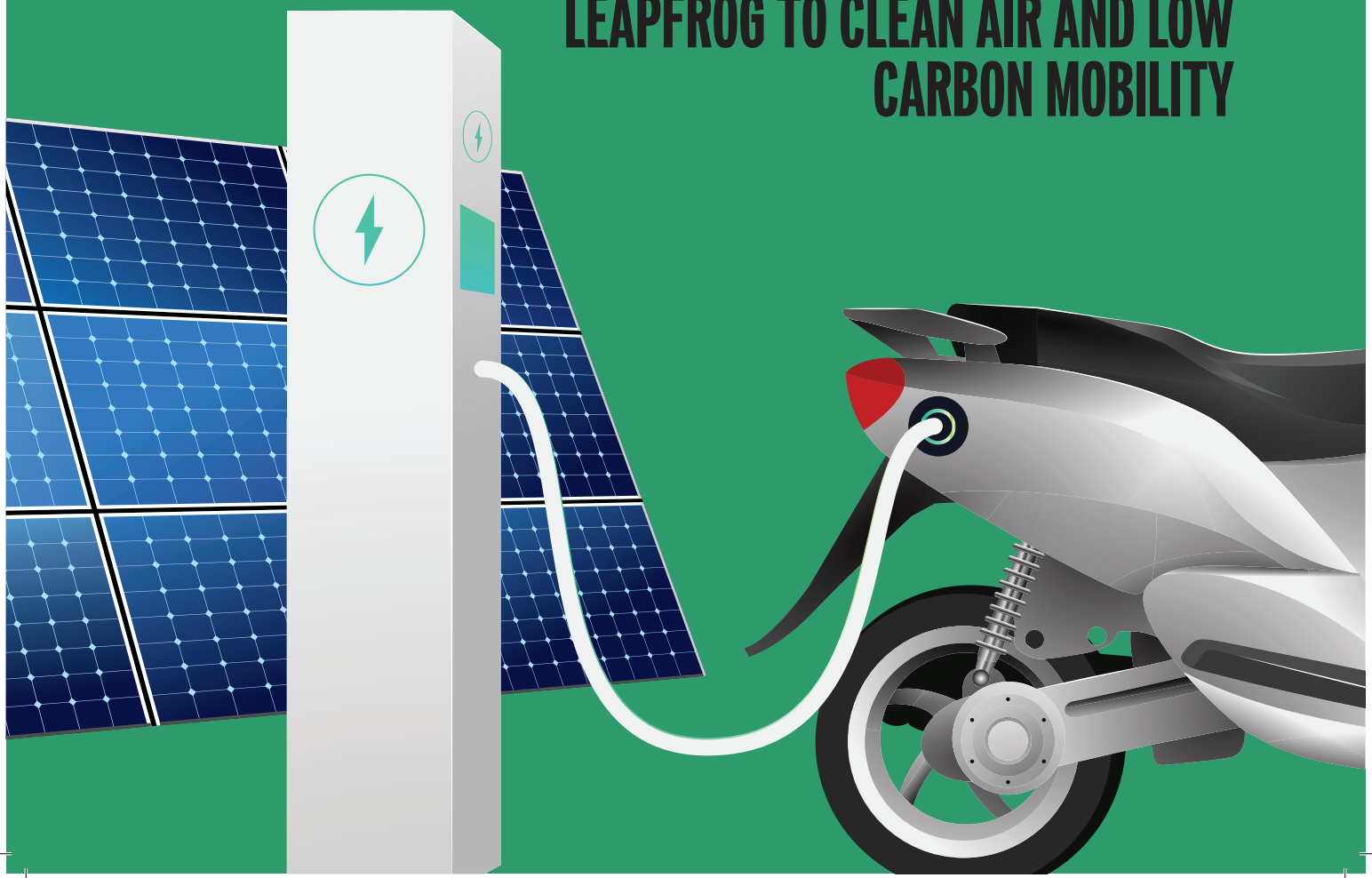
Policy Brief

ELECTRIC MOBILITY IN AFRICA

A UNIQUE OPPORTUNITY TO LEAPFROG TO CLEAN AIR AND LOW CARBON MOBILITY



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Africa, in the early stages of growth, is battling growing air pollution, energy security concerns and gradual increase in carbon emissions. Sub-Saharan Africa and North Africa have the highest population-weighted annual average PM2.5 concentrations, as per the State of Global Air 2020.[1] The rising number of vehicles is aggravating these concerns and increasing toxic exposure risk.

Even though the level of motorisation and vehicle ownership level in Africa is still low, it is rising rapidly and is largely based on very old, used and imported polluting vehicles. While some countries have made the transition to 50 ppm sulphur fuels, the rest are still using high-sulphur fuels, which can be as high as 500–5,000 ppm. This is obstructing the use of cleaner vehicles and introduction of tighter emissions standards of Euro IV across the region. Even though several countries have started to take action to fix the age of vehicles and impose higher taxes on older vehicles to control the influx of old, cheap and polluting vehicles, these vehicles still dominate the fleet.

While more enabling strategies are needed to support the acceleration and harmonisation of the roadmap for clean fuel and clean internal combustion engines (ICE) in the countries of Africa, there will still be a time lag to harmonise with the global best emissions standards. But there is an opportunity for Africa to sidestep the ICE curve and leapfrog to zero emissions electric vehicles to decarbonise and eliminate toxic exposures from vehicles.

In fact, this is a learning that is already emerging from the rest of the developing countries in Asia, including vehicle-producing countries like India, which are now shaping strategies to accelerate the transition to zero emissions. There is considerable common ground among the developing countries, including Africa, which are now taking steps to build this programme.

There are several common approaches that are also unique to developing countries. Most countries in Africa and Asia, with lower level of personal vehicle ownership, are prioritising the mass modes of transport to decarbonise urban commuting, electrifying small para transit that meet the maximum travel demand, focusing on two-wheeled vehicles that are most polluting and dominate the vehicle fleet, targeting the commercial fleet operations for delivery and the aggregator fleet to maximise impacts. Countries are also adopting industrial policy to build local vehicle manufacturing base to cater to the regional markets, retail value chain within the economy, create new and green jobs with related economic spin offs.

Simplicity of the technology has enabled start-up based industry to emerge, mobilise resources to respond quickly to the market especially in the small vehicle segments that dominate these markets.

This opportunity has also created enormous demand to shape enabling policies, regulations, technology roadmap and policy accelerators to build scale. They are finding their distinct ways to design demand and purchase incentives for consumers and fleet operators to build markets, incentivise industry to produce, designing charging infrastructure, evolving battery chemistries, and developing funding strategies to meet the cost of transition. A learning curve is gradually evolving that needs to be tapped to inform each other and enable each other.

There is considerable excitement in the Africa region as countries are developing capacities and roadmap to make the zero emissions transition. There are also concerns around affordability, high upfront costs, inadequate access to low cost finance, bankability of electric vehicles. There are also a lot of uncertainty around the product its resale values etc. But countries are evolving strategies and that is an opportunity for cross learning among the regions.

Therefore, this synthesis of emerging evidence and experiences in different countries in Africa becomes important to understand the learning curve to inform the change. It is a nascent beginning and not much evaluation or documentation of different programmes are readily available. Therefore this pieces together the jigsaw of the available evidence from literature as well as from ground and interaction with the concerned officials of the Pan-Africa network for the Centre for Science and Environment to assess the emerging trends, challenges and the way forward.

What is the scale of vehicle electrification in Africa?

Electrification of vehicles is in its nascent stages and in very early stages of growth in Africa. But already quite a few countries have got their foothold in the electrification trajectory. Though the scale, scope and the stage of development varies widely across the countries some of those who are firmly on the EV landscape include South Africa, Nigeria, Morocco, Kenya, Zimbabwe, Ghana, Mauritius, Mozambique, Ethiopia, Uganda, Egypt, Tunisia, Cote d'Ivoire, Zambia, Ghana, Mauritius, Mozambique, Tanzania, Tunisia, Cote d'Ivoire, among others. They have either started developing policies and regulatory instruments or are implementing pilot programmes or are manufacturing and setting up charging infrastructure.

Understandably, the market uptake of electric vehicles (EVs) is still very small. The market shares of EVs in the total vehicle market is less than 0.1 per cent. Even though the overall EV stock is small it is necessary to understand the delineated trends across vehicle segments.

Two-wheelers and paratransit

As noted in other countries of Asia including India, the EV promotion strategies in most countries of Africa have also prioritised high-usage, high-occupancy vehicles like taxis, buses, microbuses, paratransit like matatos, tuktuks etc, and ride-share fleet to maximise emissions and carbon reduction benefits. The smaller vehicles like two and three wheelers with small format batteries have got the priority attention. Most pilots or local assembly has begun with this segment which is also more cost effective compared to bigger vehicles. These are also numerous therefore their early transition to zero emissions technology can provide considerable benefits.

In several countries two-wheelers dominate the fleet. In Uganda two wheelers make up for 46 per cent of the vehicle fleet. In Kigali, Rwanda, motorcycles are more than half of all vehicles on the road. In Kenya, motorcycles are set to more than triple to five million this decade compared with 2018. Motorcycles and utility vehicles of all types are also the fastest-growing segment of the African automotive market.

The United Nations Environment Programme (UNEP) expects the sales of both electric and traditional two- and three-wheelers in Africa to increase substantially by 2050. However, EV two wheeler market is likely to see a different consumer base. This will be dominated by bulk purchase by businesses, including EV start-ups that buy the vehicles and then lease or rent them to drivers. The individual ownership for personal usage may be comparatively lower. Even though fuel and maintenance costs of electric vehicles are as much as 40 per cent lower on a per-mile basis than the ICE equivalent,[2] purchase of e-motorcycles by individual consumers is dampened by the upfront capital costs. Lower incomes and difficulty in accessing credit are discouraging factors so far.

The UN Environment programme is currently active in nine African countries to introduce electric two and three wheelers. These include Ethiopia, Togo, Kenya, Rwanda, Uganda, Burundi, Madagascar, Sierra Leone, and Tanzania. Some of the first line efforts have been supported by UNEP including the pilot electric bikes project in Nairobi's Karura Forest in 2021. Forty-nine motorcycles donated by Shenzhen Shenling Car Company Limited (TAILG) were part of the pilot project based on a study implemented by the Energy and Petroleum Regulatory Authority,

the University of Nairobi and Sustainable Transport Africa. This is being done along with the ministries, and national and sub-national authorities. As part of this project, 99 electric motorcycles were provided to four partners—Karura Forest, Kenya Power and Lighting company, Power Hive and Kisumu County. The initiative in Kenya is supported by UNEP with funding from the International Climate Initiative of the German Ministry for the Environment. This is expected to assess the barriers to the technological shift towards electric bikes, and feasibility and affordability. This is also getting replicated in Uganda, Ethiopia, among others.

E-mobility startups and businesses are emerging in many African countries to produce E-two-three wheelers. Zimbabwe has companies that offer leasing for electric three wheeler and scooters; electric vans for delivery service. Dealership offers beneficial loan and insurance options for imported used EVs. Uganda has companies that are leasing electric motorcycles and renting batteries. Ghana has solar-powered two-three wheelers taxis for leasing. South Africa has app-based electric three wheelers taxis that are cheaper than ICE taxi service. In Morocco, private companies are distributing electric two-three wheelers with cheaper insurance policies for EVs than for their ICE counterparts. Kenya-based ARC Ride has launched electric two- and three-wheelers for UberEats deliveries in Nairobi. In Kigali, Rwandan start-up Ampersand is introducing a fleet of electric motorcycle taxis and plans to expand to other East African countries.

A study by UK Aid and World Bank Group and others in 2022 shows three wheelers for commercial application are more affordable and need less charging infrastructure. For example, in Mali and Burkina Faso, the total cost of ownership electric three wheelers for freight is 40 percent lower than that of their ICE counterparts. [3]

Nigeria, Uganda among others are developing assembly capacity and manufacturing of new electric motorcycles. South Africa has a startup company that manufactures and operates electric three-wheeler taxis. Ghana is assembling electric two and three wheelers.

Yet another strategy that is becoming popular is retrofitting. Uganda is retrofitting existing ICE motorcycles, and assembling electric motorcycles and battery packs. Rwanda is also retrofitting ICE motorcycles to electric.

Achieving price parity in e-two-wheeler segment: Clearly, the two-wheeler segment has enormous opportunity. This segment is also expected to achieve early price parity. Analysis by UKAid's ***Manufacturing Africa programme in***

Kenya in 2021 suggests that the average price for a locally assembled ICE two-wheelers is US $1,300 while the average price for a locally-assembled electric two wheeler is currently US $1,8005. Further drop in battery costs may bring this price down slightly in the next five years.[4] But to achieve full price parity with ICE two-wheelers within that timeframe would require incentives, product innovations, and innovations in business model. This includes selling the electric two-wheelers without the battery and then renting the battery to reduce the upfront cost.

Multiple business models are emerging across countries. While some companies are importing and selling completely built up units (CBUs), several are importing completely knocked down kits (CKDs) and assembling locally. Most are investing in product development to tailor the electric two wheelers to the local market. This segment is witnessing start-up led growth as in other developing countries.

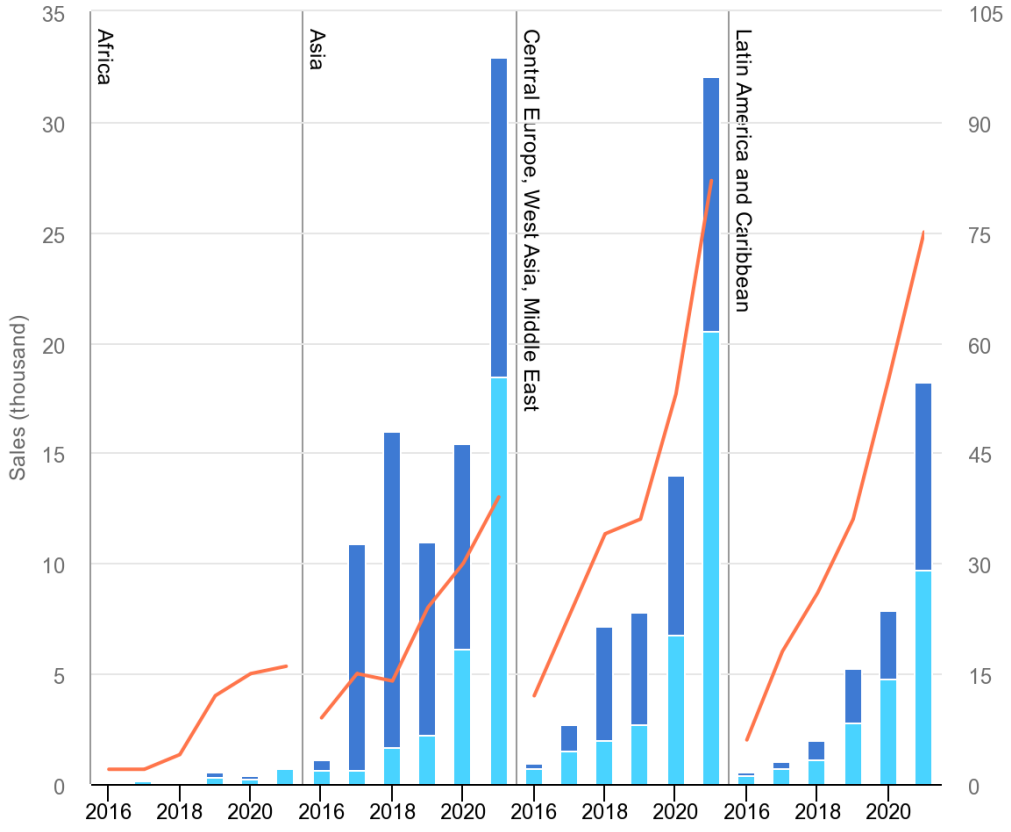
Light-duty vehicles

Interest in the car segment is also growing that can be put to personal use as well as commercial use like taxis. The International Energy Agency that tracks electrification of the global car fleet reports positive trends in this segment in 2021. Although electric car sales are very low across Africa, they have increased by 90 per cent from a very low base, of which battery operated EVs are 85 per cent. But due to the small market size currently only limited models are available throughout Africa. In South Africa, three-quarters of the available options for electric cars are from high-end brands.[5] Increase in this segment can make more vehicles available in commercial and rideshare fleets (see *Graph 1: Electric car models available in selected emerging markets by segment, sales and models available by region 2016–21*).

Nigeria has taken the lead to assemble solar powered electric cars. The National Automotive Design and Development Council (NADDC) has started this pilot programme. There are reports that about 200 units have been sold. As of 2021, South Africa has a stock of about 860 battery operated cars and 880 plug-in hybrids, as per the IEA global data explorer, 2022. Other data sets have also reported small stocks in Kenya and Morocco.

The UNEP, together with the Global Fuel Economy Initiative are working on the baseline setting and policy development for the introduction and shift to electric vehicles in Ghana, Mauritius, Mozambique, Tunisia, Cote d'Ivoire, Zambia among others.

Graph 1: Electric car models available in selected emerging markets by segment (left), sales and models available by region 2016–21 (right)



Light blue BEV Dark blue PHEV Number of available models (right axis)

Source: IEA 2020: Global EV Outlook 2022 Securing supplies for an electric future

There is also more strategic deployment of EVs. Electric cars have been introduced for tourism in National parks in Arusha and the Northern tourist circuit.[6]

It will take a while to achieve price parity in this segment. According to a 2022 study of UK Aid and World Bank Group etc electric passenger cars are 20 to 50 percent more expensive than ICE counterparts depending on the market and model.[7]

The initial application will be more in the commercial and delivery fleet and such bulk purchase for fleet operations can also help to reduce costs and promote more product diversification.

Zero-emission public transport fleet

In line with the strategy of the other developing countries, Africa has also prioritised electrification of the public transport fleet, including buses and paratransit. This is a very important strategy in the developed South as opposed to the developed North where the focus is more on personal cars, majority in African and Asian countries walk, cycle and use public transport. Therefore, investing in zero emissions public transport and paratransit that also meet the highest share of travel demand, can transform mass commuting to zero emissions.

There is a growing demand from the sector of shared mobility in nearly all countries including South Africa, Uganda, Sudan, Morocco, Angola, Ghana, Cameroon, Cote d'Ivoire, Zimbabwe, Rwanda, Tunisia, Namibia, Gambia, Mauritius, Seychelles, DR Congo, among others.

Electric bus services were introduced in Nairobi in March 2022, where BasiGo company has deployed buses in the Eastlands area connecting North Airport Road to Allsops and the Dandora–City Stadium routes. The bus company BasiGo is also expected to start local production. The company, with two public service vehicle operators, are piloting buses on two routes in the Eastlands area and has imported 15 units for other city routes.Electric boda boda or bike taxi services are also increasing. Kenya Power has announced a plan to install charging points in various parts of the countryincluding households.

In Egypt, Alexandria Passenger Transport Authority (APTA) is operating15 electric buses. Electric paratransit that include two-three wheelers and small vans are also increasing. In Kigali, e-motorcycle service Ampersand, which launched two years ago, currently has 35 vehicles doing taxi and delivery work. A company called Mellowcabs, based in Stellenbosch, South Africa operates some 60 EV light-duty delivery vehicles in South Africa, Botswana and Namibia. In Nigeria, Japan's Yamaha Corporation took part in a US $7 million funding round for electric motorcycle taxis. The start up, whose investors also include Nairobi-based venture capitalist Novastar Ventures Ltd are expected to launch 1,000 such vehicles in Nigeria by the end of 2021. It finds that the costs of recharge of EVs is 50 per cent less than refuelling cost of gasoline engines in Nigeria.

In Kampala, Uganda, 200 Kayoola electric buses that are manufactured by Kira Motors, are currently operating in Uganda. These are specially designed for urban mass transportation with range up to 300 km and sitting capacity of 90 passengers. Similarly, 140 electric buses have been rolled out in cities of Cairo, Sharm el sheikh in Egypt. Several other countries are considering mini electric buses.

The UN Environment Programme through the Global Electric Mobility Programme and the Soot-free Urban Bus Fleet project of the Climate and Clean Air Coalition is active in the following African countries: Cote d'Ivoire, Senegal, Seychelles, South Africa,Tanzania.

Cost of bus deployment will be higher than the small vehicle segment. According to the study by UK AID, World Bank Group and others, medium-sized electric buses can be twice the price of comparable ICE models. Cost can be reduced if local assembly is possible, and there is preferential taxation system. The cost also has to account for infrastructure (depots, high-capacity charging facilities).[8]

Electric buses are expected to be a growth sector. There is considerable learning in India on this that has prioritised support for electrification of buses and is working with strategies of bulk purchase by transit agencies and demand aggregation. India is also adopting different business models including a gross cost contract that allows the bus manufacturers or a third party agency to provide the service of fleet operations and to take responsibility of maintenance and operations.

Electric vehicle policy, regulations and targets for electrification

Policy design and regulatory targets are needed for a robust EV programme to provide long term policy visibility and road map to the industry and to build confidence in the market. Several countries have started to work towards target driven electric vehicle policy in Africa though it is still nascent and ad hoc. But several countries have included zero emissions transition in their respective nationally determined commitment (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC). This is also influencing local policy making.

A few countries have begun to set policy and aspirational targets for electrification. For example Cape Verde has set 100 per cent electrification targets for new sales for passenger cars by 2035 and urban buses by 2040. Interim electrification milestones are being set for various fleet segments including passenger cars, urban buses, government vehicles, and countrywide charging infrastructure. Similarly, Morocco has set an EV production target of 1 million units by 2025.

Kenya has gained market momentum and the Kenyan Ministry of Energy has set a target of 5 per cent of all newly registered vehicles to be electric by 2025.

Tanzania is developing national electric vehicle policy to support EV market

development through targeted EV implementation frameworks and capacity building. This includes the development and adoption of national electric vehicles policy, regulations, support for market transformation in cities of Dar es Salaam, Mwanza and Dodoma for fast growth. Key targets are commuter buses, three wheelers and two wheelers.

Rwanda is integrating e-mobility in their targets for reducing greenhouse gas emissions as part of their national climate action plans to meet the requirements of NDCs. Rwanda's NDC targets involve mobilizing US $900 million for electric vehicles and charging infrastructures. EVs are expected to contribute to a reduction of 9 per cent of GHG emissions in their energy sector in 2030. It has set a target for progressive adoption of electric buses, cars and motorcycles starting in 2020, replacing conventional vehicle sales and diminishing transport fuel imports. Rwanda has announced tax exemptions for EV sales. This measure depends on external financial support from donors. Earlier, e-mobility was mentioned in the Third National Communication UNFCCC had even mentioned adoption of electric cars to substitute 150,000 conventional cars by 2050.

Rwanda is also revising its National Transport Policy. Its 2019 e-mobility feasibility study that had identified the possibility of reducing greenhouse gas (GHG) emissions by 17 per cent in 2030 compared to a business-as-usual scenario, aims to achieve 30 per cent electrification of motorcycles, 8 per cent of cars, 20 per cent of buses and 25 per cent of taxi, mini and microbuses in 2030.

Zimbabwe too is working on an electric mobility policy framework and roadmap, that is expected to be functional by year-end. By 2020, Kenya is reported to have adopted 21 technical standards related to vehicles, batteries and safety requirements.

Several other countries are evolving their EV policies and regulations. It is also notable that several of these policies are taking a more holistic view of the solutions for the ICE vehicles as well as the role of the EVs.

For instance, Uganda's Electrical Vehicle (EV) policy was drafted and implemented against the backdrop of a study conducted by the Makerere University, Kampala in 2015 that showed high CO2 emissions from vehicles. It took note of energy security concerns and high oil prices. Also the role of EVs despite their high costs. Kampala City Capito Authority, Uganda Revenue Authority and Ministry of Works & Transport carried out an analysis of inventory of vehicles, average age of vehicles, and fuel efficiency of vehicles. They also considered the impact of fossil

fuel vehicles. This showed that the average fuel efficiency was about12.4 kmpl; 15 years or older vehicles were responsible for high concentration of GHG emissions; and ICE vehicles were responsible for high emissions. It therefore recommended policy shift to EVs, blanket ban on import of second-hand vehicles (r 15 years), and increasing tax rates on diesel engine vehicles. The implementation started in 2018 after the approval from the Technical Committee and Programme Working Group.

As experience in the global South has demonstrated that the devil is in the design of the policy, regulations, mandate and fiscal enablers. For the new technology to compete with the mainstream ICE vehicles a combination of target, mandate and incentives supported by a roadmap for charging infrastructure are needed. This will also require funding and financing strategies along with resource mobilization. Therefore, considerable efforts are needed to understand each aspect of the policy design for effective enablers.

Designing effective incentive programmes

Several countries have started to create fiscal incentive programmes to increase supply of EVs. Priority in Africa is to reduce the cost of the EVs and make the vehicles available in the market by providing incentives to the industry and vehicle importers. This is different from several other demand incentive programmes that provide direct fiscal incentives to the consumers to purchase electric vehicles. But to encourage ownership and usage of EVs, the cost of electricity is being reduced to lower the operational costs.

Several countries are now designing and implementing incentive programmes. These include Rwanda, Kenya, Egypt, Morocco, Zambia, Mauritius, Cape Verde, Seychelles, Uganda among others who have started to adopt incentives including subsidies and tax rebates.

Strategies vary across countries. In April 2022, Rwanda unveiled a wide set of tax breaks to push the adoption of e-vehicles. In order to reduce the ownership and maintenance cost of electric vehicles, a range of tax exemptions have been provided, which include import and excise duty exemption and zero rated VAT on electric vehicles, spare parts, batteries and charging station equipment; exemption from import and excise duties, and exemption of 5 per cent withholding tax on spare parts, batteries and other equipment. It is also providing rent-free land for charging stations. It provides preferential corporate income tax rate of 15 per cent for investors operating in e-mobility. A vehicle when imported in Rwanda has to pay 25 per cent import duty, 18 per cent value-added tax (VAT) and 5–15 per

cent excise duty depending on the engine size. EVs are exempted. Ruwana has also reduced electricity tariffs for EVs,

The Kenya government has halved the import duty for fully electric vehicles from 20 per cent to 10 per cent in 2019. The state-owned firms – Kenya Power, an electricity distributor, and KenGen, a power generator – have started phasing out fossil fuel-powered vehicles in their own fleets.

Tunisia is providing tax breaks and other incentives to increase electric vehicles. The country's Finance Act 2023, which came into effect on 1 January, has reduced customs duties on electric vehicle charging equipment to 10 per cent and the value-added tax (VAT) to 7 per cent. This is projected to lead to deployment of 50,000 electric cars by 2025 and provide attendant benefits of reduction in oil consumption of 5.9 million barrels, or a reduction in imports of fossil fuels of US$660 million over the period 2020–30.

In Egypt steps are being taken to streamline vehicle licensing processes for EVs; a formal registration procedure dedicated to EVs has been initiated in 2019. In 2013, a decree was issued by the Shura Council (consultative council) of Egypt to provide electric cars with a 100 per cent exemption from custom duties and this remains in the recent presidential decree for import tariffs. But such explicit exemptions for other types of electric vehicles, like electric two-wheelers are not yet available. The Ministry of Trade and Industry has exempted used electric cars from the restrictions on used vehicle import. Used electric cars can be imported on the condition that they are no more than three years old. In 2021, Egypt has also granted used passenger cars with electric or dual motors a 10 per cent discount on the free on board (FOB; the value at the point of export) value.

Well-designed incentive programme can help to overcome the challenge of upfront costs. According to reports upfront prices remain out of the range of average Africans. For example in Nigeria, the average cost of a new electric vehicle is about $55,600 (N23M) which higher than the average annual salary of average Nigerians in Lagos.

Step forward on incentives: However, as noted already, at this moment the incentive programme is oriented towards reducing the cost of the EVs by reducing tax burden. The region is yet to move to providing direct fiscal demand incentives to the consumers that countries like India have adopted for two wheelers and commercial vehicles. The strategy to reduce supply cost is a good step forward as Africa needs to increase the availability of cost effective EVs models in the market.

This is also needed to encourage local manufacturing and assembly. Moreover, in the import-driven countries such as Africa leveraging that policy to promote EV importation is an important approach to also combat dumping of old and polluting ICE vehicles.

Once the market begins to gain more maturity, a more target driven supply mandate can be adopted to encourage industry to produce and diversify their product base more affordably and reduce price pressures. That can also be supported by more demand incentives to build consumer demand. Moreover, as several countries are now scaling up their public transport and non-motorised transport parking policy and low emissions zone approaches, even non-fiscal incentives can be designed to connect targeted zones with electric buses, electric paratransit or e-wheelers or cars. This will create a direct disincentive for fossil energy powered vehicles and scale up the EV market.

EVs and industrial development

The electrification strategy has opened up opportunities in the developing South to create its own manufacturing base, even in countries that so far were only vehicle importing countries, to have local economic spin off, retain value chain, create employment and also make the cost of transition more affordable. This was not earlier possible with ICE vehicles in Africa. But EVs have created this opportunity. While vehicle producing countries in Asia including India and China are already on that track, the vehicle importing countries of Africa are also taking that route.

The relative simplicity of the technology of electric motors, battery packs and related assembly especially in small vehicle segments have created this opportunity. This has become a startups led growth and not dependent entirely on traditional original equipment manufacturers (OEMs).

Several African countries are developing their EV policy as industrial development policy. South Africa, Uganda, Nigeria, Ethiopia, Morocco, Rwanda, Ghana, Tunisia, Sudan, Zambia, Zimbabwe, Togo, Namibia, Botswana, Cape Verde are moving in that direction and setting up assembly facilities.

Nigeria is promoting local assembly of cars, vans and small vehicles like three-wheelers and two-wheelers. National Automotive Design and Development Council (NADDC) and Stallion Group had launched the first-ever electric car assembled in Nigeria. Less than 200 units have been sold so far.[9] Hyundai Kona is manufacturing e-cars and has recorded 120 units sale in two years. [10] The Nigerian government has signed a memorandum of understanding (MOU)

with Israeli and Japanese companies to start manufacturing electric vehicles (EVs) in Nigeria.[11]

South Africa has adopted more detailed target and approach to become a EV production hub. It wants to retain and build export market and also maintain the share of auto industry at 4.9 per cent to the country's GDP by accelerating local manufacturing. Their 2021 draft[12] A*uto Green Paper on the Advancement of New Energy Vehicles in South Africa: Road to Production of Electric Vehicles (The Roadmap)*, for public consultation, has asked for tax reforms to support industrial policy and to stimulate domestic demand for vehicles by reducing the ad valorem duty and providing benefits to the employees of automotive companies. A standard rate per kWH is being suggested to reduce the price of an EV. It is considering lowering taxes on EVs while taxing luxury vehicles higher.[13]

The thrust is on localisation of production. As per the South Africa policy document, there is an agreement to consider electric vehicle battery manufacturing. Temporary support in addition to the South Africa Automotive Master Plan 2035 can reduce the gap for local businesses. The EV industrialisation policy is considering lower or zero-rated duty for selected EV components, EV credits for offsetting manufacturing OEM's customs account. Production incentive and production rebate certificates are expected to promote local content. It is also proposing to strengthen value chain investment and transitioning from raw material exporter to product exporter. There is emphasis on skilling and employment.[14]

In Uganda, locally manufactured electric buses from Kiira Motors have started operations in Kampala. In Nigeria, Jet Motor Company has partnered with GIG Logistics to provide EVs for both transport and logistics services in the Nigerian market.[15] Interest in R&D and capacity building and innovative business model is growing in Nigeria, Ethiopia, Tanzania, South Africa, Kenya, among others. Egypt's first domestically built electric vehicle is expected in 2023. The government is incentivising customers to buy electric vehicles. [16]

McKinsey has estimated that as of the end of 2021, there were more than 20 start-ups in the ecosystem, which together have raised over US $25 million for funding in that year.[17]

There are close to 50 startups companies in Kenya in the electric two- and three-wheeler space and about 18 e-mobility companies, with more being established faster than before. In Kenya, 64 per cent of market players in e-mobility have invested in local assembly.[18]

The nascent but growing market is attracting foreign manufacturing partners in the region to establish EV production base in the region as is evident in Egypt and Morocco and other countries. German automaker Opel, Chinese automaker Dongfeng are among this group.

Companies are targeting mobile phone-based ride-sharing services that are increasingly becoming the leading mode of mobility in Nigeria and other Sub-Saharan Africa auto markets.[19] Free license and authorization will be provided for commercial electric vehicles. The governments are also de-risking the business by guaranteeing a market, where preference will be given to electric vehicles for government-hired fleet. Rwanda is adopting this strategy.

Industrial development around mineral reserves: As the transition from petro economy to electro economy is gaining ground, other opportunities are opening up around the mineral reserves that are the new battery material. This has also pushed Africa on the global map for raw material sourcing.

For instance, the Lithium-ion battery (LiB) is a major component of an EV. Key LIB minerals are available in ample quantities in South Africa (manganese, nickel and platinum), Democratic Republic of Congo (DRC) (cobalt), Zimbabwe (lithium), Mozambique (graphite) and Zambia (copper). Even though these minerals are mined in Africa the value-addition processes such as smelting, refining, cell assembly and finally the EV production takes place outside the continent.

Africa can benefit from higher returns on job-creation that occurs from participating in value creation. Studies show that African countries can aspire to participate in the beneficiation stages and also in the precursor production, cell production stages, and ultimately cell assembly. Much of the global reserves of critical minerals required for manufacturing EV batteries are in the DRC, Zimbabwe, Mozambique, Zambia and South Africa.

However, it is also necessary to track the global concern and trend towards sustainable mining to reduce the environmental and social impacts of mining. Early adoption of policies on sustainable mining and localisation of the value chain can provide considerable spin off to the mineral rich countries.

Battery recycling and urban mining: As EV programme begins to take off advance planning is needed for recycling of the downgraded and spent batteries not only for safe disposal to reduce environmental impact but also to recover the precious minerals from the old batteries for reuse. As of now most of Africa has not

implemented formal infrastructure for scrapping of old vehicles and batteries of ICE vehicles. But once volumes of EVs begin to roll this will be needed.

Next steps on EV industrial policy: As seen in other countries a focussed industrial policy to provide supply side mandate to vehicle manufacturers and vehicle importers; and purchase mandate to the fleet operators, can help to stimulate the markets quicker. Such policies are possible at both national and sub national level. In India, in addition to the national government policies and incentives, the sub-national governments are also adopting their respective EV policies to set targets and to promote local manufacturing within the state boundary with tax breaks, lower input costs including subsidised land, water etc, and easing of procedural requirements. There is a higher level of demand incentive in some states for EVs that are locally produced and locally sold and so forth.

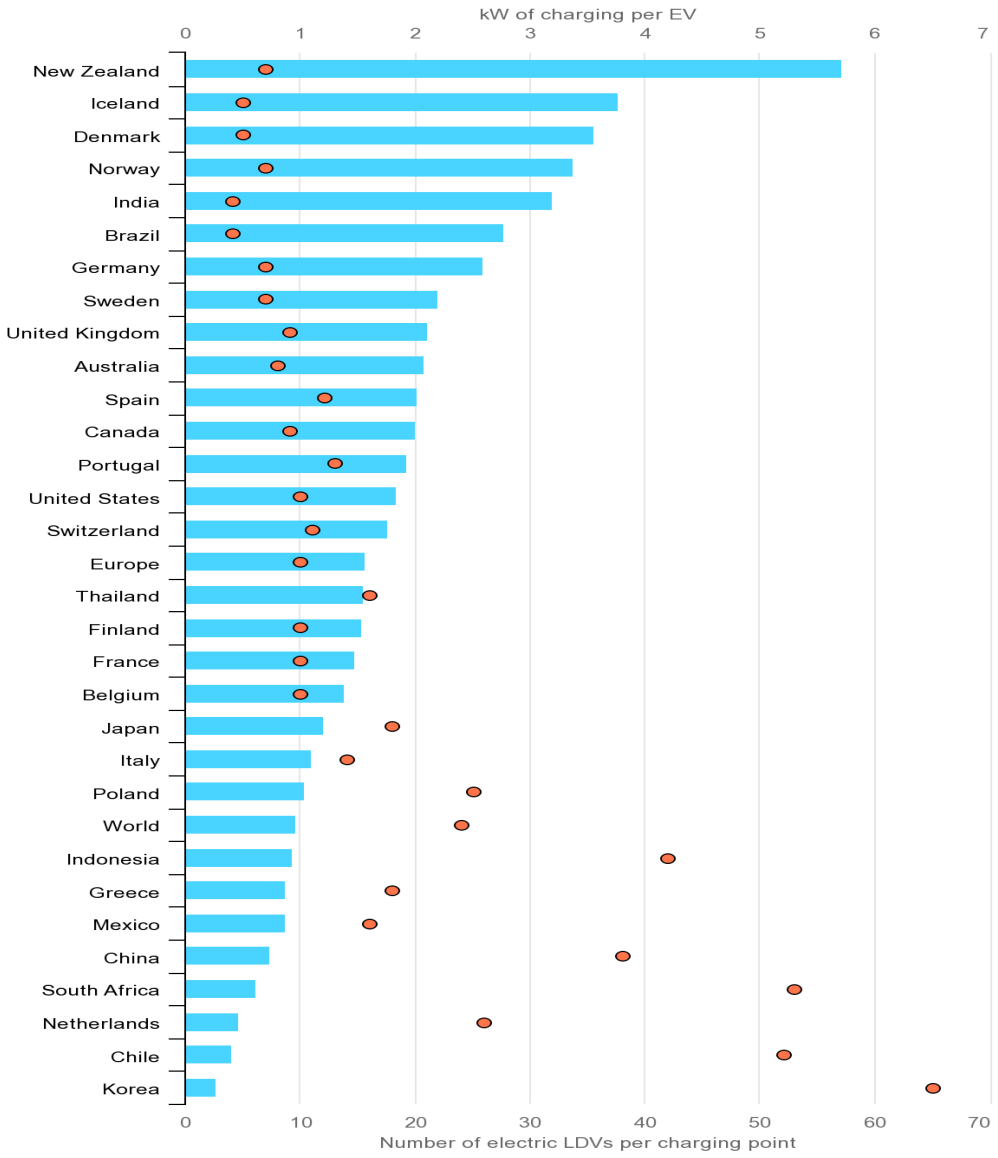
As is also the experience of other countries in the developing South like India, the much needed thrust of localisation of EV manufacturing will also eventually require local capacity for battery assembling and advanced battery chemistry, battery management including thermal management for safety. An early roadmap even as the EV market begins to take off, is important. The countries in Africa also need to pay attention quite early to these details while developing their regulations and incentive programmes to be able to plan their funding and financing strategies in advance. The growing EV market in Africa is already attracting the bigger OEMs from Europe, the US and Japan to tie up for the local market that is also stimulating new investments and international funding. This requires effective leveraging.

Expanding charging infrastructure and affordable and reliable electricity

This is a challenge that all developing country cities are facing today. Even though there is considerable dormant demand in the market for EVs it does get translated to committed demand because of hesitation and anxiety due to lack of convenient public charging and also unreliable power supply.

Charging infrastructure is beginning to take shape in a large number of countries including Nigeria, DR Congo, South Africa, Kenya, Uganda, Morocco, Angola, Ghana, Cameroon, Cote d'Ivoire, Zimbabwe, Rwanda, Tunisia, Togo, Sierra Leone, Namibia, Gambia, Botswana, Mauritius, Cape Verde, Seychelles[20] However, on a global scale it is still very limited as is evident from the documentation of IEA for selected countries across continents. This shows that South Africa that has relatively one of the largest EV programme in Africa has smaller grid (see *Graph*

Graph 2: Charging points per EV and kW per electric LDV in selected countries, 2021



Source: IEA 2020: Global EV Outlook 2022 Securing supplies for an electric future

2: Charging points per EV and kW per electric LDV in selected countries, 2021).

Other countries have also started to set up their charging network. In Egypt, the number of charging stations across the country is growing.[21] It is also evident that the role of home charging will be important. In fact, Kenya has initiated

modification of building code to plan for the integration of charging infrastructure in public buildings and residential estates.[22] This is an important step forward.

In 2019, installed charging points have exceeded one hundred points. The start-up company, Revolta Egypt, through cooperation with state owned fuel distribution company National Petroleum Company (NPCO, a.k.a.Wataneya) is installing EV charging stations at their gas stations. [iv] German carmaker Audi has announced a partnership with GridCars to install ultra-fast charging stations across South Africa.

Access to electricity: Access to reliable electricity is a concern. Sub-Saharan Africa is facing challenges due to unreliable electricity supply. According to the study by UK Aid, World Bank Group and others in 2022, only 48 percent of the population in Africa has access to electricity -- with an urban access rate of 78 per cent versus a rural access rate of 28 per cent. But some countries like Uganda and Rwanda, have sufficient supply to support E-mobility.[23]

According to a McKinsey study about six countries in Sub-Saharan Africa have urban-electricity-access rates above 70 percent and some more than 90 percent. A 2019 survey across 34 African countries found that fewer than half of those connected to the grid have reliable electricity. 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.

However, there are also countries like Kenya that are reported to have a substantial electricity surplus of 25–30 per cent and therefore an increase in demand for electricity from fleet electrification can be helpful. But it is also important to focus on the fact that while there might be excess generation capacity there may still be gaps in the electricity transmission and distribution systems that can compromise reliable and uniform supply across the regions without the problem of outages. They may need further upgrades and advance planning to address peak demand when the EV scale will be achieved.

Unreliable electricity can be a challenge to developing scale especially outside cities. In Mozambique, only a third of households have regular electricity access though the government targets universal energy access by 2030. This will also be a challenge for the paratransit who rely on informal and often home based charging.

Power generation capacity in the region is expected to more than double by 2040. The shift to transport electrification will be far easier to manage if it is factored into

grid upgrades at an early stage. There is considerable talk about smart technologies and appropriate regulation, dynamic charging and vehicle-to-grid applications.

Adopt inventive solutions based on solar powered charging stations: There is optimism about leveraging the transition to renewable energy in this region and the fact that in several countries the dependence on coal power is not that high. Most of it is old renewable including hydro power.

Studies have shown, e-mobility can provide the second highest mitigation potential for transport emissions in Kenya, as 86 per cent of the electric generation mix is from renewable energies, mostly geothermal and hydropower. Uganda and Tanzania also have robust and renewables-heavy grids. In Tanzania there are significant developments in hydropower generation that present an opportunity for e-mobility. Zimbabwe that is working on an electric mobility policy framework and roadmap, has installed solar panels in six stations and plans to equip more. As the first petroleum firm to turn to solar in Zimbabwe, the company is investing US $4 million in solar-powered service stations as part of a decarbonisation strategy that can be leveraged for setting up solar powered charging stations as well.

In Nigeria, National Automotive Design and Development Council (NADDC) has developed and launched models for solar powered charging stations that have been set up in Lagos, Sokoto etc.

This is a way forward to fully decarbonise the vehicles and source of energy. If supported with proper funding support and private investments with scaling up of the EV market this can be transformative.

Emerging business model for charging: There are several business models emerging in the region to facilitate setting of charging network.

In Egypt for instance, ten businesses and consortia have qualified to bid for the management and operation of electric car charging stations in Egypt. About 14 companies and consortia have expressed interest in managing and operating the EV charging stations. April 2022 onwards, business plans to build and operate 3,000 charging stations for electric vehicles in the governorates of Cairo, Giza, Alexandria, and Sharm El-Sheikh, and on major motorways are planned. The cost of establishing this network is estimated to be LE450 million. Based on such development the target market is expected to grow significantly.[24]

This needs coordination between utilities, fleet operators and government

agencies to ensure there is adequate electric vehicle charging infrastructure and that the necessary grid upgrades are in place to avoid straining the energy network with EV charging. This requires assessment of electricity distribution system for upgradation. The impact of electrification will impact mainly the substation level that will have to assess the peak load from full fleet electrification.

The charging infrastructure will also require standardization and interoperability of various technologies for smart operations. This vehicle-to-grid technology will require coordination between utilities, automakers and EV charging solution providers. The energy ecosystem will have to be planned well and address transmission, distribution, and charging programmes.

Leveraging fuel economy regulations for faster electrification

While there is considerable policy discussion in Africa on accelerating fuel quality and emissions standards for vehicles, the action on fuel economy regulations to reduce energy consumption and CO2 have not yet picked up to that extent. Developing such regulations and setting effective targets for fuel efficiency fleet-wide can create opportunities for electrification.

However, approach to such regulations in importing markets of Africa will need appropriate design as these standards are normally crafted for manufacturers. But importing countries will need to adopt import policy linked to the benchmark to improve fuel economy of the fleet and within that create the mandate for introducing EVs.

Evidence from some of the older studies carried out by Global Fuel Economy Initiative, ICCT and UNEP bring this out.

For instance, a 2015 study in Uganda shows that the average fuel efficiency has declined from 12.52 L/100km in 2005 to 13.73 L/100 km in 2014 due to an increase in the average age of vehicles imported into the country. Average carbon dioxide emission has also worsened from 465 g/km in 2005 to 503g/km in 2014. In South Africa the average CO2 emissions of new passenger ICE cars was 148 gCO2/km in 2015. The equivalent metric in terms of fuel consumption is 6.3 L/100 km. This is a much lower average efficiency of vehicles compared to Europe. The SUVs were found to have lower fuel economy.

In Kenya the GFEI-ICCT study found that average fuel economy was 7.5 L/100 km and the average CO2 emission was 181.9g/km for the period 2010-2012. This

is very high compare to the current EU standard of 95 CO2g/km or the Indian 2023 standard of 123 CO2g/km.

Subsequently, the Kenyan Ministry of Energy in 2020, came up with the National Energy Efficiency and Conservation Strategy. This has taken on board the baseline as estimated by the GFEI-ICCT study for 2019 and has set targets for 2025 at 6.5 L/100km 160 g/km with increased adoption of electric vehicles. It has set a target of EVs to be 5 per cent of the total annual import.

It has asked for fuel economy standards and labelling for vehicles based on average fuel consumption per mile and CO_2 emissions. The age of second-hand vehicles imported into Kenya to a maximum of five years and the collection of annual license fees based on the results of annual inspections on fuel economy and CO_2 emissions and implementation of vehicle inspection for emissions.

In the meantime, in West Africa 15 Ecowas states have adopted a regionally harmonised fuel economy roadmap that includes targets for EVs. New tax measures introduced under the fuel economy initiative in Mauritius in 2019, such as reduction in excise duties by 5-15 per cent depending on the type of electric car, have resulted in a substantial increase in hybrid and electric vehicles to 14,060 units and 206 respectively in January 2020 compared to just 43 hybrid vehicles and two electric cars a decade earlier.

Clearly, this strategy will require effective design, targets and benchmarks to drive adoption of EVs.

Electrification and meeting high levels of ambition will require deliberate funding and financing strategies for infrastructure, manufacturing as well as purchase. Countries will have to estimate the cumulative cost to meet their respective targets by 2030.

Some of the key financing barriers are related to high financing cost including high interest and insurance rates, and limited financing options for retail customers. In most parts the EVs are not yet bankable. There are concerns around resale values of EVs. Also the financial institutions will have different criteria for two/three wheelers and bigger vehicles like cars and buses.

The paratransit vehicles will rely more on unsecured borrowing from the unorganized sector at higher rates. These vehicles that rely on daily earning may face challenges in establishing viability of their business models to financial institutions.

There is a need to increase access to low-cost financing; priority sector lending mandates are needed. The governments need to continue with the policies to provide interest rate subvention; product guarantees need to be provided. Several de-risking strategies will be needed.

For e-bus operations, there is need for proper guarantees for bus utilisation to help them to achieve parity on total cost of ownership. They need to improve their

Moreover, as a great part of the EV transition is being pushed by the start-ups financing for them will become critical**.** Venture capital funding is catalysing this sector.

There is not much information available on the state of funding and involvement of the financial institutions in developing countries. There is evidence of some in-country financing programme. For instance, Abdul Latif Jameel Finance Egypt has established a new financing program for electric cars. The new initiative will pay clients up to US $208,900 (EGP 4 million) over five years to help enable access to EVs and stimulate the expansion of Egypt's EV industry.

International funding will also become important to fund the cost of transition in these countries. Deployment in emerging markets by International Council of Clean Transportation (ICCT) shows that projected required support is USD 505 million. About US $16.2 million has flowed in covering 12 countries. They have received grants in the range of US $28,500–8.4 million. There is not much information on how the international climate finance or bilateral and multilateral finance will work in this case yet.

International funding will also become important to fund the cost of transition in these countries. A global assessment by International Council on Clean Transportation (ICCT) sows that while the emerging markets need to develop ZEV transition roadmaps, regulatory frameworks, and localized capacity for supply chains etc to reach cost parity, they can further reduce the costs without imposing an extensive financial burden on government through budget-neutral mechanisms or international financing to fund targeted fiscal policies and innovative business models.

Import-based emerging markets in Africa can form trade agreements with exporting countries to lower or waive import duties for ZEVs or ZEV components and tighten standards for imported used ICE vehicles while allowing imports of slightly used EVs that meet performance and safety standards. Emerging markets need significantly greater international financial support for the ZEV transition.

In fact, these emerging markets are receiving international grants, loans, and technical support for the ZEV transition. But there is a significant gap in financial support. Over the past five years, 37 of the 117 emerging markets that ICCT has analysed have received in total approximately $163 million USD in international support for ZEVs. This amount is only 6.5 per cent of the level of funding (USD 2.5 billions) that they have estimated that is needed over the next five years to adequately support the early phase of the ZEV transition.

In view of the fact that international climate finance is taking shape and bilateral funding is also picking up, the EV programmes across the region need better assessment and scoping to leverage this funding.

According to a study by UK Aid, World Bank Group and others on e-mobility in low income countries in Africa: Finance, Governance, and Equity in 2022[25] has highlighted that overall Africa needs US $2.5 trillion of climate finance between 2020 and 2030 requires, or on average, US $250 billion each year for mitigation and adaptation. What it currently gets falls far short. Specifically related to EV deployment there is a study on future electric two -wheeler deployment in Ethiopia, Kenya, Nigeria, Rwanda, and Uganda that has found that by 2030, the number of vehicles could range from 3 to 4.4 million, with financing needs estimated between US$3.5 and 8.9 billion.[26] Africa needs to combine finance from donors and businesses and international development banks to direct funding into green transport projects.

Apply polluter pay principle to tax ICE vehicles higher to mobilise additional revenue: The markets in Africa also need local financial instruments, subsidy policy and revenue generation based on the polluter pay principle for cross subsidy need to take shape quickly.

There are examples in the global South where polluter pay principles have been effectively designed to tax the polluting diesel vehicles and diesel fuels higher to raise additional funds to create dedicated funds to finance clean air programmes and EVs.

Even in Africa there are examples of CO2 based taxation vehicles as in Mauritius. Also Malawi has imposed carbon tax on all vehicles as part of the air quality management plan.

From the global South, there is also learning from Delhi in India Air Ambience Cess has been imposed on each litre of diesel sold in the city, environment pollution

charge has been imposed on all diesel cars with 2000cc engines and above, and environment compensation charge has been imposed on each truck entry into Delhi daily. From all these three taxes Delhi has generated an enormous revenue base and created dedicated funds which are now being used to give fiscal incentive and fund charging infrastructure in the city. The tax amount is very small but cumulatively has enormous revenue potential.

Leverage policies on used vehicle import to push electrification

Most countries have now started to take steps to regulate the used vehicle import and adopt a variety of measures that include age caps, higher taxes on older vehicles, increasing import taxes to promote local assembly and manufacturing, CO2 levy and rebate system and excise duty linked to engine size, and obligation of importers.

In this bouquet of measures countries like Kenya have also started to exempt EVs from taxes and are also aiming for 5 per cent of the total import to be EVs by 2025. This strategy needs to be taken forward to create bigger opportunities.

There is also a requirement of a scrappage policy to weed out the end of life vehicles for material recovery. Such schemes may be implemented along with scrappage incentives and provide higher incentive if the replacement vehicle is EV.

The way forward

There is no doubt that a roadmap for electrification of vehicles is an opportunity in the emerging markets of Africa to avoid the pollution intensity of ICE vehicles and directly to leapfrog to zero emissions trajectory to control toxic air pollution and GHG emissions.

Even though this will be capital intensive roadmap, this may still work out to be more cost effective with local economic and employment spinoffs compared to the investments needed to make all new ICE vehicles to harmonise ate Euro IV level and go beyond to meet the Euro VI emission standards by 2030. More investments will have to be made to make them fuel efficient and control real world emissions.

The opportunities for electrification are bigger in the segments of two-wheelers, paratransit, commercial fleet operations and buses for zero emissions transition. Moreover, the big cities of Africa like Lagos, Cairo, Addis Ababa, Nairobi etc have high urban densities with reasonably small travel distances. This can make use of EVs more effective and reduce range anxiety as the normal

operational requirements will remain within the range that most EV models have achieved.

Yet another advantage of the emerging markets of Africa is that source of the electricity generation in most cases is not coal intensive and are already dominated by hydropower, geothermal, gas plants that are renewable. Thus the emissions factor of power grid is already low in terms of average emissions per kWh of electricity. With solar energy picking up and off grid standalone solar charging stations becoming a reality in the region. In fact, a study in Egypt by Frederick Ebert Foundation has brought out the advantage of low emissions grid.[27]

Next steps

The next steps require detailed enabling policy and regulatory framework to help build the market.

There are uncertainty about technical and financial feasibility, necessary legal and regulatory framework, market response, impact on employment and development of local industry.

National and city level policies need to set regulatory targets for time bound transition.

- Leverage the ongoing pilot projects to assess the barriers to further refine the strategies related to charging infrastructure, demand creation, localisation and consumer acceptance.

- Prioritise small format vehicles including two-three wheelers and paratransit vehicles to accelerate change.

- Prioritise bus transport and adopt demand aggregation methods to reduce the cost of procurement. Build bus based infrastructure for effective fleet operations.

- Leverage the restrictive policies on old and used vehicle import to create opportunities for EV imports. Mandate a certain percentage of the annual import to be EVs.

- Adopt old vehicle scrapping policy to mandate a certain percentage of replacement vehicles to be EVs. Scrappage incentives and tax waivers can be designed to achieve that.

- Design subsidy and incentive strategy to bring improved price parity with ICE vehicles and reduce total cost of ownership. Improved availability of cars and vans can also electrify commercial and ride-sharing fleet.

- Leverage fuel economy regulations to mandate EVs to improve average fuel economy and emissions of the overall vehicle stock.

- Develop financing strategy along with financing institutions and multilateral banks as well as strategy to access international finance to bridge the gap in resources.

- Need detailed plan on public charging including solar charging stations, and home based charging while addressing several technology-specific challenges related to impact on the power grid, and meeting different consumer needs for charging. Improve electricity access and leverage off-grid solar systems and mini-grids to meet electricity requirements of EVs.

- Involve private sector especially vehicle manufacturers to adopt business model that also includes provision of customised charging services and also deployment of EVs to provide service. Investments in battery swapping is needed especially for the price sensitive two-wheelers small vehicle segments.

- Need restrictive policy on ICE vehicles especially the old and polluting vehicles and higher taxes on them based on polluter pay principle to generate revenue for dedicated funding of the EV vehicles and charging infrastructure.

- Need demand management. Even though electrification of vehicle is part of the solutions, this still needs demand management to contain trend towards bigger batteries, growing dependence on personal vehicles and massive scaling up of public transport systems to reduce usage of personal vehicles.

- Need consumer awareness programme to sensitise customers about the EV products and its usage.

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