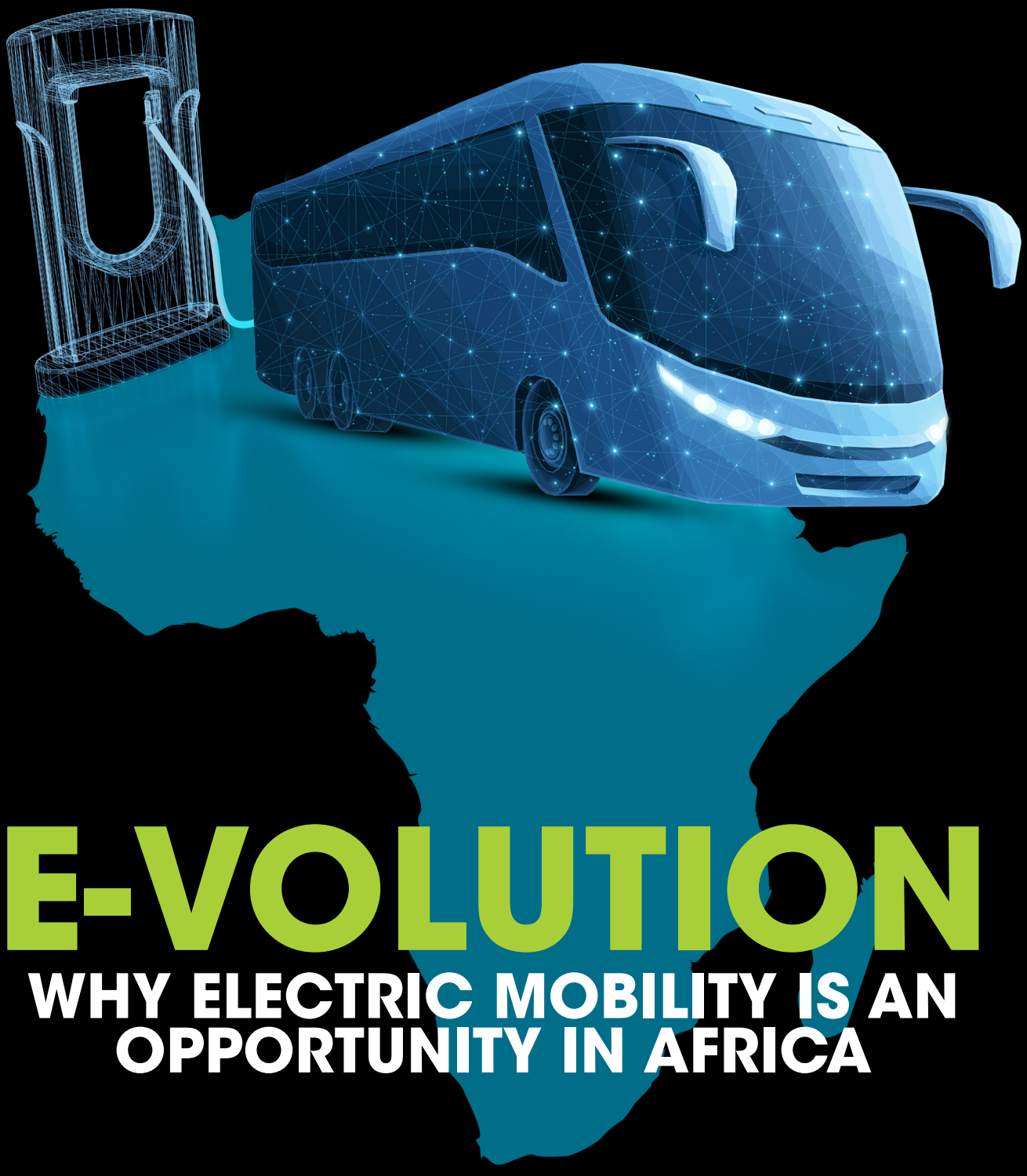

# E-VOLUTION

## WHY ELECTRIC MOBILITY IS AN OPPORTUNITY IN AFRICA


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# Contents

# Spotlight

The growing public health crisis associated with polluted air and rising carbon emissions due to growing economy and motorisation represents a difficult phase in the environmental risk transition in Africa. The imperatives of electric mobility needs to be understood within this context.

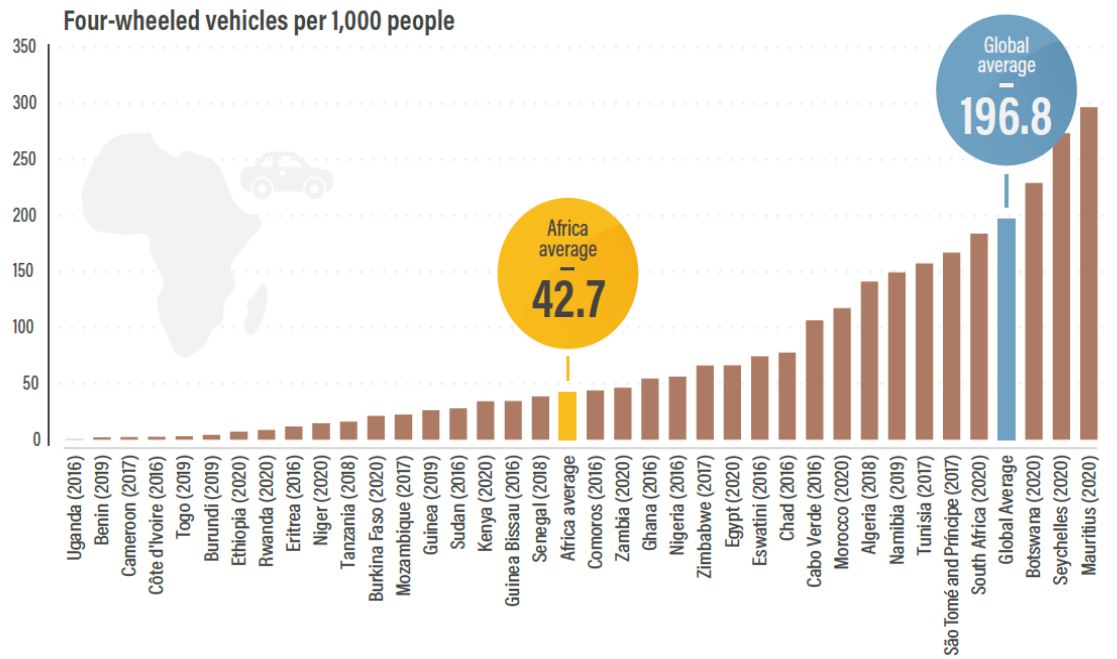
Even though these are the early stages of growth and motorisation in Africa, technology lag in combustion technologies across all sectors including vehicles, has increased health threatening emissions significantly. The State of Global Air 2024, shows that the countries in East, West, Central, and Southern Africa experience the largest burden of disease linked to air pollution. Nigeria with 206,700 deaths, and Egypt with 116,500 deaths, bear the highest death burden globally. Some regions have the highest population weighted PM2.5 concentration.

While the local toxic risk is big, Africa's share in global greenhouse gas emissions is comparatively much lower. But the trend is upwards due to growing energy demand. Africa therefore requires a co-benefit framework that will enable quicker co-control of both local emissions and greenhouse gas emissions from pollution sources. Electric mobility is a way forward. According to one estimate, transportation accounts for 10 per cent of Africa's total GHG emissions, and this is expected to rise.[1] Africa cannot fall behind in this transition.

This region experiences one of the highest exposures to vehicular pollution even though it has the lowest motorisation rates globally, with just 43 vehicles per 1,000 people compared to a global average of 197 vehicles per 1,000 people - between 2016 and 2020, *(See Graph 1: Motorisation rates per 1,000 people in Africa, 2016-2020)*. It is estimated that transport-related emissions in Africa have increased by 84 per cent during the past decade, and in 2018, the transport industry accounted for 15 per cent of the ultimate energy consumption in Sub-Saharan Africa.[2]

Africa accounts for less than 1 per cent of global vehicle production and heavily relies on imported used vehicles. The dumping of the old vehicle technology from other regions of the world keeps Africa at the lowest step of the technology ladder. The used light-duty vehicles constitute 85-100 per cent of the total vehicle fleet. From 2015 to 2018, Africa has imported the highest share of used light-duty vehicles among all regions, accounting for 40 per cent of the global total.

**Graph 1: Motorisation rates per 1000 people in Africa (2016-2020)**




Source: SLOCAT (2023), Global Status Report on Transport, Climate and Sustainability – 3rd edition, available at https://tcc-gsr.com/wp-content/uploads/2023/08/2.1-Africa-Regional-Overview.pdf

The current domestic markets of the Africa region are not robust enough to support local technology development of internal combustion engines (ICE) or enable import of high end vehicles. The transition to low sulphur fuels that is necessary for adoption of advanced emissions control systems that are fitted in Euro VI compliant vehicles, is still slow and non-uniform. The countries are still in the process of harmonising at the level of 50 ppm sulphur fuels that is compatible with Euro IV emissions standards.

Though there has been substantial progress in moving towards 50 ppm sulphur fuel in several countries, it is not yet clear how soon regional harmonisation will take place across Africa to meet the 10 ppm sulphur fuel benchmark needed for the introduction of Euro VI compliant vehicles.

From 2015 onwards, initially five East African countries—Burundi, Kenya, Rwanda, Tanzania and Uganda—adopted and implemented 50 ppm diesel sulphur fuel.[3] They were followed by Ghana, Malawi, Mozambique and Zimbabwe in 2017[4] and Benin, Eswatini, Lesotho and Namibia in 2019[5]. In 2024, Nigeria[6], Botswana[7], and Zambia[8] have transitioned to 50 ppm low-sulphur fuel. South Africa has fuel

quality with diesel sulphur levels ranging from 50 to 500 ppm[9]. Botswana and South Africa are targeting a shift to 10 ppm sulphur fuels, by 2027.[10]

In the meantime, the Economic Community of West African States (ECOWAS) has issued an advisory to all to move to 50 ppm sulphur fuel to have unified regional fuel and vehicle emission standards to address climate goals. In case of imports similar standards for regional refinery production are expected to commence by 2025.[11]

As fuel quality have been slow to improve, the development of emission standards for vehicles have remained constrained. As of 2024, only 19 countries have implemented Euro IV or higher emission standards for light-duty vehicles. The rest adhere to below Euro III standards. However, South Africa, Kenya, Tanzania, Uganda, Rwanda, and Burundi have adopted Euro IV standards. In West Africa, Mali, Senegal, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Burkina Faso, Niger, Nigeria, Guinea-Bissau, Togo, and Morocco have also moved towards Euro IV or higher standards. West African countries as directed by the ECOWAS have to adopt regional standard of Euro IV.[12]

The dominance of used vehicle import and lack of local manufacturing to produce clean and fuel efficient ICE vehicles is slowing down this trajectory. As much as 85 per cent of the imported vehicles to Africa are old and used vehicles.

The only way to leapfrog and sidestep the sluggish ICE pathway is to make a paradigm shift to embrace electric mobility. The relatively simple technology behind the electric vehicle powertrain, motor technology, battery packs and related assembly processes, particularly in the small vehicle segments, has already opened up this opportunity in this region. The growth in this sector is largely driven by start-ups, rather than relying solely on traditional original equipment manufacturers (OEMs). But this has opened up several inventive opportunities.

It is from this perspective that a spotlight is put on the electric mobility pathways in Africa to understand the local opportunities and imperatives, and tap the learning curve from other developing countries with a sizeable electric vehicle fleet like India, to inform the regulatory process.

It is important to note that an early transition to electric mobility is essential in view of the fact that the developed markets in the North including the US, European Union and China have begun to set targets to phase out ICE vehicles within the timeframe of 2030 to 2035. If local action is not ramped up, the Africa market will

remain locked into polluting ICE technologies to be dumped from the rest of the world for a considerably long time.

Several countries have included zero-emission vehicle (ZEV) transition in their respective nationally determined contributions (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and are driving their local policies based on their international commitments. For instance, Rwanda is integrating e-mobility in its targets for reducing greenhouse gas emissions as part of their national climate action plans to meet the requirements of NDCs. It involves mobilizing USD 900 million for electric vehicles and charging infrastructure. Similar efforts are gaining ground in other parts of Africa as well. It is necessary to inform and strengthen this process.

The Centre for Science and Environment has therefore carried out a review of the emerging electric vehicle (EV) market in Africa, nature and the structure of the EV industry, policy and regulatory framework, industrial and trade policies around EVs, incentive programmes and funding strategies, and vehicle segments specific approaches.

## Takeaways

This review reveals the unique imperatives and patterns of transition in the Global South. The African experience has several strands in common reflecting the inventive and affordable solutions being leveraged to co-join electrification and mobility solutions in the Global South. There is enormous potential and opportunity in electric mobility transition to build a clean and low carbon growth path even as Africa grows and motorises. Some of the key elements of this transition are already in place and lay down the foundation for the future development. The uniqueness of this transition addresses its local imperatives.

**Connecting electrification with mass mobility and commercial vehicles is a unique opportunity:** The African region like India has prioritised electrification of mass mobility modes – buses and para transit vehicles and commercial vehicles – that are high mileage and can maximise clean air and decarbonisation benefits. The fiscal incentives are oriented towards reducing the cost of these vehicles. Public expenditure is not being linked with personal vehicles yet.

One of the biggest opportunities has emerged in bus electrification and more in the electrification of the bus rapid transit systems (BRT), as in Dakar. If electrification of buses and para transit – the prime movers in African cities - can be scaled up, it can provide significant emissions and carbon reduction benefits.

There is also considerable learning from the electric bus programme in India. Demand aggregation model has succeeded in reducing the cost of procurement and operations significantly – pushing the prices down to a level even lower than their diesel counterparts. It is also working on launching a payment guarantee scheme that funds not only the capital cost of a bus but also the operation costs on a per kilometre basis for over a span of 12 years. Such co-learning can help to accelerate change.

**Leveraging import policy to scale up electrification:** Africa also represents a unique market that is nearly almost entirely dependent on import of vehicles as local manufacturing of new vehicles is very limited. Moreover, for internal combustion engines (ICE), the local manufacturing base is very small and not driven by technology forcing emissions standards as import of old and used vehicles undercuts those efforts. Newer approaches are emerging to leverage the import policy to incentivise import of fully built EVs or knocked down kits for local assembly. Most significant is the decision in Ethiopia to stop import of internal combustion engines and incentivise electric vehicles.

**Opportunity to build industrial base around EVs:** One of the compelling factors driving the electric vehicle policy in the African Continent is the serious concern over energy security and heavy drains of foreign exchange for oil imports. Electric mobility has created the opportunity to develop a well designed industrial policy to build local manufacturing of EVs that can have a larger economic spinoff. Several countries have framed deliberate policies and strategies to promote and support local manufacturing of EVs. There is a significant potential and opportunity in building a value chain around the critical mineral mining in African countries and linking this with local manufacturing. This will require deliberate policies and investment strategies.

The EV revolution in Africa is being driven by the start-up companies largely focussing on small vehicles with small battery formats – two-three wheelers and small commercial vehicles. The presence of established global original equipment manufacturers is limited in this space though it is emerging.

The industrial policies as well as the established global OEMs are also aiming to leverage the new EV manufacturing base in Africa for re-export to other regions like the European Union. It is quite likely that the African region may emerge as an export hub for EVs. This is evident in the policies of South Africa and Morocco.

**Making the transition affordable:** To keep the cost of transition low, African cities are adopting several strategies to reduce the cost of ownership of EVs. This

includes tax subsidy programmes for EVs. Also the market is adopting a battery swapping system to delink cost of batteries from the cost of vehicles. Uganda and several other countries have moved in this direction for the two wheeler segment. This needs to be designed and informed well with some degree of standardisation for a scalable market. There is also a growing interest in retrofitting old ICE vehicles with electric motors and batteries to convert them to EVs. Though this may be viable and cost effective, it will have to be guided by strong regulatory safeguards for ensuring safe operation and quality of conversion.

**Evolving financing strategy:** As e-mobility is taking off, it is very encouraging to see the way the finance and funding landscape is shaping up to enable this transition. Several models have emerged for financing. 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. There is a need to increase access to low-cost financing and establish priority sector lending mandates.

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. Asset financing companies have come forward for the small paratransit segment. Rwanda is developing an asset financing ecosystem with various microfinance entities. The start-ups provide a range of services, including local assembly and sales, asset financing and battery-as-a-service, among others.

International funding is becoming important. Development Finance Institutions from US, Europe and Africa are beginning to invest in e-mobility, but are considered too risk averse. The African Export-Import Bank (Afreximbank) and the United Nations Economic Commission for Africa (UNECA) have signed a framework agreement for implementation of a Transboundary Battery and Electric Vehicle industry Special Economic Zone in the Democratic Republic of Congo (DRC) and Zambia. Organisations like Shell Foundation and Siemens Stiftung are using catalytic capital such as junior equity positions and grants. It is possible to 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.

There are examples of CO2 based taxation on vehicles as in Mauritius that can be leveraged. Also Malawi has imposed carbon tax on all vehicles as part of the air quality management plan. For e-bus operations, there is need for proper guarantees

for bus utilisation to help them to achieve parity on total cost of ownership and some kind of payment guarantee scheme.

**Developing EV policies and technical regulations to drive the technology:** To enable a robust programme, appropriate technical regulations and standards are needed to drive the development of EV technology and its safe operations. Several governments including Nigeria, Kenya, South Africa have begun to develop these technical standards and regulations. This needs to be informed well. It is however, important to adopt regulatory electrification targets and supply mandates at the early stages of growth to provide long term policy visibility and build confidence in the market.

**Addressing charging infrastructure and access to electricity:** Charging infrastructure development and deployment has begun with South Africa leading the process. Policies and strategies on charging infrastructure are maturing quickly in Africa to encompass wide ranging strategies. For instance, the Kenya policy requires at least 5 per cent of parking spaces to have charging facilities; commercial and residential land to have battery swap stations; and building code to plan for the integration of charging infrastructure in public buildings and residential estates. This is supported by a public charging network. They have inspection, testing, and certification to guarantee compliance with safety regulations and standards. The policy recommends rent-free land for charging stations to be provided in government owned land.

The charging infrastructure will also require standardization and interoperability of various technologies for smart operations. Also, 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.

However, there are concerns around access to adequate and reliable electricity. Several countries have the advantage of a higher share of renewable energy – primarily hydro – in their grid. A few countries like South Africa are coal rich. However, it is interesting how countries like Nigeria are becoming inventive to develop modular solar powered charging stations. This is the way forward – connecting charging with decentralised solar power generation.

Countries are also making efforts to increase access to affordable electricity. Rwanda has capped the electricity tariffs for charging stations at the industrial tariff. Tunisia has reduced customs duty rates on electric car chargers. Private

investments are also flowing in. Rwanda's charging network is being set up by a petroleum company. In Egypt, ten businesses and consortia have qualified to bid for the management and operation of electric car charging stations.

**Need to pay attention to recycling of spent EV batteries for material security**: CSE's review has shown that already spent batteries have begun to emerge from the on-road EV fleet in Africa. This requires early intervention to develop EV battery recycling policy and battery tracking system and setting up of appropriate infrastructure for safe disposal and recovery of material. In fact, it is noted that there are battery recycling companies in Ghana.

This is needed not only for environmental safeguards but also to build material security. The battery material can be fully reutilised to make new batteries and that is a more cost effective way of material sourcing than virgin material from mines. This can also help to build local supply chains and value chains. Moreover, a well-designed strategy can also help to guide secondary use of EV batteries that still have considerable life left for other uses and also to identify more efficiently the end-of-life batteries for recycling. This circularity is yet another area of industrial development. In any case, Africa also needs to build its scrappage centres for the end-of-life ICE vehicles for material recovery. This effort needs to be conjoined with EV battery recycling systems as well.

**Build equitable EV programmes to benefit all income classes and disadvantaged communities:** E-mobility is part of the equitable and gender friendly strategy that links up state subsidy programmes with decarbonisation of mass modes of transport reducing toxic exposures for all affordably and creates environmental benefits for all income classes. In fact, in countries like Kenya the conversation has also moved in the direction of making EVs gender friendly in design. It is about how the potential to increase the customer base among women can increase access to job opportunities, productivity, and strengthen supply chains by engaging women entrepreneurs. The lower income groups and women can benefit from emissions savings and increased earnings from green transport investments.[13]

**Need Africa-wide framework for alignment and harmonisation of action to accelerate electric mobility**: Inter-governmental platforms including ECOWAS and EAC and also the initiatives of the UNEP need a synergistic approach to create an integrated framework for informing the e-mobility transition.

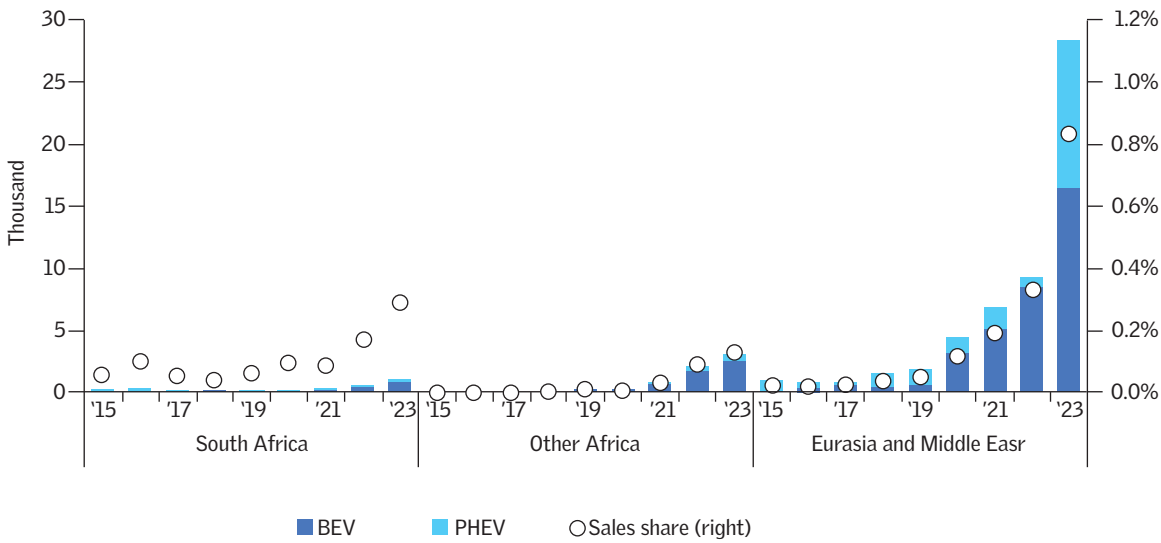
# 1: Scale of electric vehicle market in Africa

Understandably, the market uptake of electric vehicles (EVs) is still very small in Africa. The market share 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.

Africa currently accounts for just under 1 per cent of the world's EVs but expects to see the largest automotive growth in coming years. Mordor Intelligence, a market research group, estimated the African electric market size at USD15.80 billion in 2024, which is expected to reach USD 25.4 billion by 2029, growing at an annual average rate of 10.2 per cent in the next five years. *(see Graph 2: Electric car sales in Africa, Eurasia and Middle East, 2015-2023).*

There are widely varying trends across the countries. South Africa holds the highest market share within Africa. Due to rising foreign direct investment (FDI) and trade, the South African automotive industry's growth strategy has been centered on becoming strongly integrated into the global automotive environment.'

**Graph 2: Electric car sales in Africa, Eurasia and Middle East, 2015-2023**




Source: IEA, 2024

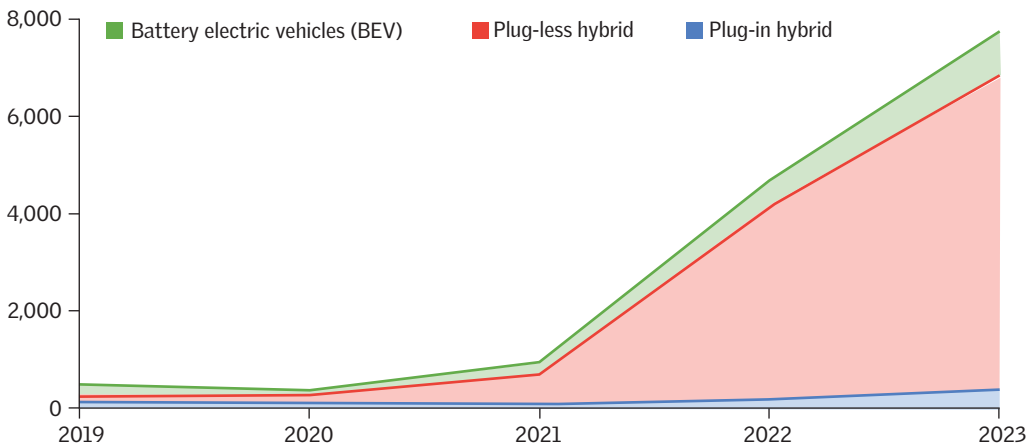
Between January and March 2024, South Africa saw sales of 3,042 New Energy Vehicles (NEVs), a significant increase from the 1,665 units sold during the same period in 2023, representing an impressive growth of nearly 83 per cent. NEVs include fully electric vehicles, plug-in hybrids, and traditional hybrids *(see Graph 3: EV sales in South Africa)*.

Segment wise, the total stock of electric two-wheelers and three-wheelers (E-2W and E-3W) was the largest in Tanzania in October 2023 *(see Graph 4: E-2W, E-3W registrations in selected countries of Africa)*, at around 10,000 vehicles. It was very low in DRC, Ghana, Nigeria, Zambia and Senegal at under 1000 vehicles, the lowest being in Senegal.

**Import of EVs:** Traditionally, Africa is a vehicle importing region and does not have much of a manufacturing base for ICE vehicles. The motorisation in the region is to a great extent based on imported used vehicles from other parts of the world. According to the United Nations Environment Programme (UNEP), as much as 85 per cent of the imported vehicles are used vehicles meeting older genre of emissions standards.

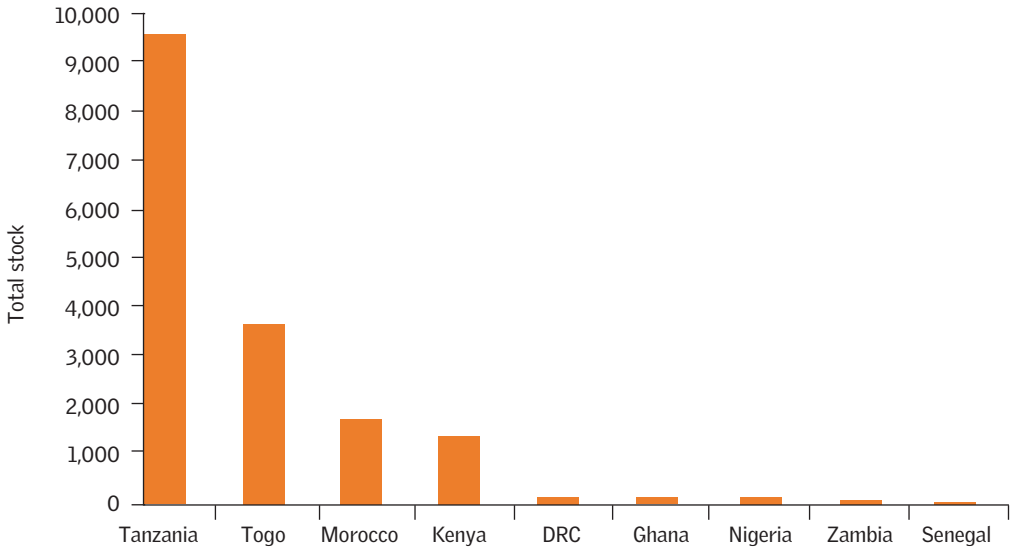
Thus, Africa is the epicentre of international trade in both new and old vehicles. An analysis of the data on the value of international vehicle trade to Africa in 2023 from the World Trade Organization's International Trade Centre reveals that the European Union, China, Singapore, and Japan are the largest exporters

### Graph 3: EV sales in South Africa




Source: Cleantechnica[14]

**Graph 4: E-2W, E-3W registrations in selected countries of Africa, October 2023**



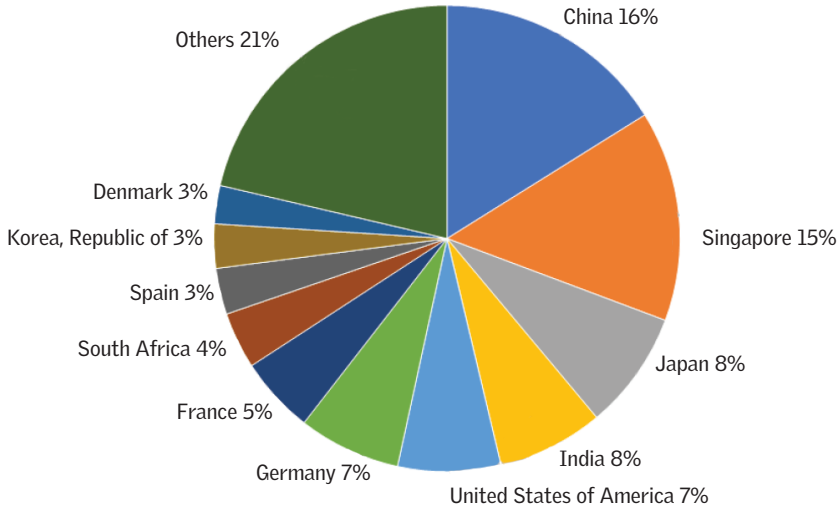

Source: Graph by CSE , data from Africaema (https://africaema.org/data)

of all vehicles to Africa. *(see Graph 5: Share of exporting countries in total vehicle import to Africa in 2023).*

Most cars come from the USA, Japan, and Germany *(see Graph 6: Share of exporting countries in vehicle segment-wise import to Africa).* India and China are not far behind. The share of China and India increases in the import of two-wheelers, commercial vehicles, and public transport. Most motorized two-wheeled vehicles are from Denmark (42 per cent), China (27 per cent) and India (21 per cent). China, Japan, and South Africa dominate the import of goods vehicles in the region. In the public-transport segment, China has the highest share at 36 per cent, followed by Japan at 29 per cent and India at 6 per cent. Public transport vehicles can accommodate over 10 people. Smaller ones are popular largely as para-transit vehicles in the informal sector and meet considerable travel demand. *(see Graph 6: Share of exporting countries in vehicle segment-wise import to Africa in 2023 (% of value of import, US Dollar thousand).*

According to IEA, in the European Union, the number of used electric cars traded internationally has grown by 70 per cent year-on year, reaching almost 120 000 electric cars in 2022. However, currently most of the exports from China, EU and Japan are going to the Middle East, Eastern Europe, Russia etc.[17]

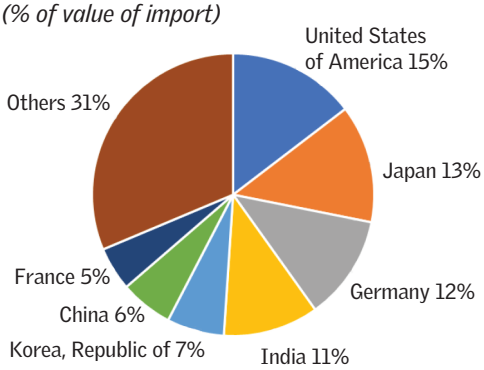
## Graph 5: Share of exporting countries in total vehicle import to Africa in 2023 (% of value of import, US Dollar thousand)



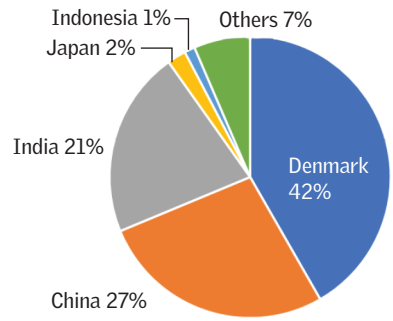

Source: Graph by Centre for Science and Environment with data from International Trade Centre statistics, 2024. International Trade Centre UNCTAD/WTO, 1994-2023, http://www.intracen.org/default.aspx

## Graph 6: Share of exporting countries in vehicle segment-wise import to Africa in 2023 (% of value of import, US Dollar thousand)

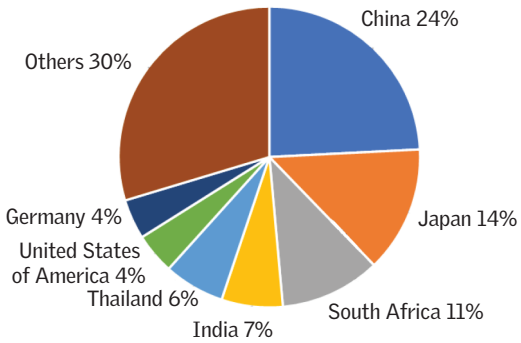
*Car imports in Africa in 2023 (% of value of import)*



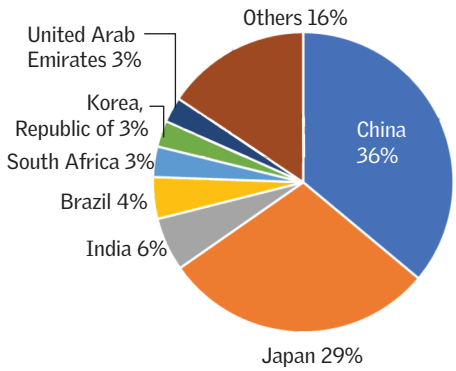

*Two-wheeler imports in Africa in 2023 (% of value of import)*



*Goods-vehicle imports to Africa in 2023 (% of value of import)*




*Public-transport vehicle imports to Africa in 2023 (% of value of import)*




Source: Graph by Centre for Science and Environment with data from International Trade Centre statistics, 2024. International Trade Centre UNCTAD/WTO, 1994-2023, http://www.intracen.org/default.aspx

**Electrification through EV import route:** As Africa is heavily dependent on import of used vehicles, it is expected that EV import to Africa will also increase as the EV stock ages in advanced countries.

A review of the international trade in used electric cars by the International Energy Agency in 2024 (IEA) shows that this trade is growing steadily with China and the European Union becoming the leading exporters of used EVs.[15]

China that had earlier banned export of used vehicles of all kinds has now reversed this decision. Since 2019, the government has allowed 27 cities and provinces to export second-hand cars. In 2022, China exported almost 70 000 used vehicles of which about 70 per cent were new energy vehicles. Soon all regions of China will be allowed to export.[16]

According to IEA, in the European Union, the number of used electric cars traded internationally has grown by 70 per cent year-on year, reaching almost 120 000 electric cars in 2022. However, currently most of the exports from China, EU and Japan are going to the Middle East, Eastern Europe, Russia etc.[17]

How this will play out in the markets of Africa remains to be seen. Currently, local policies in Africa are focussed on regulating the age and emissions standards of ICE vehicles. These countries would need to leverage import policy strategically to increase the share of safe and properly functioning EVs and also regulate the market properly. But it is important to note that global standards will play a role to enable technology compatibility - e.g. for charging infrastructure.

However, it is evident that electric two-wheeler assemblers / importers are unable to import at scale because they cannot meet the upfront payments. As a net importer of EVs, Africa must reposition itself to harness its competitive advantages including access to mineral reserves required for battery-making, renewable energy potential, and growing labour force.

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 and others 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. The most significant development is the ban on import of all ICE vehicles and incentive for EV import in Ethiopia. This can be a game changer.

A well designed import policy that incentivises EV import, discourages ICE vehicles and connects with phase out of old vehicles and scrappage of end-of-life vehicles for fleet renewal can accelerate electrification in this region.

# 2: Nascent beginning of EV Manufacturing

Vehicle fleet electrification has created new opportunities for developing countries in the Global South to establish their own manufacturing bases. Even nations that have traditionally been vehicle importers can now benefit from local economic growth, retain value within the supply chain, create jobs, and make the transition to electric vehicles (EVs) more affordable. This was not feasible with internal combustion engine (ICE) vehicles in Africa, but the advent of EVs has changed the landscape. While vehicle-producing countries in Asia, such as India and China, are already advancing in this area, African nations that were previously dependent on imports are now also embracing this path.

The relative simplicity of electric vehicle powertrain, motor technology and related assembly processes has made this shift possible. This growth is largely driven by start-ups, rather than traditional original equipment manufacturers (OEMs). Several African nations have now built EV policies into their broader industrial development strategies. Countries like South Africa, Uganda, Nigeria, Ethiopia, Morocco, Rwanda, Ghana, Tunisia, Sudan, Zambia, Zimbabwe, Togo, Namibia, Botswana, and Cape Verde are actively setting up EV assembly facilities, positioning themselves to take advantage of this emerging sector.

The EV manufacturing is led more by the start-up companies than traditional OEMs that are present in the region. Some of the multi-national OEMs including Toyota, Renault, and Volkswagen have their base for ICE vehicles in Sub Saharan Africa. Even though there is a growing interest among the OEMs in accessing the EV market in the region, their role is still limited. Nigeria has seen the emergence of Hyundai Kona model.

The current production is limited to small-scale assembly of imported kits, with limited local sourcing. 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.

The Federal Government of Nigeria has taken a conscious decision to build its local manufacturing capacity and reduce dependence on imports of vehicles. Vehicle segments that are being assembled in Nigeria include cars, vans and small vehicles like three wheelers and two wheelers. National Automotive Design and Development Council (NADDC) and Stallion Group launched Nigeria's first locally assembled Electric car Hyundai Kona in Abuja in February 2024[18]. The Nigerian government has signed a memorandum of understanding (MOU) with Israeli and Japanese companies to start manufacturing electric vehicles (EVs) in Nigeria.[11]

Countries with more ambitious programmes on EV manufacturing are targeting not only the domestic market but also the export market. South Africa has adopted a more detailed target and approach to become an EV production hub. It wants to retain and build the export market and also maintain the share of the auto industry at 4.9 per cent to the country's GDP by accelerating local manufacturing. The thrust is on localisation of production.

Similarly, the Ministry of Industry and Trade, Morocco, aims to produce about 100,000 cars by 2025 and by 2030. EVs made in Morocco are expected to contribute 60 per cent of its exported cars. Further ahead, the EU ban on fossil fuel vehicles by 2035 is seen as an opportunity for Morocco.

Countries like Morocco that already have a thriving automotive industry with annual production capacity of 700,000[19] vehicles, up from 60,000 cars in 2010, are emerging as re-export markets. The established global OEMs have a production base here to cater to their export market in Europe. Morocco produces about 40,000–50,000 electric vehicles per year, which are predominantly exported to the European market.[20] For example, Renault, which has the largest assembly plant with a capacity of 400,000 ICE units, exports most of its production. The Citroën Ami, made in Kenitra, Morocco, was the most widely sold vehicle in Spain in 2022. In December 2022, X-Electric Vehicle of China, known commonly as XEV, announced plans to produce electric cars in Morocco for the Italian market. There are Renault factories in Casablanca and Tangier and a Stellantis plant in Kenitra, coupled with a vast network of about 250 Tier 1 and 2 suppliers including Afrique Cables, Denso, Lear, Saint-Gobain, Snop, Takata, Denso or Valeo. Such an eco-system combined with the existence of technical skills in its workforce, offers huge potential for Morocco to become an EV manufacturing hub.

The nascent but growing market is attracting foreign manufacturing partners in the region to establish EV production bases in the region. For instance, in Egypt, under a deal with major Chinese automakers, the Ministry of Business Sector will

use the El Nasr Automotive Manufacturing Company to build 25,000 electric vehicles a year.[21] Additionally, the Ministry of Business Sector has worked with the Ministries of Electricity and Local Development to install rapid charging stations and has created an incentive package for electric vehicles. In Egypt and Morocco, among others German automaker Opel, Chinese automaker Dongfeng are forming partnerships.

Start-up companies are emerging as the key drivers of change. The Africa e-mobility alliance observes that the EV sector in Kenya boasts of a thriving start-up ecosystem, with over 40 start-ups providing electric bicycles, motorcycles, tuktuks, cars, and buses.[22]

Rwanda has a progressive policy to boost EV demand and production and has framed a detailed policy for promoting manufacturing that has been discussed in subsequent sections on policies for industrial promotion.

In Uganda, locally manufactured electric buses from Kiira Motors have started operations in Kampala. In Nigeria, the Jet Motor Company has partnered with GIG Logistics to provide EVs for both transport and logistics services in the Nigerian market.[23] Interest in R&D and capacity building and innovative business models is growing in Nigeria, Ethiopia, Tanzania, South Africa and Kenya among others.

Uganda began working with the automotive and smart battery design firm SPIRO in 2023 with the goal of bringing electric motorbikes and stations for charging and exchanging across the country. Over the course of five years, they aim to deploy 140,000 motorcycles and 3,000 swapping and charging stations.

African governments are also adopting various OEM friendly policies to promote in-house manufacturing. For instance, South Africa has introduced the Automotive Masterplan 2021-2035, aiming to produce 1.4 million vehicles annually by 2035, with a significant portion being EVs.

Similarly, in June 2024, Ethiopia launched its biggest EV factory in Debre Berhan, Amhara region, with an investment of over USD 52 million, which is expected to produce around 1,000 cars a year.

**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.

In addition, Morocco boasts of abundance in raw materials such as cobalt and phosphate that are key ingredients in EV battery production. The country is home to about 50 million metric tons of phosphate reserves, accounting for about 70 per cent of the world's known phosphate rock reserves. The 10th largest cobalt producer globally, Morocco had a mining production of 2,300 metric tons in 2022.

Contract negotiations between African countries and mining companies have been characterized by information asymmetries, opacity, environmental concerns, and insufficient provisions to foster the build out of local supply chains to facilitate economic development in the host country.

Investors' increased interest in key LiB minerals presents an opportunity for African countries to create a policy framework before signing agreements. The framework should include the country's vision for specific mineral endowment, reflect the country's current geological endowments, and reflect the decision whether or not to export minerals as an unprocessed raw product.[24]

# 3: Profile of EV segments

EV markets in the Global South indicate a common trend towards early electrification of smaller vehicles like two-wheelers (2W) and three wheelers (3W) and smaller commercial vehicles. Africa is home to at least 20 per cent of the world's registered motorcycles. Egypt and South Africa have the highest number of E-2 & 3W. During 2017 to 2021, the annual import value of E-2 & 3W into Africa increased by over 200 per cent.[25] This is an enormous opportunity as these vehicles dominate the on-road vehicle fleet. Their early transition to zero emissions technology can provide considerable benefits.

It is also very encouraging that public transport – buses and intermediate public transport – are being prioritised for electrification. This trend is emerging sharply across Africa.

## Electric two and three wheelers

The smaller vehicles like two and three wheelers with small format batteries have got priority attention. Most pilots or local assembly has begun with this segment which is also more cost effective compared to bigger vehicles.

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, the 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, 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 supported by UNEP include 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.[26] 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.[27]

In several countries two-wheelers dominate the fleet. In Uganda, two wheelers make up 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.

E-mobility start-ups and businesses are emerging in many African countries to produce E-2W & 3W. Zimbabwe has companies that offer leasing for electric three wheeler and scooters; and 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 wheeler 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 E-2W & 3W 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 of electric three wheelers for freight is 40 per cent lower than that of their ICE counterparts.

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.

Electrification on its own complicates the urban conundrum in Africa. Electrification of the current paratransit fleets without modernising the industry does not improve efficiency or quality of service. In addition, with tax-free and or reduced taxes on electric vehicle imports, private vehicle use will become even more attractive, further increasing congestion and the incentive to build wider car-centric roads and parking spaces rather than investing in affordable public transport and housing. Clean paratransit is necessary for the advancement of public transport, which is the most important shared resource that contributes to a nation's economically and socially healthy development.

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-wheeler is USD 1,300 while the average price for a locally-assembled electric two wheeler is currently USD 1,800. According to UK Aid report, "top ICE 2W models like Bajaj Boxer 2020 Red and Hero Achiever 150 are priced at approximately US$ 1,300 in the country." Further drop in battery costs may bring this price down slightly in the next five years. But to achieve full price parity with ICE two-wheelers within that timeframe would require incentives, product innovations, and innovations in business models. This includes selling electric two-wheelers without the battery and then renting the battery to reduce upfront cost. This option of battery swapping system is discussed in a subsequent section.

According to a report by the Shell Foundation, about USD 9 billion will be required to finance a sustainable market for electric two wheelers in Kenya, Nigeria, Uganda, Rwanda and Ethiopia by 2030. This segment can be the early propeller of change in Africa.

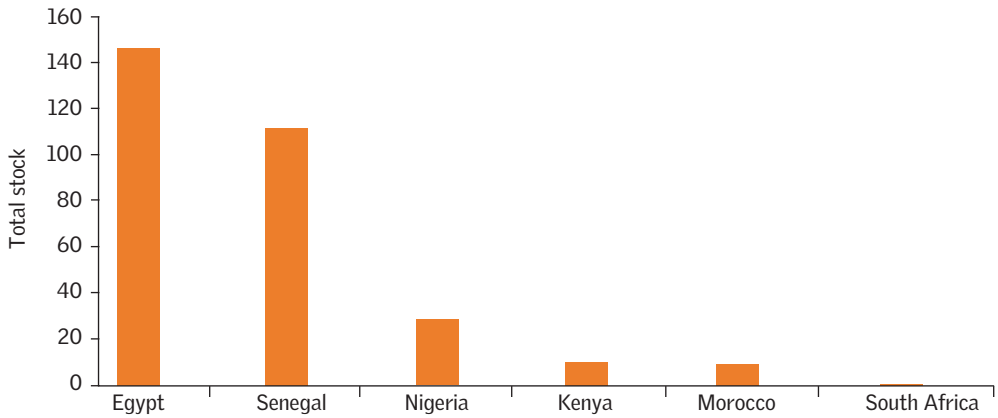
## Electric buses

Consistent with the trend in the Global South, as in India, priority is being attached to the electrification of mass modes like buses for zero emissions commuting in cities. Durban in South Africa; Dakar in Senegal; Abidjan in Cote d'Ivoire, and Nairobi in Kenya, are already operating electric bus fleets and have plans to expand operations. The largest e-bus stock is in Egypt with an estimated fleet of over 140 vehicles *(See Graph 7: Electric bus registration in selected African countries)*.

Unlike E-4W, South Africa falls behind in this segment with less than 20 E-buses in its fleet. This clearly shows a preference for personal mobility in South Africa and less inclination towards shared mobility in the country. South Africa plans to convert 5 per cent of the public and national fleet to cleaner alternative fuel and upgraded technology by 2025, with an annual increase of 2 per cent thereafter. Additionally, the country has committed to adding 40 solar-powered public EV charging stations per annum.

Electric buses and its electrification are a win-win strategy for African cities and need scaling up. *(see Graph 7: Electric bus registration in selected African countries).*

**Graph 7: Electric bus registration in selected African countries**




Source: Graph by CSE , data from Africaema (https://africaema.org/data)

**Electrification of the bus rapid transit system (BRT):** One of the biggest opportunities is the bus rapid transit (BRT) systems in African cities. These are dedicated bus lanes with priority access at intersections with off-board fare collection and provide high capacity, efficient bus services. There is a strong potential and opportunity to electrify these systems.

According to the IEA global outlook report of 2024, the new all-electric BRT system in Dakar – the first on the African continent – is an important step forward. This network, announced at the end of 2023, will serve 320 000 passengers per day.

The IEA 2024 report has further stated that Africa's largest electric bus company, has an order book of 350 buses, which represents almost 2 per cent of electric bus sales outside of China in 2023. This aims to sell another 1000 electric buses in Kenya and 200 in Rwanda.

Despite the growth of local electric mobility startups, these companies are not able to meet the growing demand for EVs. Companies like BasiGo and Roam already have waitlists for electric buses.

## Electric para transit

As noted in other countries of Asia including India, the EV promotion strategies in most countries of Africa have 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.

SolarTaxi, a Ghana-based startup offering clean and green commuting solutions, also assembles and maintains electric vehicles, including cars, bikes and tricycles. Since its inception in 2018, the company's services have expanded to include the installation of charging units, the manufacturing of battery packs and bike conversion. The company has introduced various affordable solutions for those who cannot buy the vehicles upfront. This includes a renting option, which is reserved for their electric bikes. Those interested can rent the two wheelers at an agreed amount and period.

Paratransit is by far the primary mode of road transport in sub-Saharan Africa, accounting for 50 per cent–98 per cent of daily commutes in many major cities around sub-Saharan Africa. In South Africa, paratransit served 15 million daily commutes in 2021. Despite their omnipresence, paratransit vehicles in Africa are typically old and expensive to operate. Electric alternatives could be a viable alternative to these vehicles, reducing operating costs, such as fuel and maintenance expenses, while also providing environmental benefits such as reduced tailpipe emissions and noise pollution.

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.[28] 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.

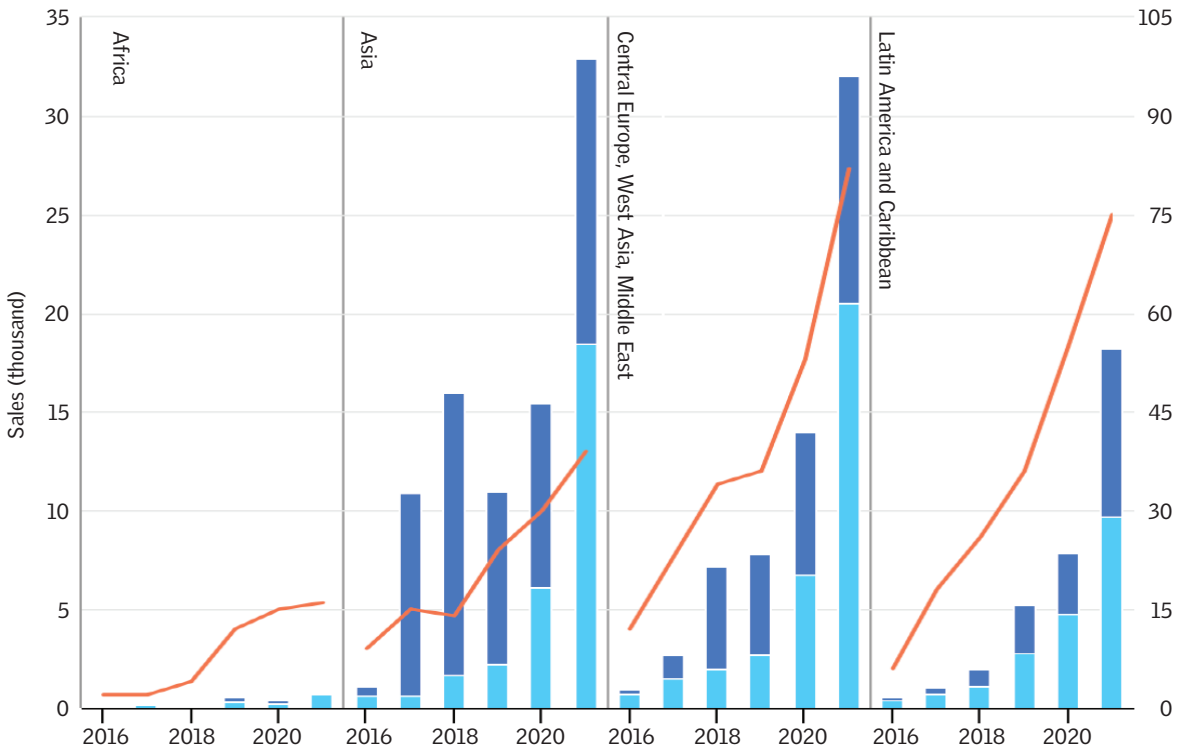
## Light-duty vehicles

Light-duty vehicles in Africa may be commercial or personal. Apart from light freight carriers, interest in the car segment is also growing that can be put to personal use as well as commercial use like taxis.

The IEA that tracks electrification of the global car fleet reported 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. Increase in this segment can make more vehicles available in commercial and rideshare fleets *(see Graph 8: Electric car models available in selected emerging markets by segment, sales and models available by region 2016–21).*

**Pilot electric bikes project**: UNEP launched a pilot electric bikes project in Nairobi's Karura Forest on 2 March 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. A host of local partners, including ministries, and national and sub-national authorities are also included.[29]

**Graph 8: Electric car models available in selected emerging markets by segment (left axis), sales and models available by region 2016–21 (right axis)**




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

# 4: Regulatory framework for EVs

It is important to develop a cohesive electric vehicle policy for the countries individually and at the regional level to guide this transition. Such policies are possible at both national and sub national level. For instance, 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.

The much needed thrust on localisation of EV manufacturing will also eventually require local capacity for battery assembling and advanced battery chemistry, battery management including thermal management for safety and optimised operations. 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.

A robust EV policy needs to be comprehensive with the appropriate design and instruments to drive the ecosystem. Policies need to set targets for vehicle segment-wise electrification, incentive programmes for demand creation, revenue model and cross subsidy policy to fund the programme, charging infrastructure, localization of production/assembly of EVs, battery management systems and battery recycling systems.

## Setting targets for electrification

Regulatory targets for policy measures is an important step forward to provide long term policy visibility, define the roadmap for industry and to build confidence in the market.

Several countries in Africa have started to work towards target-driven electric vehicle adoption, though it is still nascent, ad hoc and not mandated by law in most places. A few countries that have begun to set ambitious policy targets for electrification include Cape Verde, Morocco and Kenya. Cape Verde has set 100 per cent electrification targets for new sales of 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. Rwanda has set an objective to have 20 per cent of buses, 30 per cent of motorcycles and 8 per cent of cars electrified by 2030.

Moreover, a 30 per cent sales target for medium and heavy duty vehicles is in place in Cabo Verde and Ghana. Zimbabwe has an electric mobility roadmap. 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, high oil prices and also the role of EVs despite their high costs.

Review of the available EV policy framework in different countries brings out widely varying approaches. The wide ranging approaches that have been reviewed by the Centre for Science and Environment (CSE) shows a combination of phase out targets, demand incentives, support for infrastructure development, industrial development, business model and international support. It is necessary to identify each of these dimensions to understand the emerging good practices. (*see Table 1: Key EV policy highlights of select African countries as of September 2024*).

## Enabling supply mandate

Once the market begins to gain more maturity, a more target driven supply/import mandate can be adopted to encourage industry to produce and diversify their product base more affordably and reduce price pressures. A focussed industrial policy is emerging in different countries to frame supply side mandate for vehicle manufacturers and vehicle importers; and purchase mandate for fleet operators, to stimulate the markets quicker.

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-

## Table 1: Key EV policy highlights of selected African countries as of September 2024

| Country | Key Policy Highlights |
|---|---|
| Ethiopia | • The Ethiopian Ministry of Transport and Logistics introduced a ban on the import of non electric vehicles. Adopted a number of incentives to catalyse EV market growth, including exemptions for all EVs from VAT and excise tax.[30]<br>• Introduced duty-free import of EV parts, reduced taxes on assembled EVs, and plans to establish over 2,000 charging stations.[31]<br>• Elimination of VAT, surtax, and excise taxes on EV imports, the customs duty for partially assembled EVs is even lower, at only 5%.[32] |
| Ghana | • Launched EV Policy in December 2023.<br>• Waived import duties on electric vehicles for public transportation for a period of eight years. |
| Kenya | • In 2024, the Ministry of Roads and Transport adopted a Draft Electric Mobility Policy, provides incentives for the import, manufacture and assembly of EVs in Kenya.[33]]<br>• Reduced excise duties on EVs from 20% to 10% and approved discounted electricity tariffs for EVs.<br>• Several strategies and action plans that include measures to stimulate development of the sector, — EV technical standards, pilot projects, and public procurement initiatives to support the rollout of charging infrastructure. |
| Morocco | • Morocco aims to work towards all sales of new cars and vans being zero emission globally by 2040, or by no later than 2035 in leading markets.<br>• Target of almost 30,000 charging points for LDVs, 2/3Ws, and buses by 2030.<br>• Reduced duties, green loans and subsidies, as well as exemptions for EVs from luxury and road taxes. |
| Rwanda | • Strategic Paper on Electric Mobility Adaptation in Rwanda was launched in 2021.<br>• National Transport Policy and Strategy for Rwanda 2021 – specific direction to support electric vehicle including infrastructure and incentives and integration of renewable energy with charging network.<br>• Fiscal incentives – electricity tariff capped at industrial tariff; exemption of VAT, import duty reduction, support for charging infrastructure; introduce carbon tax to discourage polluting vehicles.<br>• Non-fiscal incentives – avail government land for charging infrastructure; green license plate and preferential treatment in special zones; free access and authorisation for commercial EVs<br>• Administrative measures – establish restricted zones for green transport<br>• Electric vehicles, spare parts, batteries and charging station equipment are exempted from import and excise duties and zero rated for Value Added Tax.<br>• Companies setting up charging stations across the country can access government's land on a rent-free basis.<br>• Companies manufacturing and assembling electric vehicles in Rwanda can now enjoy a 15% Corporate Income Tax rate and tax holiday. |
| South Africa | • Released a comprehensive EV Whitepaper in December 2023.<br>• Transition the automotive industry from primarily producing internal combustion engine vehicles to a dual platform that includes EVs by 2035.<br>• Introduce an investment allowance for new EV investments starting March 1, 2026 |
| Nigeria | • Released the Nigerian Automotive Industry Development Plan in May 2023.<br>• Promotes local EV production, with tax relief for EV manufacturers and licensing requirements established for auto assembly plants in the country.<br>• The government's Energy Transition Plan (ETP), which aims to achieve net zero emissions by 2060 calls for fiscal incentives such as the removal of import duties and VAT to incentivise local EV market development |

| Country | Key Policy Highlights |
|---|---|
| Uganda | • Released the National E-Mobility Strategy in November 2023.<br>• 0% Import Duty, 0% VAT and 0% Withholding Tax on Original Equipment Manufacturer vehicle parts, components (production parts), EV chargers, EV batteries<br>• Waived import duties for two- and three-wheel EVs, exempted all EVs from paying VAT and introduced a special electricity tariff for charging stations.<br>• Battery swapping programme for two-wheelers |
| Mauritius | • A 10-year Electric Vehicle Integration Roadmap for Mauritius was launched in Jan 2020<br>• Mauritius has also implemented removal of import duties and reduction of registration fee and road tax. |
| Egypt | • E-mobility strategy launched in 2019.<br>• To achieve a 65 percent industrialization share in the EV manufacturing value chain by 2030.<br>• To increase market share of private EVs to 14 percent by 2025, 36 percent by 2030, and 50 percent by 2040.<br>• Expanding EV bus programme |

Source: CSE Research

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 to scale up the EV market.

## Policy support for local EV manufacturing

Focussed policies are emerging to support industry to set up local manufacturing bases to augment availability in the market and reduce the cost of EVs. The other focus has to be on reducing import duty on vehicles to build the market.

Several African countries are now weaving EV policies into their broader industrial development strategies. South Africa, Uganda, Nigeria, Ethiopia, Morocco, Rwanda, Ghana, Tunisia, Sudan, Zambia, Zimbabwe, Togo, Namibia, Botswana, and Cape Verde are setting up EV assembly facilities, positioning themselves to take advantage of this emerging market.

In 2021, the South African government announced the Green Transport Strategy, to facilitate the local production of electric vehicles and the development of charging infrastructure. Their 2021 draft (*Auto 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.[34]

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 to lower or introduce zero-rated duty for selected EV components, and EV credits for offsetting manufacturing OEMs' 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.[35]

On December 2023, the Department of Trade, Industry and Competition (DTIC) published the Electric Vehicles White Paper, which is South Africa's first policy statement on the manufacture, sale and use of EVs.[36]

The White Paper recognizes that in order to maintain South Africa's prevalence as a global exporter of automobiles and automotive components, the country's automotive manufacturing sector must shift to the production of electric cars and EV components. The White Paper proposes 10 actions to support the development of South Africa's EV productive capacity which span a range of contexts, from local to global. The most relevant actions are increased levels of investment in the assembly and manufacture of EVs within the country; facilitating and developing a regional electric battery chain, from resource refinement, to production, manufacture and sale; introducing a temporary reduction on import duties for batteries in vehicles produced and sold domestically; securing duty free exports for EVs and EV components that are produced in South Africa and leveraging resource and development tax incentives to add value to the South African manufacture of EVs.

Kenya released a draft of the National E-mobility Policy in April 2024, to encourage local production and assembly of electric vehicles. Once approved, the policy will set ZEV sales targets and investment criteria for domestic car manufacturers and assemblers to be eligible for government incentives. In Kenya, the Finance Act 2023 eliminated 16 per cent VAT tax on e-2W and e-3W and exempted 25 per cent excise duty. It also cut corporate tax from 30 per cent to 15 per cent for local vehicle assemblers. In Kenya, 64 per cent of market players in e-mobility have invested in local assembly.[37]

The strategy to reduce supply cost is a good step forward as Africa needs to increase the availability of cost effective EV models in the market. This is also needed to encourage local manufacturing and assembly.

A well-designed incentive programme can help to overcome the challenge of upfront costs for consumers. 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 USD 55,600 (N23M) which is higher than the average annual salary of average Nigerians in Lagos.

In April 2022, Rwanda unveiled a wide set of tax breaks to push the adoption of e-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. The incentives include electricity tariff, infrastructure related tax exemptions, etc. on electric vehicles, plug-in hybrid electric vehicles and hybrid electric vehicles. All these incentives aim to boost the electric vehicle industry. Rwanda's long-term goal is to become carbon-neutral as articulated in its Vision 2050.[38]

Rwanda is also providing rent-free land for charging stations. It provides a preferential corporate income tax rate of 15 per cent for investors operating in e-mobility. Rwanda has also reduced electricity tariffs for EVs. Cape Verde has waived off import duty on EVs and has additional fiscal policies to bridge the cost gap between ICE vehicles and EVs. Zambia has taken policy measures by reducing or waiving off taxes and duties on EVs.

The government has exempted electric vehicles, spare parts, batteries, and charging station equipment from import and excise duties. All of these would also be treated as zero-rated value-added tax (VAT) products and will also be exempt from withholding tax. Corporate tax rate has been cut in half to 15 per cent for companies manufacturing and assembling EVs.[39]

Electric mobility initiatives in Tunisia came into effect in January 2023 under the Finance Act that has reduced customs duties on electric vehicle charging equipment to 10 per cent and the value-added tax (VAT) to 7 per cent. Tunisia is providing tax breaks and other incentives to increase electric vehicles. 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 USD 660 million over the period 2020–30. In Tunisia, encouraged by the government's electric vehicle support schemes, German-Tunisian start-up Bako Motors rolled out electric bicycles that are manufactured locally in 2023 and French oil marketer Total Energies has installed charging stations in 19 service stations in the country.

In 2023, Nigeria proposed policy incentives for EV manufacturers which included 10 years tax relief for EV and components assemblers/manufacturers.[40] These benefits did not extend to importers. Import tariff duty was changed from 2014-15 to protect local assembly and make import of vehicles more expensive. The new tax law of June 1, 2023, has imposed additional Import Adjustment Tax on imported vehicles with engines ranging in size from 2000 cc to 3999 cc and above. This is in addition to the 35 per cent import duty and 35 per cent tariff already levied on car importers. The NADDC is working on the possibility of R&D grant and elimination of import tariff on EV components, and provision of land for charging infrastructure.

Egypt introduced subsidies in 2020 to promote domestic electric vehicle assembly. The benefits will be given to the first 100,000 locally manufactured cars, it was declared. Egypt's National Energy Efficiency and Conservation Strategy 2020 has outlined a goal of 5 per cent fleet electrification by 2025.

Tanzania has the highest number of e-2W in East Africa. However it stands behind regional countries like Kenya and Rwanda in providing incentives for E- 2 & 3w adoption and assembly. Tanzania recently introduced the first set of tax incentives by exempting electric four wheelers and e-buses from excise duty, which are not applicable to light EVs despite their popularity.[41]

In Ghana, the 2024 budget speech offered to provide incentives to boost the EV ecosystem.

These include waiving duties on import of electric vehicles for public transportation for eight years; exemption of duties on semi-knocked down and knocked down EVs imported by registered EV companies for eight years; and zero rate of VAT on locally assembled vehicles for two years.[42] Ghana launched its Net Zero Advocacy Platform in 2022 and tested five different e-cargo bike models for local functionality and real-world user adaptability. By the end of the year, the bikes, made of 100 per cent recycled and local materials, had covered 45,000 kilometres, saving 3.6 tonnes of CO2 emissions.

## Demand incentives for consumers

Currently, the emerging incentive programme is oriented towards reducing the cost of EVs by reducing tax burden on manufacturing, procurement and import of vehicles. The region is yet to move to providing direct fiscal demand incentives to consumers that countries like India have adopted for two/three wheelers, and commercial vehicles. Nigeria is looking at demand creation subsidies along with

production with local content target (40 per cent) by 2032.[43] Personal consumer demand is still very limited. Most of the subsidy is oriented toward vehicles meant for public transport and commercial usage. This is yet another uniqueness of the transition in the Global South.

## Yawning gap between ICE and electric vehicle price

The demand incentive programme needs to be planned with precision to address the yawning price gap between ICE and EVs. According to various estimates, the retail price of an EV is 30 per cent to 70 per cent higher than an ICE vehicle of the same class.

Beyond the retail price, a Total Cost of Ownership (TCO) analysis provides a holistic method to compare costs between the two vehicle powertrains. TCO considers both capital cost and operational expenditure over a vehicle's lifespan. EVs incur a higher capital cost due to high battery prices, the lack of local manufacturing and resultant import duties and taxes. EV insurance costs are higher due to the higher value of the vehicle and absence of historical data. On the other hand, maintenance and energy costs of an EV are significantly lower than that of an ICE vehicle.

The timeline of achieving TCO parity between EVs and ICE vehicles will vary from country to country depending on individual national policies, and global battery price trends. Some methods deployed to achieve quicker price parity are to reduce import duties, tax ICE vehicles (polluters pay principle), provide preferential interest rates among others. Currently, only a few countries have EV cost parity with ICE vehicles.

According to a paper authored by Birhanu Bayissa Gicha , et al. in 'Energy Strategy Reviews', in Mauritius, owning a EV is less expensive because of the significant price difference between fuel and electricity, as well as the 15 per cent EV tariff compared to the 75 per cent ICE tariff. Seychelles has the largest price differential between gasoline and electricity among the 18 countries studied, which largely impacts the total cost of ownership advantage for EVs. The paper also reports that in contrast, the import tax on EVs ($0.219/mile) in Nigeria is twice that of ICEVs ($0.121/mile). Due to the high initial cost of EVs, financing charges are very high. Ghana levies a 20 per cent import tariff on EVs, compared to 5 per cent for ICEs. The tax on EVs in South Africa is 25 per cent; the levy on other vehicles is 18 per cent. Kenya's 25 per cent import incentive for EVs is insufficient to offset the high initial cost of EVs.

## Leveraging import policy for electrification

Import-driven countries in Africa are leveraging their import policies to promote EVs. Most countries have focussed on reducing import duties on EVs.

Among initiatives that stand out are the ban of used vehicle imports in Ethiopia that opens up opportunities for scaling up local manufacturing and electrification. Ethiopia has banned import of both new and used vehicles with internal combustion engine vehicles in 2024 and has introduced favourable tax incentives for electric vehicles (EVs).[44] Ethiopia encourages the import of fully built electric four and three wheelers which combined with reduced import duties and taxes on electric vehicles, has supported enhanced imports of fully built and knocked down kits of electric vehicles that are then assembled in the country.

A vehicle when imported in Rwanda has to pay 25 per cent import duty, 18 per cent Value Added Tax (VAT) and 5 to 15 per cent excise duty depending on the engine size. 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; and exemption of 5 per cent withholding tax on spare parts, batteries and other equipment.

In Tanzania, the government classifies e-scooters as bicycles. This exempts them from the 10 per cent excise duty applied to e-motorcycles and reduces their import duty from 25 per cent to 10 per cent. Piki started a food delivery service with 32 electric mopeds imported from China in 2021. E-mobility startup Tri started operations in 2020 by assembling three wheeler parts imported from China and selling them.

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.

## Regulation and technical standards for EVs

Local manufacturing as well as scaling up of EV markets will require policies, technical regulations and standards to drive technology development and also meet safety requirements. This is needed to support local EV assembly, local battery manufacturing, setting requirements for using locally sourced raw materials, recycling and repurposing of spent batteries, while encouraging the production of charging systems.

This will require policy and standards for battery technology, and charging infrastructures. This will also require technical capability to prioritise research and development programmes related to electric vehicles, and mandating manufacturers to attach user training and manuals to their products. developing curricula and skill building to train the workforce.

The Kenya Bureau of Standards has developed electric vehicle standards. The government in its National Energy Conservation Strategy 2020 has also set a target of five per cent electric vehicle share for all vehicles coming into Kenya by 2025.[45] By 2020, Kenya is reported to have adopted 21 technical standards related to vehicles, batteries and safety requirements.

NADCC in Nigeria is developing technical standards for manufacturing of EVs in Nigeria.

## Leveraging fuel efficiency regulations for electrification

It is now widely understood that fuel efficiency norms for all vehicles can create requirement for scaling up electrification. Stringent fuel economy norms fleetwide can be met if share of EVs increase. This has already been noted in the developed markets of the European Union.

While there is considerable policy discussion in Africa on accelerating fuel quality and mass emissions standards for vehicles, the action on fuel economy regulations to reduce energy consumption and CO2 emissions have not yet picked up to the desired 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 with extra incentives.

Evidence from some of the older studies carried out by Global Fuel Economy Initiative, ICCT and UNEP bring out the state of fuel economy. 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.[46] This is very high compared 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.

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 fossilfuel vehicles. This showed that the average fuel efficiency was about 12.4 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 a policy shift to EVs, blanket ban on import of second-hand vehicles (older than 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.

However, these policies will remain toothless until the cogs of Africa's economic clockwork come together to create an attractive and energetic automobile market.

A good starting point would be to introduce innovative policy measures in EV procurement by government agencies to promote commercial electric vehicles. The steps may include competitive tenders, green public procurement programmes, purchase subsidies and direct support to charging infrastructure deployment, as well as effective pollutant emissions standards.[47]

# 5: Funding strategy

According to the Climate Policy Initiative (CPI), Africa needs approximately USD 2.8 trillion between 2020 and 2030 to meet its climate change goals as outlined in the Paris Agreement. This sum is ten percent of the annual GDP of Africa.

International funding will become important to fund the cost of mobility transition in these countries. An assessment by the International Council of Clean Transportation (ICCT) reports that the projected required support is USD 505 million. However, only about USD 16.2 million has flowed in covering 12 countries.[48]

The study by ICCT shows 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.

Large participation is seen by Development Finance Institution(DFIs) from US, Europe and Africa which are investing in e-mobility, but many stakeholders believe they are too risk averse. Heavy due diligence process is required by DFIs which creates risk for start-ups as it takes a lot of time to receive funds. Foundations like Shell Foundation and Siemens Stiftung have been amongst the most active players in the investment landscape by using catalytic capital such as junior equity positions and grants. The African Development Bank Group's Sustainable Energy Fund for Africa (SEFA) has decided to give the Green Mobility Facility for Africa (GMFA) a $1 million grant for technical assistance to drive investments in electric mobility in seven countries- Kenya, Morocco, Nigeria, Rwanda, Senegal, Sierra Leone and South Africa.

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.

The African Export-Import Bank (Afreximbank) and the United Nations Economic Commission for Africa (UNECA) have signed a framework agreement for implementation of a Transboundary Battery and Electric Vehicle industry Special Economic Zone in the Democratic Republic of Congo (DRC) and Zambia.[49]

Spiro, an e-2W manufacturer and battery swapping player in Kenya, Rwanda, Benin and Togo, has signed a USD 50 million debt financing agreement with the Afreximbank to expand in Africa.[50]

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 USD 163 million in international support for ZEVs. This amount is only 6.5 per cent of the level of funding (USD 2.5 billion) 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.

A study by UK Aid, World Bank Group and others on 'E-mobility in low income countries in Africa', has highlighted that overall Africa needs USD 2.5 trillion of climate finance between 2020 and 2030 and requires on an average, USD 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 USD 3.5 and 8.9 billion.[51] Africa needs to combine finance from donors and businesses and international development banks to direct funding into green transport projects.

It is necessary to apply the 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 – as in India - 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 where 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.

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. These issues have resulted in a lack of equity investment in EV startups in Africa.

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 and priority sector lending mandates are needed. The governments need to have policies to provide interest rate subvention; and product guarantees along with other de-risking strategies to build the confidence in the market.

For e-bus operations, there is need for proper guarantees for bus utilisation to help them to achieve parity on total cost of ownership and some kind of payment guarantee scheme.

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.

Asset financing companies like Watu, Mogo, Bboxx and M-Kopa are playing an important role in driving adoption in East African countries like Kenya, Uganda,

Tanzania and Rwanda. For example, Watu dedicates 40 per cent of its portfolio to fund EV segments such as boda boda riders and battery swapping systems.[52]

In Kenya NCBA Bank has announced Sh 2 billion (~USD 14m) available for EV financing, including E-2W & 3W[53]; and KCB Bank has partnered with UNITAR(United Nations Institute for Training and Research) to provide asset financing for a hundred E-2W & 3W.[54]

Kenya and Nigeria have collectively raised over USD 80 million for electric vehicle (EV) start-ups , representing approximately 7 per cent of global venture capital investments in EV start-ups in 2022.[55]

Tanzania has received lesser investment than neighbouring Kenya and Rwanda, with EV companies having received only USD one million in investment. Banks are risk-averse to EVs due to lack of data and understanding of the EV sector.

In business preference and financing free license and authorization will be provided for commercial electric vehicles. The government will also de-risk the business by guaranteeing a market, where preference will be given to electric vehicles for government-hired fleet. [56]

Rwanda has a developing asset financing ecosystem with various microfinance institutions like Watu, Jali Finance and Bboxx aiding EV adoption. The EV landscape is dominated by a few major players like Ampersand, Rwanda Electric Motors (REM) and Kabisa. In fact, Ampersand, a battery swapping company has secured a USD 3.5 million investment from the Ecosystem Integrity Fund, largest ever e-mobility investment by a venture capital fund in Sub-Saharan Africa.[57]

# 6: Charging infrastructure and affordable and reliable electricity

Development of charging infrastructure is critical for the adoption of electric passenger cars in Africa. The lack of adequate charging infrastructure continues to be a deterrent to converting dormant demand. 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.

**Expansion of charging infrastructure:** 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.[59]

**South Africa:** The Global EV Outlook 2024 report notes that South Africa has the second-highest proportion of fast EV chargers to slow chargers at 53 per cent, behind New Zealand at 75 per cent. The PlugShare app lists over 600 EV charging stations in Africa, out of which almost 400 are situated in South Africa alone. German carmaker Audi has announced a partnership with GridCars to install ultra-fast charging stations across South Africa.

The key impediment to charging infrastructure in South Africa is the instability of the electricity grid, with its current load-shedding regime being severely detrimental to domestic market formation. Other countries have also started to set up their charging network.

**Kenya:** The 2023 Budget Policy Statement captured Kenya's commitment to roll out EV charging infrastructure in all urban areas and along the highways and to create incentives for the adoption of electric mass transit systems in all cities and towns. The National Energy Efficiency and Conservation Strategy 2020 envisions having owners of commercial buildings ensuring that at least 5 per cent of parking spaces in their facilities are dedicated to charging EVs. Kenya has recognized that commercial and residential land will play a crucial role in the

growth of charging and battery swap stations. The Ministry of Lands, Housing and Urban Development is a potentially useful partner to create policies that would accommodate EV charging infrastructure. Kenya has initiated modification of building code to plan for the integration of charging infrastructure in public buildings and residential estates.

Kenya plans to strategically deploy 700 charging stations in urban areas and 300 along highways to increase the availability of charging facilities, aligning with its goal of reducing carbon emissions in transportation.[60]

In 2023, the Energy and Petroleum Regulatory Authority (EPRA) in Kenya announced a host of measures to promote electric mobility in Kenya by developing a nationwide network of charging stations and by approving a preferential tariff for EV charging.

EPRA, as a regulatory body, has established guidelines for setting up electric vehicle charging infrastructure, specifying requirements and standards for its development across the country. These guidelines emphasize key considerations for designing, installing, and operating charging points and stations. Under the new guidelines, EPRA mandates that any person intending to install a Public Charging Station (PCS) must first obtain an electricity retail supply license from the Authority. Additionally, EPRA requires PCS operators to ensure that their workforce possesses the necessary licenses, certifications, and training to guarantee the safe installation, operation, and maintenance of chargers.

Furthermore, EPRA laid out specific guidelines for setting up Public Charging Stations. These guidelines include installing dedicated transformers and electric supply lines, adhering to safety regulations, providing suitable public amenities, and obtaining charger certification from recognized organizations. Before PCSs may be put into service, EPRA also stresses the significance of inspection, testing, and certification to guarantee compliance with safety regulations and standards.

Investments in battery charging infrastructure will be required to scale up the electric mobility transition. Kenya's electric power generation capacity is sufficient to support the charging infrastructure. However, while demand for motorcycles is high, particularly in rural areas, distribution networks are inadequate. However, this challenge may be tackled by using solar energy, setting up charging stations, consulting boda-boda operators and using lithium- ion batteries.[61]

Rent-free land for charging stations will be provided in case of government owned land. Provision for charging stations will also be included in the building code and city planning rules.

**Ghana:** In 2019, Ghana's electricity regulator, Energy Commission, launched the 'Drive Electric Initiative to promote alternative and productive use of electricity beyond Ghana's business-as-usual case of industrial, commercial and residential uses, to power EVs. Four charging stations were installed in Accra, the capital city.

The charging infrastructure has been extended to Kumasi in the Ashanti Region and Tamale in the Northern region which has led to a marginal increase in the number of EVs beyond Accra. Despite the lack of any formal policies, the private sector has been tackling the issue of charging stations in Ghana and has started preparing the groundwork for electric vehicles.

**Rwanda:** Rwanda has capped the electricity tariffs for charging stations at the industrial tariff. This means that charge point operators will be billed at close to USD 10 cents/kWh instead of around 20 cents/kWh.[62] Time-of-Day(ToD) rates have also been introduced by which tariffs for electric vehicles will be lowered during off-peak hours. Non-fiscal incentives include allocation of rent free land for charging stations on land owned by the Government and provisions for EV charging stations in the building code and city planning rules

**Morocco** plans to set up almost 30,000 charging points for LDVs, 2/3Ws, and buses by 2030. Tunisia has reduced customs duty rates to 10 per cent and value-added tax rate to 7 per cent on electric car chargers. Eskom, South Africa's largest electricity provider has rolled out 10 EV charging stations to support the growing fleet of electric vehicles in the country. Rwanda's charging network is being set up by Kabisa, a private organisation, in collaboration with Societe Petroliere Ltd (SP), which is a petroleum company.

**Egypt:** 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 LE 450 million. Based on such development the

target market is expected to grow significantly.[63] 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. In Egypt, the number of charging stations across the country is growing.[64] It is also evident that the role of home charging will be important. This is an important step forward.[65]

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 the 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.

Morocco is planning to add over 100 new charging stations by 2025. Efforts by companies like Audi and GridCars in South Africa and similar initiatives in other countries are essential to support the growing number of EVs and address potential infrastructure challenges. In July 2023, BYD launched electric vehicles in Chile, Morocco, and Brunei. In Morocco, the company unveiled three new all-electric models — the Han EV, Tang EV, and Atto 3. In August 2023, Mahindra unveiled Thar in South Africa. The electric SUV was launched in 2024.

Other countries are also showing promising growth. Senegal launched a framework to promote and regulate the use of electric vehicles in the country on July 15, 2024. Morocco's EV market is bolstered by government incentives and a strategic focus on renewable energy. Egypt is enhancing its EV market through policy reforms and infrastructure investments. Nigeria and Ghana are also emerging markets, with increasing interest from global OEMs and local entrepreneurs focusing on electric mobility solutions.

These start-ups provide a range of services, including local assembly and sales, asset financing and battery-as-a-service, among others.

## Battery swapping

According to IEA, Africa has also seen increased investment in battery-swapping technologies for 2Ws. Ampersand, a Rwanda-based company, currently performs 140 000 monthly battery swaps to more than 1 700 customers that together travel 1.4 million km every week in Kigali and Nairobi. Spiro, an African electric 2W start-up, secured around USD 60 million in 2023 in order to expand its electric fleet and fund more than 1 000 swap stations.

Battery swapping in EVs enables exchanging of a depleted battery for a fully charged one at a specialized station and can be hugely beneficial in a price sensitive market of Africa. This allows delinking of the cost of batteries from the cost of vehicles (which can be 40 per cent of the cost of the EV if fixed to the vehicle) and reduces the upfront cost for consumers. This can make the battery technologies flexible, reduce the overall public charging infrastructure costs, increase energy efficiency, reduce range anxiety, enhance battery management, extend vehicle range, and reduce the downtime.

As lessons from the global battery swapping industry reveal, it is easier to build battery swapping infrastructure for 2W and 3W because their batteries are lighter and the batteries can be swapped manually. Bigger vehicles like 4W passenger cars and heavy-duty trucks have larger and heavier batteries and therefore, require automated battery swapping stations which are powered by robots. Most of India's battery swapping stations target the 2W and 3W vehicle segments. Africa's large fleet of light-duty vehicles make it suitable to follow in India's footsteps and build scale in battery swapping by targeting 2W and 3W. 4W can migrate to this system once the technology is fully established and becomes cost effective.

As the industry moves more towards battery swapping technologies interoperability will become a major issue. Interoperability in battery swapping refers to making EV batteries compatible with different EV models and charging stations. This will require standardisation. If this is not done, each manufacturer will have to design the battery space. It will enable users to move between different battery swapping services easily and seamlessly. The governments need to adopt a swapping policy to move towards standardisation of the battery swapping technology for interoperability and to make the system scalable. Africa may start these conversations at the earliest through its multilateral forums.

There are other enabling models emerging in other countries like India. For instance, United Energy Interface (UEI) is a not-for-profit alliance in India that

is aimed at enabling easier energy transactions by integrating with electricity providers throughout the country. It is based on the Beckn protocol and is a made in India open-sourced protocol like the Open Network for Digital Commerce (ONDC). Till April 2024, UEI had facilitated 1.4GWh of energy transactions across the entire network and is expected to grow 100 times, with prominent B2C apps set to join the alliance. This is a customer-focussed initiative which would prepare ground for battery swapping in India. However, it was a low-hanging fruit for India's well-developed software industry. Africa may also progress on their battery swapping journey by targeting small wins first.

## Access to electricity

Access to reliable electricity is a concern. Sub-Saharan Africa is facing challenges due to unreliable electricity supply. According to IEA, in 2022, only 49.4 per cent of the population in Sub-Saharan Africa had access to reliable electricity. Around 750 million people still lack access to electricity, primarily in sub-Saharan Africa. Additionally, there are problems with grid dependability that impact the likelihood of charging electric vehicles. But some countries like Uganda and Rwanda, have sufficient supply to support E-mobility.

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 39.3 versus 0.87 for OECD high-income countries. In Sub-Saharan Africa, transmission and distribution losses cause additional costs of USD 5 billion annually, with levels far exceeding the world average of 10 per cent.

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. African EV leaders have surplus power, with Kenya generating 50 per cent more electricity than needed, and electricity prices in Africa averaging 0.13-0.15 USD per kWh, below the global average of 0.18 USD per kWh.[66]

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 that 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 has installed solar panels in six stations and plans to equip more.

South Africa is among the most coal-reliant countries globally, with coal contributing to 85 per cent of electricity generation in 2023. Zero Carbon Charge, a private player, aims to establish a national network of 120 off-grid, sustainable charging stations across South Africa by 2025. These stations will generate electricity using on-site solar PV, storing energy in lithium iron phosphate batteries, and will provide back-up power using generators fuelled by hydrotreated vegetable oil. [67]

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 sources of energy. If supported with proper funding support and private investments with scaling up of the EV market this can be transformative.

One of the important enablers on this path is that Kenya's electricity is very green with more than 80 per cent generated by hydro, solar, geothermal and wind. Shifting to electric bikes in Kenya, Rwanda, Uganda and elsewhere will reduce costs, air pollution and greenhouse gas emissions, as well as create jobs. [68]

# 7: E-retrofitment of vehicles

Yet another strategy that is becoming popular in Africa is retrofitting.

In Africa, legislation, technical regulations and incentive measures specifically targeting EV retrofitting is largely missing. For example, the EV White Paper released by South Africa in December 2023 is one of the most recent and comprehensive electric mobility policy documents among African countries. It focusses only on the manufacturing of electric vehicles and their components rather and mentions retrofitting used vehicles only in passing.[69]

The EV retrofitting industry in Africa is nascent and is dominated by startups, predominantly in countries with large urban centres. In the African context, these players consider EV retrofitting as a more immediate solution for electrifying transportation, due to the lack of new electric vehicles to become widely available in the market.

In Egypt, Shift EV is a startup focussing on retrofitting fleets of Suzuki minivans in Cairo.

Similarly, in South Africa, Electric Powered Vehicles Africa (EPVA) is a start-up specializing in e-retrofitting which has been involved in converting ICE safari vehicles, light delivery vehicles and even tractors. The University of Stellenbosch has presented a tangible and illustrative use case of retrofitting a Toyota-manufactured Hiace Ses'fikile taxi, a widely used southern African paratransit vehicle. Retrofitting fleets composed of the same vehicle model provides the advantage of homogeneity by providing a common chassis for retofitment kit development.[70]

While in South Africa and Egypt, retrofitting has been carried on large vehicles, in East Africa, two wheelers (Boda Bodas) and three wheelers have been of particular interest to retrofitters.

In Uganda, GOGO (earlier known as Bodawerk) is involved in retrofitting two and three wheelers. The Government of Rwanda and UNDP launched a retrofit electric motorcycles project with a local company, Rwanda Electric Mobility. In Kenya, companies like GECSS and Greenwheels are also retrofitting Boda Bodas.

Kenya has seen activity in other vehicle segments too. Roam Electric has targeted the safari and tourism industries, which operate vehicles on specific routes, with predictable range capacity.

Kenya Power has announced plans to convert over 2,000 vehicles from ICE to EV in the next four years. Other companies, such as Knights Energy, have received approval from the Kenya Bureau of Standards (Kebs) to convert vans and buses into hybrid and electric vehicles in the country.[71]

In Tanzania, E-Motion has also focused on the tourism sector, using previous experience from parent company Hanspaul Ltd in assembling open-top safari vehicles to retrofit and manufacture electric versions for high-end safaris.
With respect to regulation and standards for EV retrofitting, two countries have been considered.

In South Africa, the National Road Traffic Act requires a retrofitter to be registered as a builder, which would make them subject to inspection under the National Regulator for Compulsory Specifications(NRCS). The NRCS stipulates strict weight and manufacturing requirements, specifying that the modified vehicle must not exceed the original registered gross vehicle mass. Additionally, the NRCS prohibits any permanent modifications to the vehicle's chassis, including manufacturing techniques such as drilling, cutting, and welding. Instead, all newly assembled parts must be attached using existing drilled holes or fitted brackets.[72]

In Kenya, there are 21 electric vehicle standards developed by the Kenya Bureau of Standards that cover the safety, operation, and test procedures of three different classes of electric vehicles namely, road vehicles, motorcycles, and hybrid vehicles. However, no specific standard for EV retrofitting has been defined.

## Lessons from India's experience with EV retrofitting

The primary reason for interest in retrofitment is the high upfront cost of new EVs and challenges in motivating a large consumer base to move quickly towards new EVs and bear the cost of this transition.The EV retrofitting industry in India is also nascent like in Africa. However, there are certain differences in India's approach to the retrofitting sector which can be used to inform the initiatives that are emerging in Africa.

**State EV policies support retrofitment, but lack comprehensive guidelines**: Currently, there is no separate incentive programme for e-retrofitment at the

central government level in India. However, nearly eight Indian states including, Delhi, Assam, Chandigarh, Rajasthan, Telangana, Tamil Nadu, Uttar Pradesh and Kerala have provided for e-retrofitment in their respective electric vehicle policies. In most states, e-retrofitment has been permitted without adopting proper guidance framework for quality control of the programme. Only the Government of NCT of Delhi has a defined policy on e-retrofitment that defines the type of diesel and petrol vehicles that can be retrofitted.

**Scope of implementation is still very limited:** Despite some state governments offering financial incentives for retrofitment, this market is yet to scale. In most states the market is still very limited and largely confined to some niche vehicle segments, use cases and pilot projects. There is barely any data and evidence from systematic assessment of on-road performance of retrofitted vehicles. Most of the understanding is anecdotal.

**Nascent growth of the e-retrofitment industry:** This industry largely includes small companies and start-ups. Retrofitment centres have been set up in metropolitan cities and industrial hubs such as Delhi NCR, Bangalore, Hyderabad and Pune. Retrofitters usually offer services for selected vehicle models, as the retrofitment kits are designed and certified for specific models and cannot be applied generically across all models. But separate homologation procedures add to costs significantly. Challenges such as expensive certifications and low consumer awareness/confidence are some of the impediments to achieving scale.

**Evolving regulatory framework for retrofitment**: There is already a regulatory mechanism in place for the certification of retrofitted vehicles. Specified regulatory requirements and conditions need to be fulfilled for quality control and safety. To address the concerns around safety, integrity, on-road performance and durability of the e-retrofitment technology and kits, regulatory framework and technical standards (Automotive Indian Standards(AIS) 123: Part 1,2,3) have been framed to ensure quality control, and safety, stability and on-road performance.

**Need to align the technical standards for retrofitment with the newly amended safety standards:** The retrofitting standard AIS-123 and AIS-048 standard for battery testing and certification are in place, but these have not incorporated newly amended EV battery safety standards AIS- 038 (Rev 2) and AIS-156 that are more stringent and apply to new EVs. AIS-123 also does not cover safety and integrity of the battery in the retrofitted system. There are no tests for ensuring lower vibration levels with secure installation of the battery in the old vehicle chassis. This needs to be mandated.

**Testing and certification capacity is limited and causes delay:** For a retrofitted vehicle to be certified roadworthy, it needs to be homologated by a competent authority such as ARAI and ICAT. This includes fitness tests, emission and safety and road-worthiness tests as per the central motor vehicle legislation. But there are only two testing authorities to service large numbers of certification requests. The homologation process is also time consuming apart from being expensive. Often the certifying body has to begin by buying the equipment required to test technology-rich vehicles. The high cost of certification affects the profit margin. Moreover, certification of one kit for a particular vehicle model cannot be used for another variant of the same model. If the kit fails the certification process, retrofitters have to re-apply and pay again.

**Cost of e-retrofitment:** The cost of e-retrofitment of older ICE vehicles is much cheaper than the upfront cost of new EVs. The cost components of a new EV include the upfront costs of purchase and for the battery replacement after five to eight years. The total cost of ownership of new vehicles includes the entire useful life of the vehicles. Retrofitted vehicles have a much smaller lifespan depending on the age at the time of retrofitment. With retrofitment, a vehicle may get an additional life of another four to five years depending on the age of the vehicle. The GST on a new EV is five per cent while on spare parts (other than batteries), it is 28 per cent. The retrofitters also usually include registration fees in their overall retrofitment cost. However, overall, the lower cost of retrofitment (the range may vary across models and vehicle segments) makes this an attractive option for addressing the problem of old ICE vehicles.

**Demand for adequate and effective safeguard while implementing retrofitment programme:** While technically, retrofitment is possible and feasible, there are concerns that, if not done with adequate quality control, it may compromise on-road performance and safety. The Clean Air Policy 2022 of the Air Commission of Delhi-NCR states that "while technically and principally e-retrofitment is possible and feasible, several safeguards and preparedness are needed for its conditional implementation for safe and reliable conversion." This policy recommends that retrofitment be permitted under certain conditions, including the certification of retrofitment kits for specified makes and models according to established standards. Additionally, based on the central government rules, the state governments need to further define and notify the implementation mechanism for retrofitment. In fact, the Delhi government, in its EV policy, has outlined the technical and regulatory conditions to be fulfilled for e-retrofitment and even though the ARAI standards technically allow vehicles of 1990 vintage to

be e-retrofitted, Delhi government policy does not allow diesel vehicles that are more than 15 years old to be retrofitted. Petrol vehicles are allowed to be retrofitted only if they fulfil fitness criteria.

**Need effective screening of internal combustion vehicles for retrofitment**: There are also concerns around maintaining the structural integrity of the chassis of a used ICE vehicle being considered for retrofitting. This needs very stringent screening and prevention of retrofitting of already compromised vehicles. The chassis will require proper testing for static and dynamic loads, fatigue and durability, etc to assess the prospects of installing battery pack etc on the old chassis. Even though AIS-123 addresses these aspects in the respective models, its on-ground enforcement will be critical.

**Build consumer awareness about quality of retrofitment:** Customers need to do a thorough background check of the retrofitter including aspects such as the location of their workshop and headquarters, certification and audits, whether their financials are capable of supporting the warranties they are offering on their components, especially the battery. Due diligence must be mandated to ascertain the retrofitter's supply chain feasibility and whether their vendor systems are capable of handling the particular request and also to find out whether the retrofitter is taking up projects based on their own technical expertise or has outsourced most of the work to third party with no quality control. These necessary checks have to be incorporated into regulation set up by the government.

**Making state-level fiscal incentives performance linked for quality control and issues related to financing:** As state governments are providing fiscal incentives, it may be linked with the performance and audit. Moreover, retrofitters also highlight the challenge of inadequate fiscal support and financing instruments for retrofitment, which is a common challenge in the EV sector. Several three wheeler retrofitters have pointed out that it is only recently that private financiers have begun to show interest in financing this strategy. In fact, one of the business models where retrofitters working on a vehicle are also providing batteries on a rental basis has drawn interest from financiers.

**Frame comprehensive guidelines for state-level implementation:** It will be beneficial if states have a national guidance framework for the implementation of retrofitment to guide the efforts and ensure effective quality control. This is important especially in view of the possibility of decentralized small enterprises and outsourcing of practices to third parties.

As this nascent market begins to scale it is necessary to define and enforce the regulatory terms for a robust and an effective programme.

- E-retrofitment requires alignment with stringent safety standards to prevent the risk of an accident. Any episode of a safety-related accident in the retrofitment segment can jeopardize the overall EV market and its progress.

- The state governments need to notify and adopt detailed guidelines on the conditions to be fulfilled for quality control of e-retrofitment. Like Delhi, state EV policies need to specify the vehicle vintage and types that are eligible for e-retrofitment and also those that do not qualify.

- It is important to ensure that the method of screening of vehicles for fitness of chassis, overall structural stability and strength etc are assessed adequately before e-retrofitment is undertaken. Assessing the adequacy of the infrastructure at the automated fitness testing centres that are to undertake the screenings is also important.

- The fiscal incentives being offered by the state governments for e-retrofitment need to be performance linked and the conditions need to be clearly laid down.

- There should be an oversight and monitoring body to audit the e-retrofitment workshops.

- Notify the list of prospective e-retrofitment agencies/vendors at the central and state level after proper verification and certification of the facilities.

- Ensure after-market maintenance services and fulfilment of the warranty conditions.

- New private financing models for e-retrofitment and their terms and conditions need to drive quality control and put in place proper checks.

- The financing models can also help to establish residual value for sprucing up financing mechanisms. The central government may also help to frame a comprehensive guidance on e-retrofitment to guide implementation in states.

- The retrofitment agencies also need to be brought within the fold of end producer responsibility for disposal of the spent batteries.

# 8: Learning from India: India's EV Policy Eco-system

## Designing a national demand incentive programme

India has focused its EV promotion strategies towards small segment vehicles such as two-wheelers, and three wheelers due to their ease of charging and smaller upfront costs, which helps in reaching price parity with ICE models more easily. It has also focused on high-occupancy commercial vehicles like taxis, buses, and paratransit fleet to maximise emission reduction benefits by electrifying passenger trips. Demand incentive played a major role in boosting EV sales in India.

The National Electric Mobility Mission Plan 2020 (NEMMP 2020) envisioned registering 6-7 million electric vehicles between 2013 and 2020. Following this, DHI introduced Faster Adoption of (Hybrid &) Electric Vehicles (FAME) scheme in 2015 to provide purchase incentives for electric vehicles in India. Later in 2019, the scheme was revised, now called FAME II that revamped fund utilisation, indigenous manufacturing capacities and product quality, for both vehicle and battery.

**Phase 1:** The first attempt at the demand incentive programme missed out on several opportunities and had major flaws in its regulation and operation. Learnings from FAME I are crucial to understand how demand incentive schemes can manoeuvre the market towards both favourable and unfavourable outcomes:

The 2015 iteration of FAME (FAME I) allowed mild hybrids, with only 10-15 per cent fuel consumption improvement, to be eligible for the incentives. In its first year after commencement, Rs 40 crore of the Rs 70 crore budget for demand incentives were availed by mild-hybrids, and by the end of four years, out of the total car sales under FAME I, 95 per cent were mild hybrids.

Moreover, FAME I incentives were given out in two levels, Level 1 (lower) for "Conventional batteries" such as lead acid, etc., and Level 2 (higher) for "Advanced Batteries" such as Lithium composition batteries, due to which the cheaper (but less efficient and more hazardous) lead acid batteries dominated the market. The total two-wheeler share in all electric vehicles registered by the end of 4 years in India was 39 per cent, however most of these sales were lead acid batteries.

In response to this, benefits for mild hybrids were withdrawn in 2017 and for lead acid batteries in 2018 to best utilize funds on cleaner vehicle segments.

**Phase 2:** The second phase of FAME began in 2019, with a much larger budget earmarked for incentives, however this time performance and other specifications of the vehicles were tied with vehicle eligibility. This included more parameters other than minimum vehicle range, such as minimum energy consumption, minimum max speed, minimum acceleration, and so on.

The scheme now supported commercial vehicles only, with an exemption for the two-wheeler segment, since it was the fastest growing segment after e-rickshaws in the country back in 2019.

Incentives were linked with battery sizes, which provided a directly stipulated segment-wise incentive amount. FAME II also set targets for the number of vehicles (segment-wise) to be electrified. The scheme was complemented by a phased manufacturing programme (PMP) that promoted domestic manufacturing of EV components in India, including battery backs and traction motors, etc. Additionally, FAME II discouraged import of completely knocked-down (CKD) kits for two-wheelers and three-wheelers and other EV components, by providing a timeline for increasing basic customs duty (BCD) on imports.

The scheme was set to operate for three years (till FY 2021-22), however in lieu of COVID-19 restrictions which slowed down the industry, it was extended for two more years and concluded in March 2024. During this period, FAME II financial outlay was augmented to include more registrations, especially in the two- and three-wheeler segment.

The revised FAME III programme is awaited.

**Experience with phase down of subsidies**: Electric Mobility Promotion Scheme (EMPS), 2024 came into effect in April 2024, that only supports electric two-wheelers and three-wheelers through demand incentives, and all other vehicle segments were left out of the scheme.

This move was sudden and abrupt for both consumers and the industry. EMPS slashed the incentives by 50 per cent or more per kilowatt-hour of vehicle battery capacity, and set two caps on the maximum incentive which can be received by a vehicle (whichever is lower of the ex-factory cost cap and the maximum incentive cost cap) thus reducing monetary support substantially.

The scheme asks for re-registration of OEMs, their dealers, and their vehicles on an online portal to be eligible for subsidies. Vehicles manufactured before the certification approval will not receive discounts, making it challenging for OEMs to liquidate their already existing vehicle stocks.

While gradual reduction of financial support is an important step to ensure fiscal sustainability in the industry and for market-driven development of a sector rather than policy-driven, if the ecosystem lacks critical pre-requisites, an incentive phase-out programme cannot qualify as positive development. Such pre-requisites can be a zero-emission mandate to keep the industry motivated to induce demand, or other robust non-fiscal strategies that keep electric vehicles desirable, such as number plate restrictions, lower cost or free parking, traffic restrictions with waivers to EVs, and so on.

Further, phase-out needs to be gradual with ample warning to consumers and industry, especially in volatile markets which are largely dependent on fiscal subsidies.

The Indian electric vehicle market has shown high sensitivity towards fluctuations in incentives in the past. In June 2021, when incentives for two-wheelers under FAME were increased, a 274 per cent increase in sales of electric two-wheelers was observed in the month of June, and 213 per cent increase in July compared to their previous months respectively.

When in June 2023, the policy reinstated the discount to Rs 10,000 per kWh the sales plummeted by 56 per cent. Ever since the EMPS was launched in April 2024, electric two-wheeler registrations have dipped to 2021 levels today. The annual average growth rate of electric two-wheeler registrations in 2024 before the launch of EMPS (Jan-March) was 24.8 per cent. After EMPS till date (Jan-Aug), the average annual growth rate has dropped to -2.7 per cent.

In conclusion, India's strategy evolved through trial and error, shifting from broad and often misallocated subsidies to more targeted and performance-based incentives. The experience underscores the need for precise targeting of incentives to ensure that they effectively promote the desired technology—electric vehicles with advanced batteries, for instance—without encouraging suboptimal alternatives.

The shift from FAME I to FAME II illustrates that performance-based criteria and segment-specific incentives can refine market outcomes. However, India's

recent experience with the Electric Mobility Promotion Scheme (EMPS) serves as a cautionary tale about the risks of abrupt policy changes. The sharp reduction in incentives and the sudden narrowing of eligible vehicle categories led to a dramatic slowdown in market growth, emphasizing that any phase-out of fiscal support must be gradual, well-communicated, and accompanied by non-fiscal measures which translate to preferential treatment for EVs in urban settings, and supply side drivers such as zero-emission mandates.

## E-buses for electric mobility in India: A success story

Electrification of public buses in India is considered as a huge success, as within a short span of seven years, since the first electric bus was deployed on an Indian road, India has deployed more than 8,000 electric buses. Another 20,000 electric buses are planned to be added to the fleet by next 3 to 4 years. This transformation that has begun with the state owned transit agencies, is now being planned for the private bus sector as well as for massive deployment of electric buses.

Robust policy action along with continuous learning and improvement has enabled this transition that now creates a valuable global learning curve. From the beginning the Government of India's policy has prioritised buses for electrification to decarbonise the mass movement.

India's bus electrification journey provides great insight to all those cities who are determined to transform their bus sector for low carbon and clean pathways. The lesson from India is relevant for African cities, as their socio-economic and travel patterns are quite similar to the Indian conditions.

**Initiation through policy action:** Since the beginning of India's electric mobility programme, the bus was considered as one the key sectors for electrification as this provides a unique opportunity to decarbonize a sizeable share of daily travel trips in cities and reduce toxic exposures.

In 2015, Faster Adoption and Manufacturing of Electric vehicles scheme or FAME-1 was introduced by the central government to include buses as well. Electric bus technology is totally new in Indian conditions and the global experience and learning curve is also very limited.

The scheme prioritised the public transit authorities (Government operated State Transport Undertaking – STU or Special Purpose vehicles – SPV). They had the flexibility to choose their own method of introducing these electric buses. The scheme originally offered an incentive amount up to 60 per cent of total

purchase cost or Rs 0.85 to Rs1 crore, whichever was higher, depending upon their localization factor from 15 to 35 per cent. It also provided a 10 per cent additional subsidy for installing charging infrastructure for the buses.

Around 425 electric buses were introduced under FAME-1 funding in nine big cities in India, including Mumbai, Kolkata, Hyderabad etc. As majority of these cities used to operate buses (earlier diesel buses) on their own, thus seven out of nine cities procured these buses under out-right purchase model. Hyderabad chose to go with a Gross Cost Contractual (GCC) model of operation, whereas Mumbai procured initial few electric buses under out-right and later on followed GCC model to operate these buses.

Even though, 60 per cent upfront subsidy on the purchase cost excited many public transit authorities to go for or at least think of introducing electric buses in near future, soon public transit authorities started experiencing various challenges of operating buses under the out-right model, due to their inexperienced staff, immature technology. This led to poor performance, problem of limited or poor supply of spares etc. This affected the service quality.

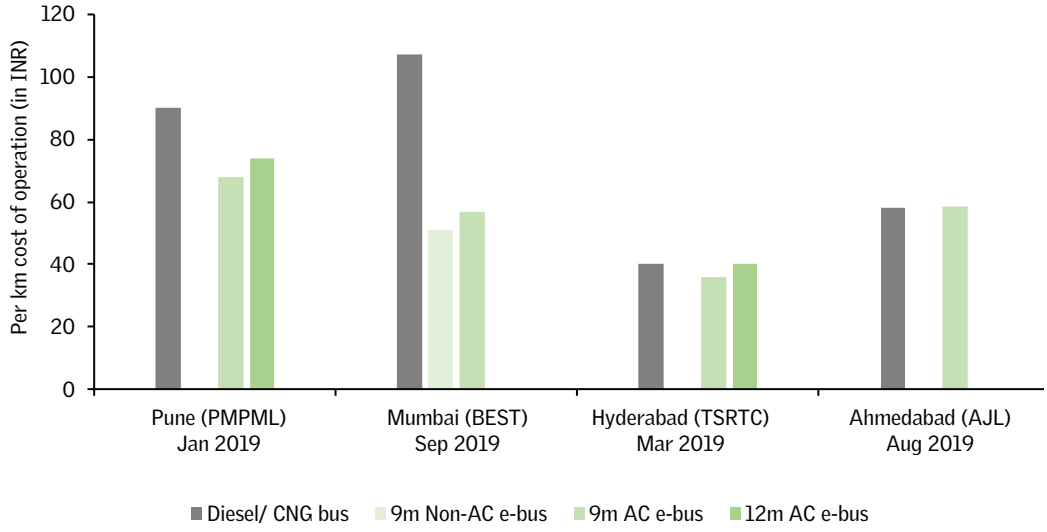
On the other hand, cities with GCC models were performing much better and cost of operation was also quite comparable with ICE buses and in some cases, even lower. *(See Graph 9: Cost comparison between ICE and Electric bus under GCC).*

It is important to highlight that, due to lack of experience with operations of electric buses, OEMs were given additional responsibility of operating electric buses. This is a departure from the convention of contracting private operators to run the buses.

Uncertainty around the technology, confusion around the selection of the right kind of business model, and costs, many cities including Bengaluru and Delhi, who had shown interest in augmenting the electric bus fleet, scrapped the deal even after going through several procurement processes, as any mistake will force them to get locked in for the next 10–12 years.

**Targeted approach:** Experience and these lessons from the FAME-1 scheme, helped policymakers to formulate the next phase of FAME, i.e., FAME-2 in a much better and effective manner. The FAME-2 commenced on April 1, 2019, with a much more concentrated push towards electrification.

**Graph 9: Cost comparison between ICE and Electric bus under GCC (FAME-1)**




Source: Multiple sources, complied by CSE

To achieve economies of scale, coverage of the FAME-2 incentives was extended to 40 cities with planned deployment of 7,000 e-buses, almost 8 times more than the FAME-1 scheme.

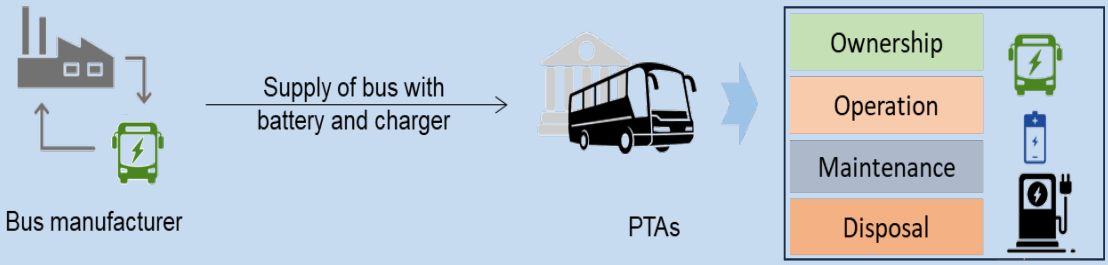
Realising the issues with the outright purchase model, GCC became mandatory for all the public transit authorities to avail the FAME-2 subsidy, i.e., 40 per cent of cost of bus or for standard bus – INR 55 lakhs; midi bus – INR 45 lakhs; mini bus – 35 lakhs, whichever is higher.

Cost of bus is calculated considering 50 per cent of the entire cost related to procurement, operation and maintenance of electric buses for project duration.

This time, in addition to operating electric buses, GCC partners were given additional responsibilities of creating necessary electrical infrastructure (below the metre) including charging points and others to operate and maintain the buses as well. However, the public transit authority had the responsibility of providing land, necessary civil infrastructure including administrative area, parking and repair pit, washing area etc. In addition, the public transit authority was also responsible for connecting depots with high powered electricity lines to provide electricity to operate these buses.

## GLIMPSE OF EXISTING ELECTRIC BUS OPERATION MODELS IN INDIA[73]

Out-right purchase model:



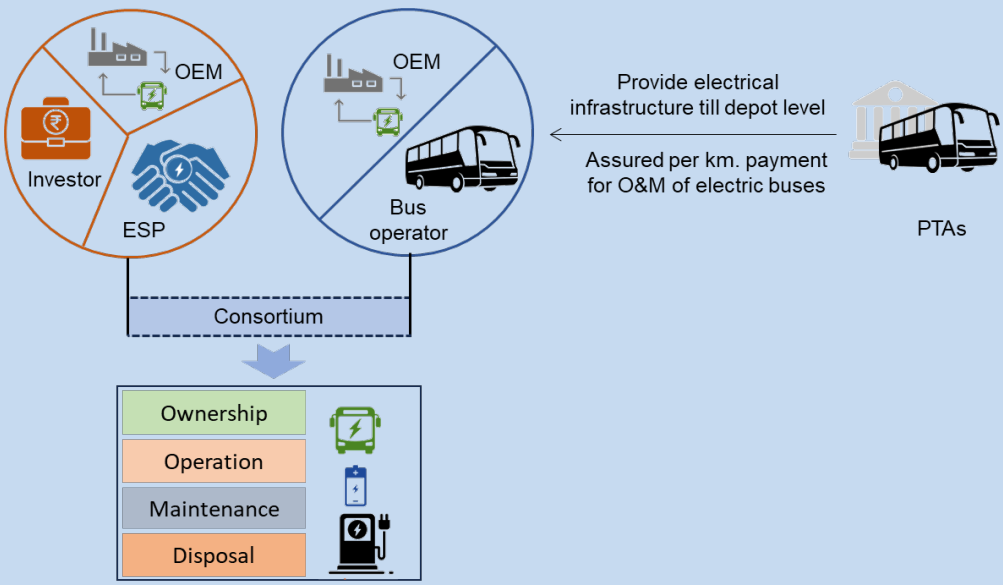

In this model, the manufacturer supplies electric buses along with batteries and chargers to public transit authorities (PTAs). PTA directly owns, operates and maintains all the assets including electric bus, battery and charger with help of their own manpower. Thus, PTAs bear the entire cost of services including capex and opex. All the revenue related risks are also with them.

Due to lack of knowledge about electric bus operations PTAs are facing a lot of difficulties including battery failure, range issues, issues with availability of spare parts etc., while operating electric buses under this model.

Presently, Kolkata, Jammu, HRTC-Shimla and Manali, Guwahati among others are operating their electric buses under this model.

Gross cost contract model: In the GCC model, OEM, bus operator, energy service provider, investor all come together to form a consortium to operate electric buses under some specific conditions and get a fixed remuneration from the PTAs based on the operated km. Thus, the consortium (a private entity financed, owned, operated and maintained) all the assets and PTA bore all the revenue risks of the operation.

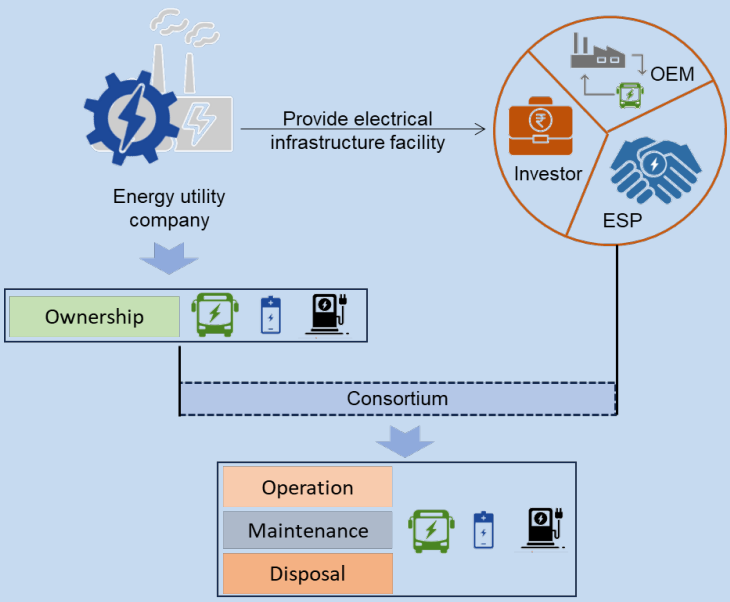
GCC model is mandatory to get purchase incentive under FAME 2 scheme. Even recent CESL procurements under the national electric bus programme have also floated two tenders in GCC model.



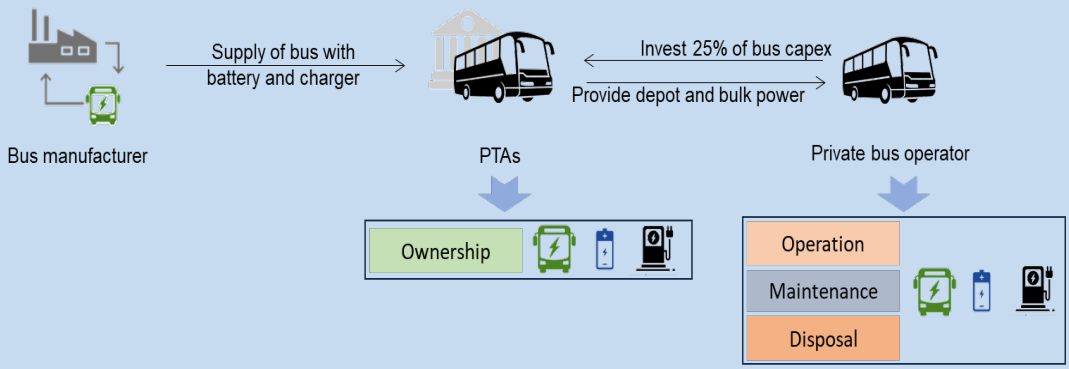
Pune, Ahmedabad, Navi Mumbai, Mumbai among others are presently operating electric buses in GCC.
Other than the out-right and GCC model, Indian cities have also explored two additional models to operate electric buses.

Utility provider led model: Here, the energy utility company is the key stakeholder that owns the assets including electric bus along with battery and chargers and creates a consortium with a private entity (including OEM, energy service provider and investor) for electric bus operation and maintenance activity.

National Thermal Power Corporation (NTPC) has done this experiment in Andaman.




Net Cost Contract model: Currently, Indore electric buses are running on this model of agreement. In NCC, both PTA and private bus operators invest (i.e., 75:25 ratio) in procuring buses along with batteries and chargers. In exchange all the responsibility of operating and maintaining buses is vested on private bus operators. They also bear all the revenue risk. To support private bus operator, PTA provides depot and bulk power for operation.




Indore NCC model is a special case, as along with electric bus routes PTA has also given premium inter-city diesel bus routes to private bus operators to cross subsidise its operations and to minimise the revenue risk. Additionally, unlike other partnership model where OEM also involved directly by forming a consortium with a private operator, here private bus operator alone entered into this contract due to its close relationship with OEM as dealer.

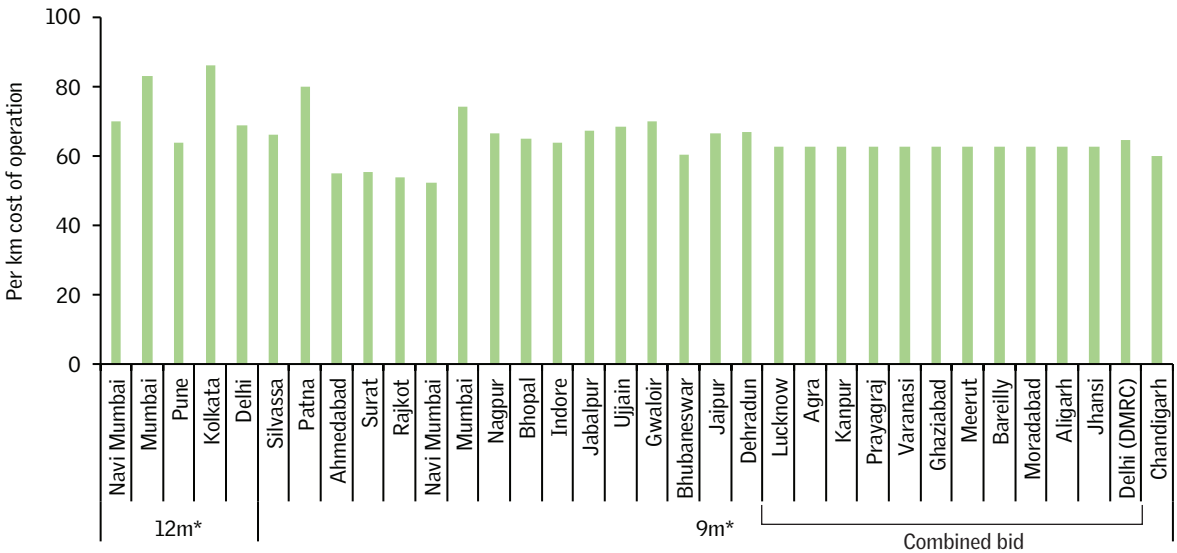
In the meantime, the central government had taken up some policy decisions to reduce goods and service tax (GST) on electric vehicles from 12 per cent to 5 per cent and on electric chargers from 18 per cent to 5 per cent, to provide a much greater push towards entire vehicle electrification including buses.

After this notable change, an overwhelming number of cities and states have participated in a competition to avail the funds. Approximately 5,595 electric buses for 64 cities were sanctioned to receive the funds from the central government.

Mandating GCC helped in reducing the operational risk and the total cost of ownership. However, during the procurement stage, city authorities realised that even after following similar procurement model (for similar type of 12m or 9m buses), there was a wide price disparity and significant variation in tender rate (L1 i.e., lowest quotes) in the range of ffl 15 to 30 per cent, with higher variation observed in 12-metre bus category. Some cities even received bids of INR 80 to 85 per km – much higher than operating diesel/ CNG buses – raised the question of scaling up these services. *(See Graph 10: City-wise operational cost comparison under GCC (FAME 2 Phase-1).*

In case of combined bids with large contracts, cities received much better prices, e.g., 11 cities in Uttar Pradesh had gone for a combined bid of close to 800 electric

**Graph 10: City-wise operational cost comparison under GCC (FAME 2 Phase-1)**




*including low floor; standard floor - air conditioning; non air conditioning buses.
Source: Multiple sources, complied by CSE

buses, which resulted in better prices for all 11 cities, irrespective of their bus numbers. As a result, operating 25 electric buses in Jhansi would cost them around Rs 62.55, whereas operating a similar number of buses in Patna would require Rs 79.83.

Additionally, public transit authorities with a large manpower base in terms of drivers, conductors and other maintenance staff are not keen to engage private partners under the GCC model, as it would impact them negatively. Thus, many of them distanced themselves from taking subsidies under FAME 2.

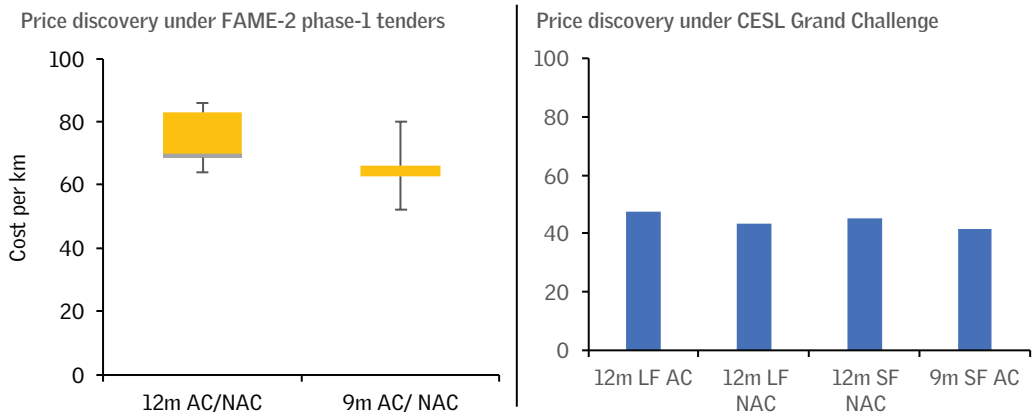
**Aggregating demand to provide scale and reduce costs:** In view of these challenges, even after two years of commencement, not more than 3500 electric buses were introduced under FAME-2 funding. Amidst slowdown, FAME-2 was further amended in June 2021, and demand aggregation concept was introduced to reduce the cost of operation by providing scale.

Centre created an entity named Convergence Energy Solution Limited (CESL), a fully owned subsidiary of the Energy Efficiency Services Limited (EESL), a joint venture of the Central Public Sector Undertakings including NTPC Limited, PFC Limited, REC Limited and Power Grid Corporation of India Limited, to aggregate the bus demand on behalf of nine selected cities (i.e., Mumbai, Delhi, Bangalore, Hyderabad, Ahmedabad, Chennai, Kolkata, Surat and Pune) for targeted deployment. Focusing on these cities is particularly important as the majority of them have already placed orders, thus, deploying the remaining 3500 buses among these cities will help in providing the scale it requires and also developing adequate eco-system for electric buses.

CESL introduced "Grand Challenge" (GC), to deploy 5450 electric buses in five cities in April 2022. which is supposed to be the largest tender globally. This has helped lower the prices for operations of electric buses quite significantly. Per kilometre (per-km) cost discovery under CESL GC was approximately 23 to 27 per cent lower than the price of diesel/CNG buses in cities, even without any subsidy, whereas in cities with subsidy offered by the central government, the prices were 31 to 35 per cent lower. *(See Graph 11: Comparative price discovery with and without demand aggregation.)*

Viewing the success of the grand challenge, in 2022, the central government came out with a more ambitious programme (i.e., National Electric Bus Programme – NEBP) of deploying 50,000 electric buses within next five years (i.e., till 2027).

**Graph 11: Comparative price discovery with and without demand aggregation**




[LF – Low floor; SF – Standard floor; AC – Air conditioning; NAC – Non air conditioning.]
Source: Multiple sources, compiled by CSE

Under the NEBP programme, CESL floated another wet lease tender for deploying another 6465 electric buses in cities and states. Although this time, the cost of operation had become slightly expensive, but still it was far below that of diesel and CNG operation.

Difference between Wet-lease and Dry lease tender: Both are two different forms of GCC tender model. Under wet-lease tender, a private partner/ OEM is responsible for providing buses with drivers. Whereas, in dry-lease private partners only provide buses not drivers. In both cases, we assume other conditions of GCC are similar.

The demand aggregation model provides the desired success by reducing the price of operation less than the internal combustion engine (ICE) technology buses. But such a large deployment of electric buses and creating associate charging infrastructure require huge capital investment from bidders' side.

Thus, when the bidders or OEMs had their order book full and faced lack of timely payments from the existing cities, they started showing their disinterest in taking further bids. As a result, even after repetitive efforts, dry-lease tender to deploy close to another 4600 electric buses got cancelled due to low participation.

Additionally, NEBP programme was also designed to deploy buses in big Indian cities, thus certain bid qualification criteria, e.g., minimum order number (i.e., 150 for type-1 and 300 for type 2 & 3 buses), daily and annual assured kms (i.e.,

daily assured km - 192 for type-1 and 350 and 450 for type-2 and type-3 buses respectively), were kept quite high. Small and medium sized cities including the hilly cities, failed to participate and deploy electric buses under this programme.

**Expanding bus electrification in small and medium cities:** In view of the above challenges, PM e-bus Seva scheme was launched in August 2023 to deploy 10,000 electric buses in 100s of small and medium sized cities in India. To ensure the participation of the right candidates, the scheme banned all the cities with 4 million plus population from this scheme.

The scheme already relaxed the strict criteria of minimum order number for less than 5 lakh population cities – 50; 5 to 20 lakhs population cities – 100 and 20 to 40 lakh cities – 150 buses. Whereas minimum assured km for 7m buses 160km, 9m buses 180km and 12m buses 200 km. – which can easily be fulfilled by most smaller and medium sized cities.

Instead of up front subsidy (based on bus purchase cost or bus cost calculated on the basis of entire project duration), the scheme will provide the subsidy on a per km basis for the entire project duration which will ensure long term success of the electric bus operation in the cities.

In addition, to provide timely payment assurance to the bidder, the scheme also introduced payment security mechanism (PSM), which is considered as one of the most reformative steps towards ensuring long term sustainability of electric bus operations.

Under this mechanism, the state, the private partner and Government of India will have a legal binding through which the state will be liable for making payments in a timely manner or else money will be deducted by the central bank – Reserve Bank of India (RBI) while disbursing state's dues. Currently, the procurement process under the PM e-bus sewa scheme has just started.

## Role of EV policies of the state-level sub-national governments

In addition to the central government's incentive programmes for demand and production, sub-national state governments in India have notified electric vehicle policies which serve as policy instruments to advance the national electrification ambition. These policies offer incentives over and above the national incentive policy.

There is a broad spectrum of policy approaches that have been adopted by the states. The general architecture of any state level electric vehicle policy in India includes: defined targets and mandates, demand and supply side incentives, support for charging infrastructure development, infrastructure support for promoting manufacturing and skill building, recycling and reuse provisions, and EV funding mechanisms, proposed institutional mechanism, and a periodic review mechanism.

Two approaches have been adopted by states for target setting—set the overall target for fleet electrification by the end of the plan period; and a more stratified approach to setting targets for individual vehicle segments, charging infrastructure, investments and job creation.

Demand incentives have been broadly grouped as fiscal incentives and non-fiscal incentives. Fiscal incentives include purchase subsidy, tax exemption, interest subvention on loans, toll exemption, parking subsidy, scrappage/retrofitment and permit exemption. Non-fiscal incentives include green or special mobility zones, preferential parking and public awareness strategies.

Policies have defined charging requirements and battery models which can be used, and have given purchase incentives (along with other approaches such as lower lease for land, etc.) for charging and support for electricity tariff for both distribution companies and consumers. To this is added the criteria for setting up networks of charging points and responsibility of agencies to provide charging facilities.

Industrial promotion incentives can be categorised into two categories - to develop EV manufacturing as part of the industrial plan of the state and to incentivize manufacturers to set up industries in the state.

This includes stratified incentives based on the size of EV projects, with specific benefits for large, mega, and ultra-mega projects, including joint ventures for integrated automobile and battery plants. Capital subsidies are provided across the EV supply chain, with variations depending on the investment size, and some states offer additional subsidies for cleaner production or investments in specific sectors.

Tax and duty concessions are widespread, including exemptions or reimbursements for stamp duty, interest subventions, state GST, and road tax, along with interest-free loans and concessional registration charges. Infrastructure support covers

subsidies for fixed power costs, electricity tariff discounts, subsidised water rates, and land conversion fee reimbursements, alongside incentives for effluent treatment, skill development, and marketing.

Startups receive prioritised support through funding, budget allocations, and infrastructure incentives. Land allocation is facilitated for EV parks with ready-made infrastructure, including water treatment plants, dedicated power lines, and EV quality test centres. Research and development is supported through grants and funds for technology acquisition, with some states offering customised incentives for large-scale battery manufacturing.

Additionally, pilot projects related to clean energy management, wireless EV charging, and smart mobility solutions are being promoted to integrate electric mobility with broader transport planning. Overall, these measures aim to foster the growth of the EV manufacturing industry by addressing capital investment, infrastructure needs, and innovation.

Several state policies mention skill development and innovation programmes. States offer skilling and reskilling allowances for contractors and assembly line workers. Other approaches include setting up seed and venture capital funds, offering financial incentives for job creation, and contributing to employee provident funds. Additionally, there are provisions for employment incentives, skilling and reskilling programs, and allowances to support workers affected by the transition from ICE vehicles to EVs.

Many states lack clear policies or incentives for recycling and reuse of batteries. While some states have taken steps to promote battery recycling through financial incentives, mandatory labelling, buy-back schemes, and the establishment of recycling units, others have yet to define specific strategies. Policies have emphasised labelling and collection schemes, while some have aimed to set up Battery Industrialisation Hubs.

Very few states have provided for dedicated EV funds or have earmarked revenue sources to create that fund. The establishment of an EV fund represents a state's commitment to vehicle electrification. An EV fund may be set up through budgetary allocation or through a feebate scheme that aims to disincentivize ICEs.

States like New Delhi have provided for extra steps for creation of a dedicated fund that also includes the principle of polluter pay for ICE vehicles to meet the cost of EV transition. This includes the feebate concept—inefficient polluting vehicles to incur surcharge and efficient ones to receive rebate.

State EV funds in Delhi are to be created from: Pollution cess on diesel (Air Ambience Fund); additional road tax on diesel and petrol vehicles on a sliding scale (diesel vehicles to pay higher and two wheelers lower); congestion fee on all trips with ride hailing and aggregator services (petrol and diesel vehicle trips); and environment compensation charge.

## Standards for EV product development

As African nations gear towards increased local manufacturing of EVs, regulations in product development will play a key role in ensuring safety and exportability. African countries can draw from the experience of evolution of standards and regulatory landscape in the Indian automotive industry.

The Ministry of Road Transport, Highways (MoRTH) acts as a nodal agency for formulation and implementation of various provisions of the Motor Vehicle Act and CMVR. The ministry is assisted and advised by various technical committees. The Automotive Research Association of India (ARAI), one of the prime automotive testing and certification agencies, is responsible for publishing the Automotive Industry Standards (AIS) which all OEMs operating in India have to adhere to.

Indian standards have been issued since the late 1960s for domestically manufactured vehicles, based on global standards bodies like ISO, DIN, EEC etc[74] . India took an important step in harmonizing its automotive industry with Global Technical Regulations (GTR) in 2006. It became a signatory of UN Economic Commission for Europe (UNECE) WP-29[75], 1998 agreement. The WP-29 guidelines prescribe standards for universal adoption, facilitating cross-border acceptance and trade. The standards published under AIS are technically aligned with UNECE GTRs as these are used as a base to develop regulations in India while adapting them to Indian environmental conditions. Currently, only four African countries – South Africa, Nigeria, Egypt, and Tunisia have adopted the UN regulations[76].

Standards in India have been promulgated for the testing and evaluation of Electric Vehicles and Hybrid Electric Vehicles. The AIS-038(Rev 2) sets the safety and performance standards for M and N (four-wheeler, bus, trucks) category vehicles. AIS 156 defines the safety standard for L category (two and three-wheeler) EVs. The standards lay down specific requirements for construction, design, safety requirements, and performance parameters.

India strengthened its regulatory framework related to EV battery safety after a spate of EV fires took place in 2022. The official investigation by the MoRTH into the fire incidents highlighted several quality issues with sourcing of components.

The investigation committee found that apart from the use of inferior quality (low-grade) cells, a key factor resulting in the safety lapses was the inadequacy of the Battery Management System (BMS) which failed to prevent thermal runaways or provide a warning signal. OEMs had deployed suboptimal BMS in their vehicles. Additional safety requirements were published as part of amendments to EV standards related to battery cells, battery management system, on-board charger, design of battery pack and thermal propagation due to internal cell short circuit leading to fire.

Since large parts of Africa share similar tropical/sub-tropical climatic and road conditions, and a light- electric vehicle dominated fleet like India, there lies great value in adopting learnings on cell chemistry, battery pack design, thermal management systems, and the associated regulatory framework for safe and optimal use of the battery in an EV.

## India's EV charging infrastructure evolution

Apart from demand incentives and supply-side policy, proliferation of charging infrastructure is the other crucial pillar of EV adoption. India has witnessed an exponential rise in the number of Pubic Charging Stations (PCS). According to the Bureau of Energy Efficiency (BEE), in 2021, there were only 451 PCS, but by May 2024, this number had surged to over 16,300.

Electricity supply in India is a highly regulated market, with regulations at the central and state levels. The Ministry of Power governs the provision of electricity connections for EV charging under a set of regulations and guidelines[77].

The MoP first issued guidelines and standards in 2018 for EV charging infrastructure. It delicensed the operation of PCS by Charge Point Operators which was a major step in democratizing the charging infrastructure in the country. The Central Electricity Authority (CEA) introduced technical standards for charging stations in 2019. The guidelines by MoP have been revised from time-to-time with the latest version being released in early 2024. The newest guidelines recommend that in urban areas, at least one charging station should be available within a 1 km x 1 km grid by 2030.

The central government's FAME II scheme aimed to spur EV charging infrastructure by providing location-based subsidies to government entities ranging from 50% to 100% for 7,580 stations across the country. The government has also reduced tax(GST) from 18% to 5% on chargers. It also amended the "Model Building Bye Laws 2016" to include requirements for parking spaces to be equipped with charging infrastructure in private and commercial buildings.

Aiming to enhance localization in the charger manufacturer ecosystem, the PMP (phased manufacturing programme) for EV chargers mandates a 50% domestic value addition for various charger sub-systems.

In addition to central government policies, state governments have also been providing capital incentives, tax breaks, subsidized electricity tariffs and time-of-day rates to accelerate the development of charging infrastructure.

There are a diverse range of EV chargers available in India including both AC and DC(fast charging) types, each corresponding to unique technical specifications(voltage/power levels) and standards. The AC chargers, such as Bharat AC - 001, Type-2 AC, and LEV AC (IS-17017-22-1. the DC charging standards, Bharat DC - 001, CHAdeMO, CCS-II, and two LEV DC versions (IS-17017-2-6 and IS17017-2-7)[78].

Bharat AC-001/Light EV Chargers have emerged as the most common charger, which are primarily designed for smaller vehicles like E-2Ws and E-3Ws

For fast charging, the CCS-II standard has seen extensive adoption by auto manufacturers across India. This reflects a concerted effort among OEMs and charging point operators (CPOs) to establish a common, interoperable charger type for 4- wheeler passenger cars. A similar convergence towards a common fast charger for Light EVs is yet to emerge in the market in India.

The challenges faced by the EV charging ecosystem are the lack of charger interoperability, incidents of vandalism and theft and lack of reliable supply, especially in highway chargers.

Many African countries have initiated measures to boost charging infrastructure. The takeaways from India's experience include extending financial incentives to private CPOs, ensuring a robust compliance mechanism for localized manufacturing, sensitization of electricity distribution entities for supplying timely connections and innovative tendering models for renewable energy based charging systems.

**Production linked incentive (PLI) scheme and localization of manufacturing**
India has a strong interest in localising EV manufacturing in India as part of its industrial policy. This has led to slew of incentives for EV battery production and components.

Through its Advanced Chemistry Cell production linked incentive (PLI), which was launched in June 2021, the government of India aimed to incentivise investments into the manufacturing of ACC battery storage devices in the country. The scheme applies to only ACCs and integrated advanced batteries with pre-specified minimum performance criteria. The key criteria for disbursing these funds were that all the beneficiary firms must account for a cumulative capacity of 50GWh and each beneficiary firm must commit to individually setting up a minimum capacity of 5GWh. The government restricted its total annual cash subsidy disbursal to 20GWh per beneficiary firm. The government laid out clear Domestic Value Addition (DVA) criteria as well. The beneficiary was required to achieve a domestic value addition of at-least 25 per cent and incur the mandatory investment (₹ 225 crore /GWh) within 2 Years and raise it to 60 per cent domestic value addition within 5 Years.

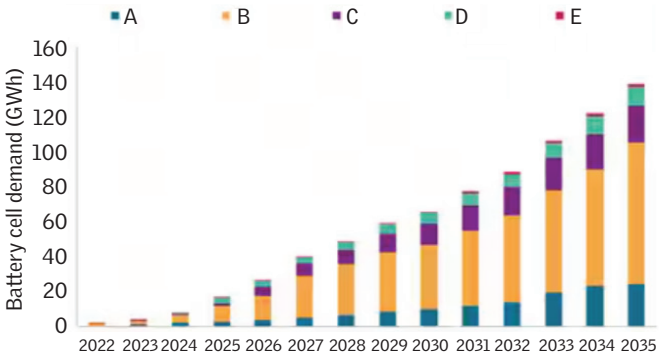
In addition to the ACC PLI scheme, the government approved the PLI-Auto scheme in September 2021. This scheme was also aimed at encouraging localised manufacturing of Zero Emission Vehicles. Main objectives of the scheme included overcoming cost disabilities, creating economies of scale, generating employment, building a robust supply chain in areas of Advanced Automotive Technology products and facilitating the Automobile Industry to move up the value chain into higher value-added products.[79]

The PLI schemes were well-intentioned schemes, which have spurred domestic manufacturing of EV batteries by firms like Ola, Exide and Amara Raja. S&P Global Mobility predicts that by 2030, 13 per cent of total EV battery cell demand will be sourced domestically, with the rest still outsourced from other countries.[80] *(see Graph 12: Lithium ion cell demand in India).*

The first round of the Advanced Chemistry Cell (ACC) PLI bidding was concluded in March 2022, and three beneficiary firms were allocated a total capacity of Thirty GWh, and the programme agreement with selected beneficiary firms were signed in July 2022. The companies are Reliance New Energy Limited, Ola Electric Mobility Private Limited and Rajesh Exports Limited. Ministry of Heavy Industries (MHI) had received bids from seven bidders under global tender for the bidding of PLI for 10 GWh ACC manufacturing with maximum budgetary outlay of Rs.3,620 crores, announced on 24th January 2024.

Secondly, the DVA targets emerged to be too ambitious, while the country was unprepared, with the absence of upstream supply chains. For example, in 2023, OEMs operating in India were cumulatively fined nearly Rs. 500 crores for

**Graph 12: Lithium ion cell demand in India**




Data complied March 2024
Source: S&P Global Mobility, Auto Techinsight

- B-segment vehicles are expected to dominate the market, while A-segment vehicles will see the next maximum growth rate.
- Currently, Tata is the top battery cell consumer for EVs in India.
- Although Suzuki has a tiny EV market share, its battery cell demand is expected to be the second largest, ~20% after Tata with ~22% in 2035.
- With the plan of launching new EVs is Indian market, Hyundai is expected to have 3rd-largest EV market share in India by 2035.

violating the DVA criteria of the FAME-II scheme. This incident revealed that upstream supply chains for key materials like graphite and copper are not fully developed in the country, causing the OEMs to falter on their localisation targets.

## Critical Minerals Policy

India has a larger strategy of securing critical minerals supplies through global partnerships. Some of the critical minerals like lithium are not available in adequate quantity locally.

Khanij Bidesh India Ltd (KABIL) a joint venture of three PSUs, formed to scout for mineral assets overseas, is likely to acquire a lithium block in Australia this year. KABIL has also signed an Exploration and Development Agreement with CAMYEN, a state-owned enterprise of Catamarca province of Argentina, for Exploration & mining of 5 Lithium Blocks in Argentina.[81] At the same time, India became a member of Minerals Security Partnership (MSP) in 2023. MSP is a partnership of 14 countries and the EU to accelerate public and private investment in responsible critical minerals supply chains globally.

This year, India's Finance Minister removed import duty from 25 critical minerals, including lithium, nickel and cobalt which are essential for the production of EV batteries. In addition to foreign mining partnerships and removal of import duty, the Ministry of Mines opened the domestic reserves for auction in March 2024. However, that auction was annulled as the ministry did not receive the minimum required number of qualified bids.

Unlike India, Africa is rich in the reserves of critical minerals like lithium, nickel and cobalt, which are the essential components of an EV battery. However, Africa

needs to resolve the ESG and supply chain challenges governing its mines. The practice of child labour, which is rampant in the Cobalt mines of Democratic Republic of Congo needs to be curtailed. There may be many such ESG challenges that may come up in Africa's EV manufacturing journey.

While presenting an opportunity as a large emerging global market, Africa is also a key source of EV raw materials. The Indian example can present opportunities for learning in governance and foreign diplomacy. To be able to adequately capitalise its resources while enriching its people, it is very important that Africa assumes the role of a strong diplomatic force on the global stage. Negotiations can turn in everyone's favour if the African negotiators insist on funds, resources and skilling from the Global North countries in exchange for their critical minerals.

This would open doors for Africa to not only emerge as a key exporter of raw materials but also to become a global manufacturing hub with skilled human resources and responsible technology transfer. A workshop conducted by the Carnegie Endowment for International Peace concluded that the balance of power between African governments and investors is changing. Increasing African bargaining power implies bargaining more collectively; African governments must understand the criticality of this context and identify and define their redlines and non-negotiables.[82]

## EV Battery Recycling

As electric mobility is set to make significant inroads into the transportation sector in Africa, it offers a rare chance to make the system sustainable from the ground up — to maximise the recovery of battery material while ensuring that heavy metals and other problematic toxins from this e-waste do not end up in a landfill and contaminate the environment. This is also an important part of building material security.

Since many African countries are in the process of introducing clear policies supporting e-mobility, future End-of-Life (EoL) battery volumes from electric vehicles are hard to predict. While volumes will stay low to moderate for the next few years, there is bound to be an increase once the electric mobility sector gains market share.

Moreover, an estimated three million used EVs may arrive in Africa by 2050 from the countries of the Global North[83]. In this context it is important to address the issue of battery circularity in Africa.

India, which is part of the Global South, is on the path of establishing a circular value chain and a battery recycling ecosystem.

In India, the handling and managing of used batteries has been regulated in India since 2001 under the Batteries (Management and Handling) Rules. A big step further was taken with the notification of the Battery Waste (Management and Handling) Rules, 2022, which addresses concerns beyond lead acid batteries to include lithium-ion batteries from electric vehicles. The Rules bring within its ambit all manufacturers, producers, collection centres, importers, re-conditioners, refurbishers, dismantlers, assemblers, dealers, recyclers, auctioneers, vehicle service centres, consumers and bulk consumers.

The Rules said producers, which include battery manufacturers, importers and automakers that produce products with batteries, "shall have the obligation of Extended Producer Responsibility (EPR) for the Battery that they introduce in the market to ensure the attainment of the recycling or refurbishing obligations".

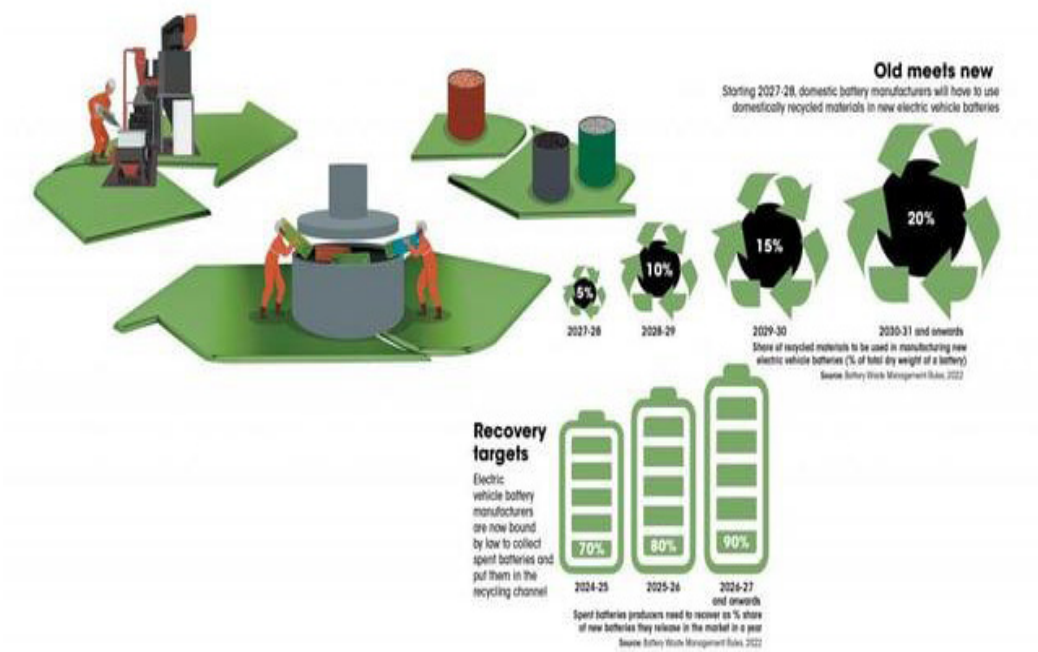
This means they will have to collect, either directly or through third-party vendors, waste batteries from the market and ensure the collected batteries reach authorised recyclers and not end up being landfilled or incinerated. Producers will also be required to file an annual record of sales and buyback with the state pollution control board (SPCB) and ensure safe collection and transportation of batteries to authorised / registered recyclers.

The Rules have for the first time defined measurable targets for collection and recycling within a compliance timeframe. They have set a target of 90 per cent recovery of the battery material — 70 per cent by 2024-25, then 80 per cent by 2026, and 90 per cent after 2026-27 onwards (see Figure 1: Recovery target according to BWMR 2022).

Producers will also have to include 5 per cent of recycled material in the total dry weight of a cell by 2027-28, expanding to 20 per cent by 2030-31. In case of imported cells, the producer has to meet the obligation by getting the same amount of recycled materials utilised by other businesses or by exporting a similar amount of materials.

To ensure compliance with the obligations as well as safe and formalised recycling of batteries that are in use, the 2022 Rules mandated that EPR registration system will be managed online on a portal by the Central Pollution Control Boards (CPCB).

**Figure 1: Recovery target according to BWMR 2022**




Source: https://www.downtoearth.org.in/energy/battery-recycling-rules-need-to-be-revamped-to-make-process-more-efficient-and-economic-92902

The portal, which is yet to be operational, will enable producers to engage a third-party or recycler to collect and process the waste and will empower recyclers to issue EPR certificates to producers based on the quantity of battery they send for recycling.

## Key strategies for circular economy

A good recycling programme and a robust battery tracking system can be leveraged to reduce the overall carbon footprint of the batteries, reduce human and environmental impact and improve sustainability. African countries should work on their lack of regulation and invest in environmentally compliant recycling mechanisms for Lead acid batteries. Many used Lead acid batteries are disposed using an open-smelting method which releases toxic emissions into the air, and have also lead to soil contamination[84].

Several methods and recycling technologies exist that need to inform the pathway for implementation in Africa. Recyclers can choose between several technology choices (variations of hydrometallurgy, pyrometallurgy and biometallurgy). The emerging recycling industry would need to address both second life of batteries and recycling of end of life batteries. Second use will require assessment of degradation, scope of other applications, dis-assembly for applications and so forth.

Second use helps to prolong the use of the existing batteries before they are recycled. This brings in more efficiency in the resource cycle. Promoting the reuse of batteries aligns with innovations in battery energy storage systems which are crucial for the penetration of renewable energy in the electricity grid. Africa has a large off-grid population and an abundance of solar energy wherein spent vehicle batteries can be repurposed and used as grid storage.

Companies like Glencore and Managem announced that they have partnered to produce cobalt at Managem's CTT Hydrometallurgical Refinery in Morrocco, using recycled cobalt, nickel, and lithium. There are also battery recycling companies in Ghana, such as ERG (Electro Recycling Ghana) which however only operate a disposal plant for electronic waste in Accra.[85] In Tanzania, Chilambo General Trade Company Ltd has started to assist in interim storage, packaging and shipment (including Basel Convention notification procedures) of Lithium ion batteries, though there are yet no local experiences for handling larger batteries resulting from electric vehicle[86]. Enviroserve is a recycling company based in Kenya and Rwanda which is developing battery recycling capabilities.

Some of the challenges that may confront the upcoming battery recycling industry in Africa are hindrances to regional movement of used batteries and possible restrictions on black mass (mix of crushed metals produced by shredding battery scrap) shipment. The recycling industry will have to deal with fluctuating material prices and introduction of new chemistries.

**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.

For the economic operation of a recycling plant, high quantities of recycled material are usually necessary, which will not be available in Africa for the foreseeable future. The re-use of old battery systems or modules for stationary storage systems will be the business case that will be implemented the easiest. In the long run, recycling will play a big part of the refining industry establishing in African countries when those nations try to reduce their reliance on foreign countries.

# 9: Takeaways

There is enormous potential and opportunity in electric mobility transition to build a clean and low carbon growth path even as Africa grows and motorises. Some of the key elements of this transition are already in place and that lays down the foundation for future development. The uniqueness of the transition addresses its local imperatives.

This review reveals the unique imperatives and patterns of transition in the Global South. The African experience has several strands in common reflecting the inventive and affordable solutions being leveraged to co-join electrification and mobility solutions in the Global South. There is enormous potential and opportunity in electric mobility transition to build a clean and low carbon growth path even as Africa grows and motorises.

**Connecting electrification with mass mobility and commercial vehicles is a unique opportunity:** The African region like India has prioritised electrification of mass mobility modes – buses and para transit vehicles and commercial vehicles – that are high mileage and can maximise clean air and decarbonisation benefits. The fiscal incentives are oriented towards reducing the cost of these vehicles. Public expenditure is not being linked with personal vehicles yet.

One of the biggest opportunities has emerged in bus electrification and more in the electrification of the bus rapid transit systems (BRT), as in Dakar. If electrification of buses and para transit – the prime movers in African cities - can be scaled up, it can provide significant emissions and carbon reduction benefits. There is also considerable learning from the electric bus programme in India that a demand aggregation model has succeeded in reducing the cost of procurement and operations significantly – pushing the prices down to a level even lower than the diesel counterparts. It is also coming up with a payment guarantee scheme that funds not only the capital cost of a bus but also the operation costs on a per kilometre basis for over a span of 12 years. Such co-learning can help to accelerate change.

**Leveraging import policy to scale up electrification:** Africa also represents a unique market that is nearly almost entirely dependent on import of vehicles as local manufacturing of new vehicles is very limited. Moreover, for internal combustion engine (ICE) vehicles, the local manufacturing base is very small and

not driven by technology forcing emissions standards as import of old and used vehicles undercuts those efforts. Newer approaches are emerging to leverage the import policy to incentivise import of fully built EVs or knocked down kits for local assembly.

**Opportunity to build industrial base around EVs:** Electric mobility has created the opportunity to develop a well designed industrial policy to build local manufacturing of EVs that can have a larger economic spinoff. Several countries have come up with deliberate policies and strategies to promote and support local manufacturing of EVs. There is significant potential and opportunity in building a value chain around the critical mineral mining in African countries and linking this with local manufacturing. This will require deliberate policies and investment strategies.

The EV revolution in Africa is being driven by start-up companies largely focussing on small vehicles with small battery formats – two-three wheelers and small commercial vehicles.

The presence of established global original equipment manufacturers is limited in this space though it is emerging.

The industrial policies as well as the established global OEMs are also aiming to leverage the new EV manufacturing base in Africa for re-export to other regions like the European Union. It is quite likely that the African region may emerge as an export hub for EVs. This is evident in the policies of South Africa and Morocco.

**Making the transition affordable:** To keep the cost of transition low, African cities are adopting several strategies to reduce the cost of ownership of EVs. This includes tax subsidy programmes for EVs. Also the market is adopting a battery swapping system to delink the cost of batteries from the cost of vehicles. Uganda and several other countries have moved in this direction for the two wheeler segment. This needs to be designed and informed well with some degree of standardisation for a scalable market. There is also a growing interest in retrofitting old ICE vehicles with electric motors and batteries to convert them to EVs. Though this is viable and cost effective, it will have to be guided by strong regulatory safeguards for ensuring safe operation and quality of conversion.

**Evolving financing strategy:** As e-mobility is taking off, it is very encouraging to see the way the finance and funding landscape is shaping up to enable this transition. Several models have emerged for financing. 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. There is a need to increase access to low-cost financing and priority sector lending mandates.

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. Asset financing companies have come forward for the small paratransit segment. Rwanda is developing an asset financing ecosystem with various microfinance organisations. The start-ups provide a range of services, including local assembly and sales, asset financing and battery-as-a-service, among others.

International funding is becoming important. Development Finance Institutions from US, Europe and Africa are beginning to invest in e-mobility, but are considered too risk averse. The African Export-Import Bank (Afreximbank) and the United Nations Economic Commission for Africa (UNECA) have signed a framework agreement for implementation of a Transboundary Battery and Electric Vehicle industry Special Economic Zone in the Democratic Republic of Congo (DRC) and Zambia. Foundations like Shell Foundation and Siemens Stiftung are using catalytic capital such as junior equity positions and grants. It is possible to 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.

There are examples of CO2 based taxation on vehicles such as in Mauritius that can be leveraged. Also Malawi has imposed carbon tax on all vehicles as part of their air quality management plan. For e-bus operations, there is need for proper guarantees for bus utilisation to help them to achieve parity on total cost of ownership and some kind of payment guarantee scheme.

**Developing EV policies and technical regulations to drive the technology:** To enable a robust programme, appropriate technical regulations and standards are needed to drive the development of EV technology and its safe operations. Several governments including Nigeria, Kenya, South Africa have begun to develop these technical standards and regulations. This needs to be informed well. It is however, important to adopt regulatory electrification targets and supply mandates at the early stages of growth to provide long term policy visibility and build confidence in the market.

**Addressing charging infrastructure and access to electricity:** Charging infrastructure development and deployment has begun with South Africa leading the process. Policies and strategies on charging infrastructure are maturing quickly in Africa to encompass wide ranging strategies. For instance the Kenya policy requires at least 5 per cent of parking spaces to have charging facilities; commercial and residential land to have battery swap stations; and building code to plan for the integration of charging infrastructure in public buildings and residential estates. This is supported by a public charging network. They have inspection, testing, and certification to guarantee compliance with safety regulations and standards. Their policy also has provisions for rent-free locations for charging stations to be provided in government owned land.

The charging infrastructure will also require standardization and interoperability of various technologies for smart operations. Also, 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.

However, there are concerns around access to adequate and reliable electricity. Several countries have the advantage of a higher share of renewable energy – primarily hydro – in their grid. A few countries like South Africa are coal rich. However, it is interesting how countries like Nigeria are becoming inventive to develop modular solar powered charging stations. This is the way forward – connecting charging with decentralised solar power generation.

Countries are also making efforts to increase access to affordable electricity. Rwanda has capped the electricity tariffs for charging stations at the industrial tariff. Tunisia has reduced customs duty rates on electric car chargers. Private investments are also flowing in. Rwanda's charging network is being set up by a petroleum company. In Egypt ten businesses and consortia have qualified to bid for the management and operation of electric car charging stations.

**Need to pay attention to recycling of spent EV batteries for material security**: CSE's review has shown that already spent batteries have begun to emerge from the on-road EV fleet in Africa. This requires early intervention to develop EV battery recycling policy and battery tracking system and setting up of appropriate infrastructure for safe disposal and recovery of material. In fact, it is noted that there are battery recycling companies in Ghana.

This is needed not only for environmental safeguards but also to build material security. The battery material can be fully reutilised to make new batteries and that is a more cost effective way of material sourcing than virgin material from mines. This can also help to build local supply chains and value chains. Moreover, a well-designed strategy can also help to guide secondary use of EV batteries that still have considerable life left for other uses and also to identify more efficiently the end-of-life batteries for recycling. This circularity is yet another area of industrial development. In any case, Africa needs to build its scrappage centres for the end-of-life ICE vehicles for material recovery. This effort needs to be conjoined with EV battery recycling systems as well.

**Build equitable EV programmes to benefit all income classes and disadvantaged communities:** E-mobility is also part of the equitable and gender friendly strategy that links up state subsidy programmes with decarbonisation of mass modes of transport reducing toxic exposure for all affordably and creates environmental benefits for all income classes. In fact, in countries like Kenya the conversation has also moved in the direction of making EVs gender friendly in design. Also how the potential to increase the customer base among women can increase access to job opportunities, productivity and strengthen supply chains by engaging women entrepreneurs. The lower income groups and women can benefit from emissions savings and increased earnings from green transport investments.[88]

**Need Africa-wide framework for alignment and harmonisation of action to accelerate electric mobility**: Inter-governmental platforms including ECOWAS and EAC and also the initiatives of the UNEP need a synergistic approach to create an integrated framework for informing the e-mobility transition.

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