging network to come from nowhere and become the market leader. How did this happen? Nissan depended on its proven design and manufacturing capabilities, while Elon Musk realised that while the design was important, selling electric cars would require a robust charging network. Tesla envisioned the EV as a platform good that needed both a geographically dispersed network of charging stations and a critical mass of car buyers to justify the fixed costs of building the charging stations [7].

While total life cycle costs for the EV are evolving, the dramatic decline in new battery pack prices creates a challenging situation for early adopters. The residual value of used EVs falls more rapidly than their ICE counterparts. Currently, batteries typically account for more than half of the value of a new EV. As battery technology evolves and drives down retail vehicle prices, current owners will lose out in the second-hand market. The average resale value of electric vehicles and plug-in hybrids is less than 40% of the original purchase price, versus 50% to 70% for ICE cars. [8]

EV adoption in the developed world varies widely, with Europe leading the way. Electric cars of all types accounted for 6% of the cars on Europe's road network in 2020, up from 1.6% in 2019. In the US, only 4% of cars were electric in 2020 [9]. Viewing the EV as a rapidly depreciating platform good focuses our attention on coordinating the rollout of EV charging infrastructure with EV adoption. The early targets would be to replace ICE vehicles that see heavy use in a small geographic area, such as taxis, delivery

vehicles, and local public transport. The next phase might focus on the roadways that connect economic activities, such as ports and trade centres.

EVs are viable in African countries

In November 2020, Hyundai launched the assembly of its Kona EV in Nigeria. Germany's Volkswagen already assembles EVs in Rwanda, as does Hyundai in Ethiopia.[10] Indigenous EV producers are also joining the fray. Uganda's Kiira Motors and Ghana's Kantaka are good examples.[11]

The growth of EV's generates demand for infrastructure. Japanese automakers Nissan and its German competitor BMW, which sell EV models in South Africa, are jointly developing EV charging infrastructure across the country. [12] If this public-private partnership (PPP) succeeds, the rest of the continent may soon emulate this emerging EV ecosystem model.

Table 1: EVs v ICEVs in Africa

Pros	Cons
40-70% potential fossil fuel savings	Higher (though declining) upfront costs
9-17% more energy efficient	No significant impact on poverty alleviation
Reduced air and noise pollution	Less labour intensive, especially if imported
Reduced exposure to oil price volatility	Environmental pollution from battery disposal
Need for cleaner mobility options	A shortage of charging infrastructure
EVs less expensive to maintain than ICEVs	Unreliable grid electricity supply
EV overcomes fossil fuel scarcity constraint	Lack of enabling policies

Source: Dane (2014)[13] & Pittaway (2019)

Some African cities already experiment with electric taxis. In January 2021, Kenyan electric taxi service Nopea Ride announced its plan to increase its Nairobi fleet from thirty EVs to one hundred by end-2021.[14] The planned expansion by Nopea Ride, launched by Finland's EkoRent Oy in 2018, points to the EVs potential to become a viable mobility solution in African cities. In Kenya, EV adoption increased despite the country's lack of public EV charging stations (See Table 2).[15]

Table 2: Publicly accessible chargers (slow & fast) by country

	2017	2018	2019
South Africa	124	239	246
Rest of the World	434,347	537,443	861,872
World Total	434,471	537,682	862,118

Source: IEA Global EV Outlook 2020[16]

Kenya is an exemplar from a sustainability perspective. More than 93 per cent of Kenya's electricity supply comes from renewable sources.[17] Charging EVs on electricity grids powered by renewable sources has a minimal environmental impact. While the energy infrastructure in many African countries is hugely under-capacity, the ongoing shift towards renewable sources will lead to greener EV recharging.

Electric tuk-tuks and motorcycles are also beginning to replace their fossil-fuel counterparts in some African cities. East Africa is leading the charge at the moment. But success there may encourage other regions. In Rwanda, for instance, the authorities want all motorcycles to be electric as soon as possible. [18] Startups pushing the drive include Ampersand and Safi in Rwanda, ARC Ride and Ecobodaa in Kenya, and Bodawerk and Zembo in Uganda.[19]

Faster charging and longer-lasting batteries are essential to the success of EVs. Battery performance is even more critical in the African case. If EV batteries take too long to charge and are quick to discharge, in African countries where power is scarce and its availability is often erratic, their utility diminishes significantly. Fortunately, emerging technologies may mean that African countries may not need to worry about weak and slow-to-charge batteries for much longer.

Israeli startup StoreDot developed a technology that can power a flat EV battery to store 100 miles worth of charge in five minutes. The firm plans a mass rollout by 2025.[20] In partnership with oil major BP, also an investor. StoreDot plans to install its super-fast chargers in refitted BP filling stations.[21] Thus, EV owners would be able to charge their batteries in about the same way and in equal or less time than needed to fill the tanks of ICEVs. A near-future reality of ultra-fast EV chargers in gas stations is an easily adaptable model for African countries.

African electricity grids are often weak. However, the existing ecosystem of standby fossil-fuel generators can mitigate this constraint. Off-grid generators provided eight per cent of African electricity generation in 2018, according to the International Energy Agency (IEA). Nigeria accounted for almost half, generating 18 TWh of power from 9 GW of back-up capacity. The IEA notes that businesses are the primary users of back-up systems. Some of these might serve as the premises where new EV owners can charge their batteries. While this solution is far from environment-friendly,[22] operators can gradually migrate to off-grid renewable energy sources.

Solutions to avoid the goal conflict of plugging EVs into dirty energy sources are emerging in Africa. Many potential EV owners are likely to commute to work. Thus, solar-powered charging stations in parking facilities at their workplaces is an environment-friendly solution to the dirty charging problem.[23] Excess solar power from the charging stations could flow to the main grid. This arrangement could earn income for owners or provide power to buildings and other facilities to save costs.

Government policies would be key

Restrictions and outright bans on fossil-fuel vehicles are likely to accelerate global EV adoption around the globe.[24] European car manufacturers would perhaps be less eager to produce EVs if governments like the United Kingdom were less insistent on phasing out ICEVs by 2030. Such overseas policy shifts have significant implications for the African auto industry. African governments must consider the impact of these proactive policies and seek outcomes that serve both their economies and the environment.

Table 3: African countries with transport regulations & targets supporting EVs

Country	Key policy measures & targets	Announced:	Source
Cabo Verde	Targets of: - 100% of public authorities fleet to be EVs by 2030 - 35% of PLDV sales to be EV by 2025 - 70% of PLDV sales to be EV by 2030 - 100% of PLDV sales to be EV by 2035	2019	Ministry of Industry, Trade & Energy (2019)
South Africa	Target of 20% HEVs by 2030	2012	Intended National Determined Contribution

Source: IEA Global EV Outlook 2020

Notes: PLDV = Passenger Light-Duty Vehicles; HEV = Hybrid Electric Vehicles

While African countries account for 2 per cent of global imports of new light-duty fossil-fuel vehicles, they account for 40 per cent of used ones.[25] With estimates of 22 per cent of global vehicle sales expected to be electric by 2025 and 35 per cent by 2030, a global shift to EVs raises the prospects of imminent dumping of ICEVs in African countries if similarly EV transitioning policies are not put in

place.[26] As shown in Table 3, Cape Verde plans to stop importing ICEVs by 2035.[27] South Africa aims for 20 per cent of all light-duty passenger vehicles to be hybrid EVs by 2030.

For EV adoption to accelerate, African governments must put in place currently non-existent enabling incentives and policies.[28] Ordinarily, fossil-fuel vehicle imports are expensive in many African countries owing to high duty. Financing at atrociously high interest rates also means buying a new car is not an option for many Africans. These constraints are worse in the case of EVs. Import duty on EVs is higher than for ICEVs in some countries. In South Africa, for instance, EVs attract a 25 per cent import duty, whereas imported ICEVs are charged less at 18 per cent.[29]

International development organisations now provide EV transition policy assistance to African governments. For example, the United Nations Environment Programme (UNEP) is currently working to introduce electric two- and three-wheelers in Ethiopia, Morocco, Kenya, Rwanda, and Uganda.[30] UNEP also assists with EV-related policy development in at least 12 African countries and several efficient light-duty vehicle initiatives that include EVs.

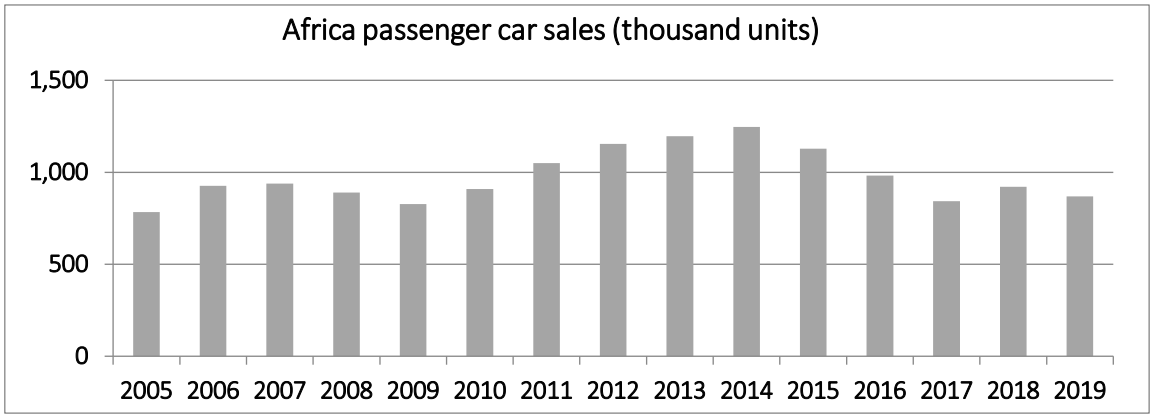
Some African governments are already warming to the idea of EVs. Kenya has set a 5 per cent target of all registered vehicles being EVs by 2025 and plans to install charging stations in new government buildings.[31] The Nigerian government expects 30 per cent of all cars to be electric by 2025 and plans to review its automotive policy towards achieving this target.[32] Cabo Verde, perhaps the most ambitious African country regarding EVs, offers a small market. Yet South Africa, which set a 20 per cent hybrid EV target by 2030, is encouraging and worth engaging commercially.

Achieving scale might take a while

According to the African Association of Automotive Manufacturers (AAAM), total new vehicle sales in Africa was 1.1 million in 2019.[33] As shown in Figure 1, the International Organization of Motor Vehicle Manufacturers (OICA) puts the 2019 new vehicles sales figure for Africa at about 870,000. Averaging the two sources results in an estimate of roughly one million new vehicle sales per annum.

African EV sales data is scarce and often incomplete. The sale of EVs may be reported in an "others" classification due to their currently insignificant market size. South Africa is the only African market worthy of enumeration at the moment (See Table 4). In 2019, there were about 1,000 EVs in South Africa.[34] While the AAAM projects 5 million new vehicle sales in Africa by 2035, how much of that will be EVs is anyone's guess at the moment.

Figure 1: Africa passenger car sales (2005-2019)



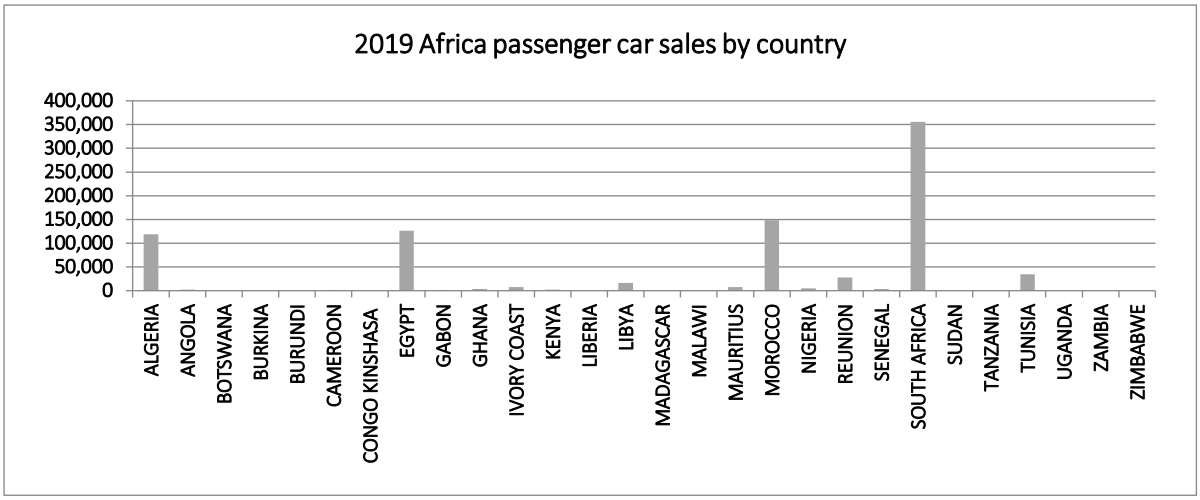
Source: OICA

Besides, judging from the 15-year passenger car sales trend shown in Figure 1, the 5 million units projection by the AAAM seems somewhat optimistic. Instead, the historical trajectory supports an annual average of 1 million new car sales over the next ten years. We use the Kenyan EV target of 5 per cent of all registered cars by 2025 as a lower bound and the more ambitious 30 per cent Nigerian

target as an upper bound. This range places EV adoption between 50,000 to 300,000 new EV sales by 2030, when the global EV transition is expected to be in high gear.

The IEA reports that 68 out of every 1000 urban households in Sub-Saharan Africa owns an air conditioner, and 125 out of every 1,000 owns at least one car.[35] This data suggests that 12.5 per cent of urban African households are likely to afford owning and maintaining an EV. More than a few middle-class African consumers can afford standby generators or grid electricity to power multiple air conditioners and refrigerators at their homes and offices. This segment can easily afford to charge and maintain a current EV model.

Figure 2: 2019 Africa passenger car sales by country



Source: OICA

Intelligent adaptive product design and support by EV manufacturers could accelerate adoption beyond current expectations. The recently launched Hyundai Kona EV model in Nigeria can be charged from any regular electric socket with enough wattage to power air conditioners and refrigerators.[36] And while charging a vehicle battery typically takes 8 to 10 hours with a standard charger, faster chargers can do this in half the time.

Even so, the EV sales trend in South Africa, the only significant market currently, is not encouraging. As shown in Table 4, annual new EV sales in South Africa of 70 to 160 units over the past three years hardly suggest scale would be plausible for any manufacturer or importer anytime soon. The historical trend suggests EV volumes are likely to remain in trickles for the decade to 2030, at least. The ascendant EV markets like Nigeria and Kenya would still require some time to be well-established. Judging from the South African experience, it might take a while for that to happen.

Table 4: Global EV sales & stock (Africa v Rest of the World)

New battery-electric car sales (thousands of vehicles)					
	2015	**2016**	**2017**	**2018**	**2019**
South Africa	0.12	0.10	0.07	0.07	0.16
Rest of the World	323.98	464.65	756.42	1,343.33	1,533.26
World Total	324.10	464.75	756.49	1,343.40	1,533.42
New plug-in hybrid electric car sales (thousands of vehicles)					
	2015	**2016**	**2017**	**2018**	**2019**
South Africa	0.12	0.28	0.13	0.08	0.07
Rest of the World	222.37	285.61	415.89	636.66	568.19
World Total	222.49	285.89	416.02	636.74	568.26
Electric car stock (BEV & PHEV) (thousands of vehicles)					
	2015	**2016**	**2017**	**2018**	**2019**
South Africa	0.30	0.70	0.90	1.00	1.20
Rest of the World	1,235.43	1,987.48	3,135.88	5,110.92	7,166.63
World Total	1,235.73	1,988.18	3,136.78	5,111.92	7,167.83

Source: IEA Global EV Outlook 2020

However, top African ICEV markets like Egypt, Algeria, and Morocco have massive potential for EVs (See Figure 2). The government support for EVs in Egypt is demonstrable, especially for use as city taxis. In June 2020, Egyptian authorities mooted a plan for an annual EV production of 25,000 units by 2021 and signed an MoU with China's Dongfeng Motor Corporation in this regard in January 2021.[37][38] There is evidence of traction in Morocco.[39] The case of Algeria is relatively lacklustre, even though authorities signalled interest in March 2020.[40]

Thus, while EV viability is assured in light of the small strides and feats already underway, scaling up to current continental ICEV levels may not be significant until 2040. While ICEVs dumped in economies transitioning to EVs are expected to compete with EVs for African wallets. However, innovations that would significantly reduce the cost of acquiring EVs could still favour electric cars. Thus, the International Council on Clean Transportation (ICCT) target of 39 per cent of all of Africa's stock of light-duty vehicles being electric by 2050 seems plausible.[41] For that time range, the ICCT estimation could even turn out to be conservative.

Conclusion & Recommendations

We see compelling evidence that the EV is viable in Africa. However, accelerating the transition to EV will require policy changes and carefully targeted investments. Even with these in place, achieving scale is likely to take a while. 50,000 to 300,000 new EV sales by 2030 seems realistic. Used ICEVs may initially overwhelm markets on the continent, as owners abroad dump them for electric vehicles. The supply of used EVs would also accelerate as overseas owners move on to newer models. Even so, EV models adapted for the peculiar African environment may increasingly become more attractive, buoying new EV sales. Incipient innovations that make EVs cost significantly less to acquire could also turn the tide.

Africa's largest economies —South Africa, Nigeria, Egypt, and Kenya— are likely to be the critical EV markets on the continent to 2030. Currently, the biggest African market for EVs and ICEVs, South Africa's evolution is already well underway. While new South African EV sales of about 230 units are

minuscule compared with an annual 355,000 new ICEV sales in 2019,[42] there will be ample opportunity to convert many South African ICEV owners to EVs.

The business cases for Nigeria and Kenya are confirmed by anecdotal evidence of emerging buyer-seller interest and government support. Additionally, according to the IEA, Nigeria and Kenya have some of the highest car ownership per urban household rates on the continent. For potential scale, Algeria, Egypt and Morocco, which after South Africa recorded the highest passenger car sales in 2019, are likely to be commercially successful targets. The Egyptian market is most desirable amongst the North African trio. New EV sales are probably going to be slow initially. Still, there is likely latent demand for cleaner mobility options in large cosmopolitan cities like Johannesburg, Cape Town, Cairo, Casablanca, Nairobi, and Lagos.

With more pressing priorities, African governments would probably be slow to act on EV transition policies. Still, more would likely follow in the footsteps of Cape Verde and South Africa, setting EV adoption targets and time-bound ICEV bans. The interest in the more labour-intensive $10 billion African ICEV market by foreign ICEV manufacturers might be too tempting for African governments to resist.[43] With demand for ICEV parts and accessories estimated to reach $15 billion by 2022, EV models are likely to face stiff resistance while seeking to gain market share.

Besides, foreign automakers would likely seek to extract as much value as possible from their soon to be redundant ICEV assets from 2030 onwards. Owing to aggressive EV transitions in their home countries, they might be reluctant to cannibalise sales of their ICEV models by bringing in EVs. Additionally, ICEV components that were hitherto imported for local assembly would increasingly be manufactured locally, leaving less room for similar EV ventures.

Thus, achieving scale with EVs is likely to be a daunting task without a deliberate push by governments, combined with superior value propositions by EV manufacturers and importer. And considering the extent to which grid electricity demand is yet unmet in many African countries, the potential for an added burden from EVs on weak power infrastructure may discourage some governments.

Investors, managers and policymakers may consider the following course of action:

EV manufacturers and local dealerships: Target large cities in already big ICEV markets like South Africa, Egypt, Algeria, Morocco, Nigeria and Kenya for new EV sales. Investments in public charging infrastructure should receive priority in capital allocation decisions. Public-private partnerships (PPP) would be ideal in this regard. Collaborating with competitors as a group in these PPP arrangements should be the adopted approach. A phased and gradual entry into target markets would be a sound approach in light of slow transitions to EV. Ethical lobbying of public officials should be a top priority. There may be a need for legislation to penalise the dumping of ICEVs and incentivise EV imports or manufacturing.

Governments: Provide incentives for EV adoption. EV manufacturers, dealers and component suppliers should qualify for special tax rebates. Non-financial incentives like penalties for high-emission ICEVs, special road lanes, toll-free public road access, and so on should also be put in place to encourage citizens and residents to give up their ICEVs for EVs over time. To stimulate demand, governments should progressively replace the ICEVs in their fleets with EVs. Electricity grids should also be programmed to identify and apply special tariffs and consideration for EV charging. A comprehensive regulatory framework that integrates all these incentivising measures and more would be ideal.

Author: Rafiq Raji
Editor: Dr. A. Lee Gilbert
Editor-in-chief: Prof. Sam Park

References

[1] Yiu, Y.H. (2019, August 27). Air pollution is starting to choke Africa. *Earth.Org*. Retrieved from https://earth.org/air-pollution-is-starting-to-choke-africa/

[2] Hall, D. & Lutsey, N. (2018, February). *Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions*. San Francisco: The International Council on Clean Transportation. Retrieved from https://theicct.org/sites/default/files/publications/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf

[3] Penney, V. (2021, January 15). Electric cars are better for the planet – and often your budget, too. *New York Times*. Retrieved from https://www.nytimes.com/interactive/2021/01/15/climate/electric-car-cost.html

[4] Eberhard, A., Gratwick, KI, Morella, E. & Antmann, P. (2016). *Independent power projects in Sub-Saharan Africa: Lessons from five key countries*. Washington DC: World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/23970/9781464808005.pdf

[5] Douglas Broom (2021), 2020 was a breakthrough year for electric vehicles. World Economic Forum. Accessed online at https://www.weforum.org/agenda/2021/01/electric-vehicles-breakthrough-tesla-china/

[6] Nissan Leaf, Wikipedia, accessed online at https://en.wikipedia.org/wiki/Nissan_Leaf.

[7] Ashley Lobo (2020), A case study on Tesla, Inc**,** accessed online at https://medium.com/@ashleylobo98/a-case-study-on-tesla-the-worlds-most-exciting-automobile-company-535fe9dafd30

[8] Source: Chris Edwards, The EV lifecycle conundrum, Engineering and Technology, July 10, 2020. Accessed online at https://eandt.theiet.org/content/articles/2020/07/the-ev-lifecycle-conundrum

[9] JP Morgan Global Research, The Future is Electric (2020). Accessed online at https://www.jpmorgan.com/insights/research/future-is-electric?source=cib_os_tw_1220#__prclt=1h0gMVG6

[10] Kuhudzai, R.J. (2020, November 21). The all-electric Hyundai Kona is now assembled in Nigeria! *CleanTechnica*. Retrieved from https://cleantechnica.com/2020/11/21/the-all-electric-hyundai-kona-is-now-assembled-in-nigeria/

[11] Kazaresam, P. (2020, August 28). Is there a demand for electric cars in Africa? *Business Chief*. Retrieved from https://www.businesschief.eu/technology/there-demand-electric-cars-africa

[12] Kuhudzai, R.J. (2020, April 10). Electric vehicles in South Africa: Where are we now? *CleanTechnica*. Retrieved from https://cleantechnica.com/2020/04/10/electric-vehicles-in-south-africa-where-are-we-now/

[13] Dane, A. (2014). *The potential of electric vehicles to contribute to South Africa's greenhouse gas emission targets and other development objectives*. Cape Town: University of Cape Town Energy Research Centre. Retrieved from https://media.africaportal.org/documents/13-Dane-Electric_vehicles.pdf

[14] Elmendorp, R. (2021, January 26). Kenya's electric taxi fleet expanding fast. *VOA*. Retrieved from https://www.voanews.com/africa/kenyas-electric-taxi-fleet-expanding-fast

[15] Msingo, J. (2021, February 20). Why its time for Kenya to embrace electric vehicles. *The Star*. Retrieved from https://www.the-star.co.ke/opinion/star-blogs/2021-02-20-why-its-time-for-kenya-to-embrace-electric-vehicles/

[16] International Energy Agency (2020). *Global EV Outlook 2020: Entering the decade of electric drive?* Paris: IEA. Retrieved from https://www.iea.org/reports/global-ev-outlook-2020

[17] Watts, J. (2020, November 11). Climate heroes: the countries pioneering a green future. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2020/nov/11/climate-heroes-the-countries-pioneering-a-green-future

[18] Rwandans switching from petrol to electric motorcycles (2019, August 31). *Africa News*. Retrieved from https://www.africanews.com/2019/08/31/rwandans-switching-from-petrol-to-electric-motorcycles//

[19] Gillespie, T. (2020, December 22). East Africa's electric motorbikes are fueling a carbon-free future. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2020-12-22/east-africa-s-electric-motorbikes-are-fueling-a-carbon-free-future

[20] Vardi, A. (2021, March 7). Israeli 5-minute battery charge aims to fire up electric cars. *AFP*. Retrieved from https://www.google.com/amp/s/news.yahoo.com/amphtml/israeli-5-minute-battery-charge-035954413.html

[21] Carrington, D. (2021, January 19). Electric car batteries with five-minute charging times produced. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2021/jan/19/electric-car-batteries-race-ahead-with-five-minute-charging-times

[22] Adegoke, Y. (2019, September 30). Africa's noisy, expensive generators boost electricity supply but are an environmental hazard. *Quartz Africa*. Retrieved from https://qz.com/africa/1718400/africas-noisy-generators-boost-electricity-but-bad-for-climate/

[23] Booysen, M.J. & Apperley, M. (2020, July 9). Electric vehicles could add to carbon emissions and load shedding: but there's a solution. *The Conversation*. Retrieved from https://www.google.com/amp/s/theconversation.com/amp/electric-vehicles-could-add-to-carbon-emissions-and-load-shedding-but-theres-a-solution-142094

[24] Babu, A.J. & Machado, S. (2020, November 18). Fossil fuel-based vehicle bans across the world. *Reuters*. Retrieved from https://www.reuters.com/article/climate-change-britain-factbox-idINKBN27Y19F

[25] United Nations Environment Programme (2020, October 26). Used vehicles get a second life in Africa – but at what cost? Retrieved from https://www.unep.org/news-and-stories/story/used-vehicles-get-second-life-africa-what-cost

[26] Gaventa, J. (2021, January 6). Africa's bumpy road to an EV future. *Energy Monitor*. Retrieved from https://energymonitor.ai/sector/transport/africas-bumpy-road-to-an-electric-vehicle-future

[27] International Council on Clean Transportation (2020, November 12). The countries and states leading the phase out of fossil fuel cars. *The Driven*. Retrieved from https://thedriven.io/2020/11/12/the-countries-and-states-leading-the-phase-out-of-fossil-fuel-cars/

[28] Aghoghovbia-Gafaar, V. (2021, February 1). Why sub-Saharan Africa's teeming cities need electric vehicles. *Financial Times*. Retrieved from https://on.ft.com/3oAIa68

[29] Pittaway, A. (2019, December 17). Advancing eMobility in Africa. *Global Fleet*. Retrieved from https://www.globalfleet.com/en/technology-and-innovation/africa-middle-east/analysis/advancing-emobility-africa?a=API07&t%5B0%5D=eMobility&t%5B1%5D=EVs&t%5B2%5D=Africa&curl=1

[30] *Why does electric mobility matter?* United Nations Environment Programme. Retrieved from https://www.unep.org/explore-topics/transport/what-we-do/electric-mobility/electric-mobility-projects-africa

[31] Kolek, B. (2021). Electric vehicles: What is the future? *Renewables in Africa*. Retrieved from https://www.google.com/amp/s/www.renewablesinafrica.com/electric-vehicles-what-is-the-future/%3famp

[32] Iloani, F.A. (2021, February 5). 30% of cars in Nigeria will be electric by 2025 – FG. *Daily Trust*. Retrieved from https://dailytrust.com/30-of-cars-in-nigeria-will-be-electric-by-2025-fg

[33] African Association of Automotive Manufacturers (2020, December 31). *The African Association of Automotive Manufacturers (AAAM) applauds the launch of the AfCFTA* [Press release] Retrieved from https://aaamafrica.com/2021/01/12/the-african-association-of-automotive-manufacturers-aaam-applauds-the-launch-of-the-afcfta/

[34] Malinga, S. (2019, June 21). There are 1000 electric vehicles on SA roads. *IT Web*. Retrieved from https://www.itweb.co.za/content/mQwkoq6Kb2gv3r9A

[35] International Energy Agency (2019*). Africa Energy Outlook 2019*. Paris: International Energy Agency. Retrieved from https://www.iea.org/reports/africa-energy-outlook-2019

[36] Kalu, N. (2021, March 1). First electric car unveiled in Abuja. *The Nation*. Retrieved from https://thenationonlineng.net/first-electric-car-fully-assembled-in-nigeria-unveiled-in-abuja/

[37] Egypt to produce electric cars beginning 2021 at LE300K consumer price (2020, June 29). *Egypt Today*. Retrieved from https://www.egypttoday.com/Article/3/89101/Egypt-to-produce-electric-cars-beginning-2021-at-LE300K-consumer

[38] Egypt signs MoU to localize electric cars industry (2021, January 19). *Asharq Al-Awsat.* Retrieved from https://english.aawsat.com/home/article/2751436/egypt-signs-mou-localize-electric-cars-industry

[39] Diab, H. (2018). *UEMI EV Readiness Assessment: Casablanca, Morocco*. Berlin: UEMI. Retrieved from http://www.uemi.net/uploads/4/8/9/5/48950199/uemi_ev_readiness_morocco1.pdf

[40] Ngounou, B. (2020, April 13). Algerian president aims for electric cars. *Afrik 21*. Retrieved from https://www.afrik21.africa/en/algeria-algerian-president-aims-for-electric-cars/

[41] International Council on Clean Transportation (2020). *Vision 2050: A strategy to decarbonize the global transport sector by mid-century*. San Francisco: ICCT. Retrieved from https://theicct.org/sites/default/files/publications/ICCT_Vision2050_sept2020.pdf

[42] International Organization of Motor Vehicle Manufacturers (2020*). New Passenger Car Registrations or Sales.* Paris: OICA. Retrieved from https://www.oica.net/wp-content/uploads/pc_sales_2019.pdf

[43] Singh, T. (2020). *Mobility 2030 ICE in Africa*. Johannesburg: KPMG. Retrieved from https://assets.kpmg/content/dam/kpmg/za/pdf/pdf2020/mobility-2030-ice-in%20africa.pdf

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | NTU-SBF Centre for African Studies Nanyang Business School

NTU-SBF Centre for African Studies

The NTU-SBF Centre for African Studies (CAS) is to develop thought leadership and capacity for doing business in Africa. It includes bringing Africa to Southeast Asia and Singapore and helping Singapore to be positioned as the gateway into Southeast Asia. As such, CAS aims to build and expand its local and international profile by means of publications, conferences, seminars and business forums through collaboration with local businesses, other research entities and business schools in Singapore and Africa.

Partner Organizations

Contact Information:
Que Boxi
Email: cas@ntu.edu.sg
Phone: +65 65138089
Address: S3-B1A-35 Nanyang Business School
Nanyang Technological University
50 Nanyang Avenue Singapore 639798