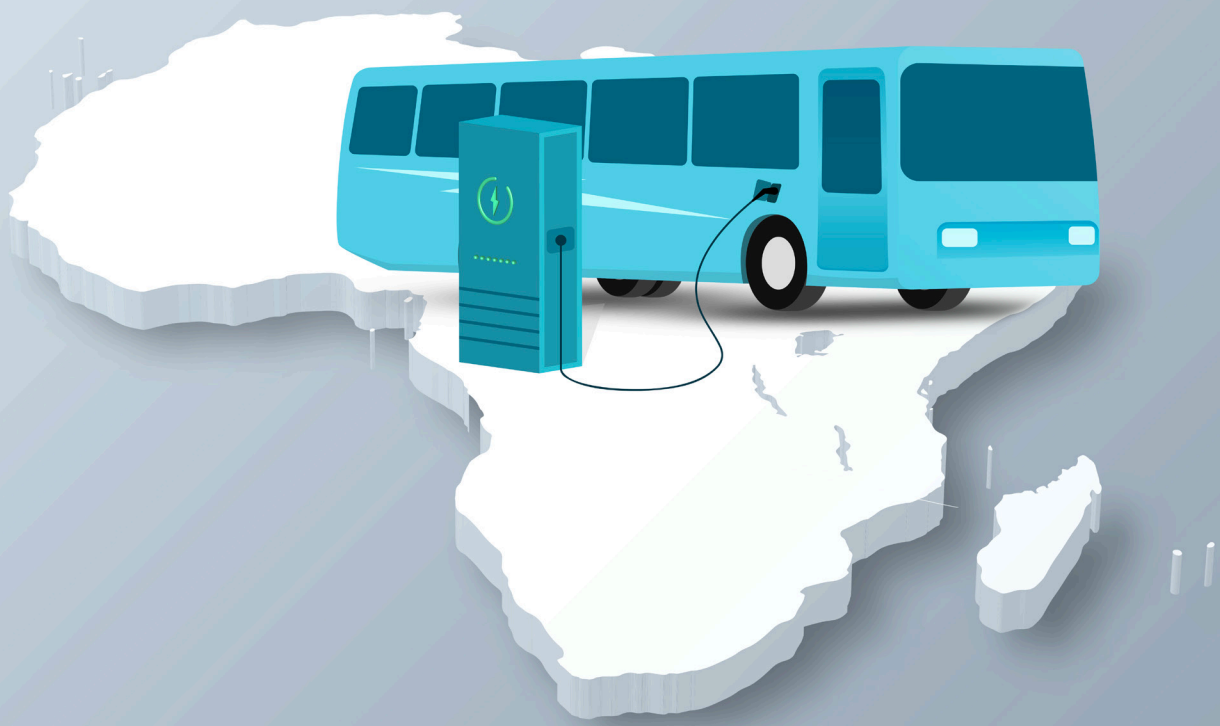

PROCUREMENT AND FINANCING OF ELECTRIC BUSES IN INDIA

Lessons for Africa

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The Centre for Science and Environment is grateful to the Swedish International Development Cooperation Agency (Sida) for their institutional support

Citation: Anumita Roy Chowdhury and Sayan Roy 2024, *Procurement and Financing of Electric Buses in India: Lessons for Africa*, Centre for Science and Environment, New Delhi

Published by
Centre for Science and Environment
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Why this spotlight?

As the Africa region is framing solutions for clean air and low carbon pathways and building momentum for action, a considerable focus is on transport and mobility solutions including electric mobility. This has triggered regulatory interest in the emerging good practices in electric mobility transition in the Global South including India.

This has emerged from the discussion in the Pan Africa Network on Clean Air Solutions that has been initiated by the Centre for Science and Environment (CSE) to bring together key regulators and stakeholders from different countries of Africa for knowledge sharing and cross learning. Since 2015, this network has catalysed Pan-Africa level exchange of ideas on emerging issues, initiatives and solutions. This network has mobilized participation from Nigeria, Ethiopia, Kenya, Uganda, Zambia, Mauritius, Zimbabwe, South Africa, Rwanda, South Sudan, Tanzania, Zanzibar, Senegal, Cote d'Ivoire, Ghana, Egypt, Mozambique, and Malawi.

To enrich this discussion and exchange, efforts are being made to document emerging good practices in different areas of interventions and issue specific deep dive to inform specific initiatives.

In view of this, one of the issues that have been selected for the action tracker series is the spotlight on the way India has upscaled its electric bus procurement and financing strategy to reduce the cost of transition and expand the production base of the country to enable this transition. The two critical aspects include demand aggregation strategy and payment guarantee scheme to support the longer term cost of operations of the electric bus operations in cities.

This is of great interest in the Africa region. Like India, countries of Africa have also prioritised electrification of the bus programme to decarbonise mass commuting. At this early stage of growth, only a few countries have begun the deployment of electric buses. But this signals a positive shift towards cleaner energy solutions in Africa cities.

Many African cities are struggling with the growing levels of air pollution, traffic congestion, and rising greenhouse gas emissions. Electrification of the bus sector is seen as one of the most effective solutions to achieve mass commuting based on zero tailpipe emissions technology of electric buses.

As African countries begin to explore the potential of electric buses, India's experience presents a comprehensive model to address high upfront costs, limited infrastructure, and inadequate technical capacity, while maximizing environmental, social, and economic benefits. India's diverse geographic and socio-economic context makes its successes and lessons particularly relevant for Africa's journey towards clean and sustainable urban transport.

By examining India's approach, Africa can accelerate its transition to electric buses, thereby achieving its goals of reducing carbon emissions, improving urban air quality, and providing efficient and sustainable public transportation for its rapidly growing population.

Electrification of public buses in India is considered a huge success, as within a short span of seven years, since the deployment of the first electric bus, India has deployed more than 8,000 electric buses. Another 30,000 electric buses are slated to be added to the fleet within the next 2 to 3 years. Seeing the transformation in public services, the Government of India is also keen to transform the private bus sector to enable massive deployment of electric buses. This is a story of continuous evolution that is addressing hurdles and barriers in the e-bus transformation journey. Robust policy response to continuous learning has helped to overcome the challenges and improve the process and deployment.

1. The Africa context

Status of electric bus deployment in Africa: Africa is still at the nascent stage in the global electric mobility landscape, with only a few countries beginning the deployment of electric buses. The countries like South Africa, Kenya, Uganda, and Ghana are leading the charge, with initial pilot programs in place. These efforts are primarily driven by a combination of government initiatives, international funding, and partnerships with private companies. Here are a quick snapshots of the emerging programmes in Africa.

Egypt: In Northern Africa, Egypt is leading the e-bus transition with around 200 e-buses plying on the Egyptian roads. Initially, 140 e-buses were deployed for the COP27 event in Sharm El Sheikh. Subsequently, those buses were redistributed to Alexandria and Cairo[1]. In addition, 100 more e-buses are being procured for the Cairo Transit Authority, plus 100 more for the Cairo Ring Road Bus Rapid Transit project[2].This programme is poised for expansion.

Ethiopia: Ethiopia has well-established e-bus services, with around 230 operational e-buses. All these e-buses are providing services to the areas surrounding Ethiopia's capital Addis-Ababa. These electric buses are assembled by a local company called "Belayneh Kindie Metal Engineering Complex", using components imported from China. In 2021, the Ethiopian government planned to deploy around 48,555 e-buses as a part of its 10-year strategic plan[3]. The overall electric vehicle programme is going to get impetus in the country after Ethiopia stopped import of petrol and diesel cars.

South Africa: South Africa is one of the most advanced in terms of overall electric vehicle programme. Its bus (e-bus) deployment is also taking off. Cape Town is working towards integrating 30 electric buses into their existing transit systems (i.e., MyCiTi bus services) by 2027[4]. Cape Town had launched its first electric MyCiTi buses in 2018[5], but this attempt was not successful. Recently, BYD has signed up to supply 120 electric buses to Golden Arrow Bus Services (GABS), a 163 year old premier bus operator, which are expected to be fully operational by December 2025[6]. Since 2021, BYD has been testing these e-buses under demanding driving conditions of Cape Town which includes undulating terrain, steep inclines and busy and overcrowded streets to understand the reliability and robustness of the electric bus technology. South Africa's push for renewable energy also makes it easier to integrate e-buses into the national grid, to enable clean energy

for charging. Apart from Cape Town, other cities including Durban, Ekurhuleni, Johannesburg and Tshwane have set their targets for electrification of the bus fleet, following South Africa's vision to reduce emission from transportation by 80 per cent by 2050 and to shift 70 per cent to low-emission options.

Kenya: In East Africa, Nairobi is at the forefront of e-mobility innovation. Recent efforts to introduce electric buses into the city's congested roads have gained traction. In 2022, the Kenyan-Swedish start up "Opibus" introduced electric buses that are now being tested in Nairobi. At the same time, another electric vehicle technology and financing company "BasiGo" came up with an innovative financing model through a unique battery financing arrangement known as "Pay-as-you-Drive". Initially, it started the operation with just two e-buses, which later on increased up to 30 e-buses and now they are planning to deploy 500 more e-buses in Nairobi. BasiGo has raised three million dollars from CFAO Group to open an e-bus assembly line to assemble and deliver 1000 e-buses in eastern African countries including Kenya and Rwanda[7]. Another e-bus maker Rome recently partnered with County Bus Services (CBS) with the aim of deploying 200 e-buses in Kenya by the end of 2026[8]. Kenya's robust renewable energy sector, especially its reliance on geothermal and hydropower — over 90 per cent of Kenya's electricity derived from renewable energy[9] - positions the country to lead in the electrification of transport.

Rwanda: Kigali, the capital of Rwanda, has positioned itself as a green mobility hub. The city has started integrating e-buses and electric motorcycles (e-motos) into its transportation network with support from both local companies and international organizations. This initiative aligns with the country's broader green economy strategy. Recently, BasiGo, the Kenyan e-bus start up, which is testing its e-bus operations in Kigali, has received a grant of 1.5 million dollars from the United States Agency for International Development (USAID), to expand the services in Rwanda[10].

Uganda: Uganda plans rapid transition towards electric vehicles. This is reflected in the vision set in Uganda's National e-Mobility Strategy. This has a bold target of fully transitioning to e-Mobility in public transport and motorcycles by 2030 and passenger vehicle sales by 2040[11]. Uganda has taken steps to support domestic manufacturing of electric buses. Kiira Motors Corporation (KMC), a state-backed company, developed the Kayoola EVS, Africa's first domestically produced electric bus. This development is significant for East Africa as it represents the potential for local manufacturing to address both mobility challenges and economic growth.

Currently, KMC is working with Tondeka Metro Bus Services (TMBS), RentCo Africa and Golden Dragon to produce and deploy around 1030 e-buses by 2035[12].

Senegal: Among west African cities, Senegalese capital Daker, commenced the first fully electric bus rapid transit system (BRT), first in Africa, on 15th of May 2024. The project is supported by the World Bank, European Investment Bank and UN Green Climate Fund. Dakar BRT is 18.3 km long and carries 300,000 passengers/day. This has a bus fleet of 144 articulated e-buses, with 560 kWh battery requiring 6-hour charging time. This has a solar generated renewable energy charging system. They have adopted a fare & revenue model in which zone-based fares have reduced fare for low-income riders by 50 per cent. The minimum revenue and passenger guarantee is set at 100,000 passengers per day. The Government provides support of USD USD17 million subsidy over15 years for reduced fares, and ensuring feeder services to build passenger volumes. They are also formalising informal transport. Private operators and cooperatives are expected to speed up fleet renewal. The private sector involvement in Dakar Mobilité has mobilized Private investment of USD 144 million.

Ghana: Accra, the capital of Ghana, is exploring electric buses as part of its efforts to modernize the city's public transport system. A pilot project for electric buses is being implemented in collaboration with the government and international partners to test the feasibility of electric mobility in the region. The government is also planning to procure 100 e-buses by the end of 2024[13].

Morocco: Morocco: In 2022, Morocco tested Mercedes e-bus "eCitaro" in Rabat. The test was part of the public private partnership (PPP) between Moroccan authority and German auto maker. In an effort to align with Morocco's 2050 low carbon strategy and to reduce carbon footprint of its road network, Marrakech Transport and Korea International Cooperation Agency (KOICA) have partnered together to implement an eco-friendly e-bus network in Marrakech[14]. As a result of these initiatives, soon the e-bus numbers on Moroccan roads will increase from 12 to 60 e-buses in next couple of years.

Apart from the above countries, Tanzania (Dar es Salam), Ivory Coast (Abidjan), Seychelles (Victoria) and others have also planned to introduce electric buses in coming years.

KEY DRIVERS OF THE ELECTRIC BUS PROGRAMME IN AFRICA

Environmental and health benefits: One of the prime reasons for African governments to turn towards electric buses is the desire to reduce air pollution and greenhouse gas emissions. Motorisation based on internal combustion engines, and import of very old and used vehicles are exacerbating the emissions. The big cities are severally impacted by traffic congestions. An estimate suggests that Uganda lost 800 million dollars per annum due to congestion15. An accelerated electric vehicle programme with a focus on electric public transport can cut harmful emissions dramatically.

Global commitment towards climate change mitigation: African countries are vulnerable to the effects of climate change, including extreme weather events. Several African countries recognise the need to adopt climate-friendly policies and set ambitious goals in their respective Nationally Determined Contributions (NDCs) under the Paris Agreement. For instance, Kenya's NDC commits to reduce the GHG emissions by 32 per cent by 203016. Electric vehicle programme including the primary focus on the electric buses offer a solution to reduce the carbon footprint of the transportation sector, which is one of the largest contributors to greenhouse gas emissions.

Opportunities to create employment: The shift towards electric vehicles including buses provides new economic and employment opportunities, particularly in terms of job creation and local manufacturing. Uganda, South Africa, Nigeria and Ethiopia are developing local supply chains and manufacturing capacities. The electric bus industry can create jobs in vehicle assembly, battery manufacturing, maintenance, and infrastructure development. For example, in Kenya, BasiGo has planned to open an assembly line for producing 1000 e-buses, which has resulted to creating 300 new green manufacturing jobs. This project will also create additional 300 jobs in the areas such as charging infrastructure, service and maintenance, and electric vehicle finance etc17.

Integration with renewable energy sources: One of the major advantages of electric buses is their potentiality to integrate with renewable energy sources. Africa is rich in renewable energy resources, including solar, wind, hydro, and geothermal power such as Kenya and Ethiopia, have the potential to power their e-bus fleets with clean, locally produced energy, reducing reliance on imported fossil fuels.

Kenya already generates over 90 per cent of its electricity from renewables, making it an ideal candidate for e-bus adoption18. By charging electric buses with renewable energy, African cities can further reduce their carbon emissions and strengthen energy security.

Reduced operational costs: While the upfront cost of electric buses is still higher than that of diesel and other ICE buses, the lower operational and maintenance costs of e-buses make them economically viable in the long run. Electric buses have fewer moving parts, resulting to less wear and tear, and subsequently reducing the need for frequent repairs. Further, e-buses are more energy-efficient, meaning that they can travel longer distances on less energy. Over time, this can lead to substantial cost savings for transport operators and governments.

Opportunity for clean and zero emissions mass commuting: The modal share of African cities reflect that the majority use public transport and walk. If this mass commuting can be shifted to electric buses with zero tailpipe emissions both clean air and climate gains can be maximised.

2. Key enablers for bus electrification in Africa

Government support and policy initiatives: Governments across Africa have started to put in place supportive policies or strategies that will accelerate the adoption of electric buses. These policies range from direct subsidies and tax incentives for electric vehicle purchases to investments in charging infrastructure and local manufacturing.

National electric mobility policies/strategies: Several countries, including Kenya, South Africa, Uganda, have already drafted and several others are developing their national e-mobility policies or strategies to provide a framework for transitioning to electric buses. These policies provide broad outlines such as reducing carbon emissions, improving air quality, and promoting green jobs to accelerate the transition towards vehicle electrification, including buses.

Fiscal and non-fiscal incentives: To make electric buses more attractive to transport operators, governments are beginning to offer fiscal and non-fiscal incentives. For instance, South Africa has provided incentives to encourage local manufacturing of e-buses, Kenya is exploring tax exemptions for electric vehicle imports, Rwanda is establishing restricted areas for green transport, preferential treatment at parking and free entry to congested zones[19].

Green energy strategies: Many African countries, such as Kenya, Rwanda, and Ethiopia, have renewable energy strategies that align well with the deployment of e-buses. By using clean energy to power their public transport systems, these countries can further reduce their carbon footprint. For instance, Kenya's National Energy Efficiency and Conservation Strategy 2020 envisions that by 2025, 5 per cent of all registered vehicles in Kenya will be electric powered[20].

Public-Private Partnerships (PPPs): Public-private partnerships (PPPs) are emerging as a key framework and instrument for financing and scaling the electric bus sector in Africa. Governments are partnering with private firms to leverage technical expertise and investment capital while ensuring that electric buses are commercially viable.

Collaborations with private firms: Electric bus manufacturers, energy

companies, and local transport operators are increasingly collaborating on e-bus projects. For instance, Kenya's BasiGo has partnered with matatu operators to provide affordable electric buses on a pay-as-you-drive basis, reducing the financial burden of purchasing buses upfront[21].

International Investment: International organizations including the World Bank, the African Development Bank (AfDB), British International Investment among others are providing financial and technical support for electric bus initiatives. This includes offering low-interest loans, grants, and technical assistance to help African cities transition to cleaner public transport. For instance, the World Bank is providing assistance to Egypt to deploy 100 e-buses in Greater Cairo Area[22],

Local manufacturing and innovative business models: Local manufacturing is becoming an important part of Africa's electric bus transformation. Several countries are focusing on developing the local capacity to produce electric buses, which could help bring down costs and create jobs. Uganda's Kiira Motors Corporation is leading the charge in local manufacturing with its Kayoola EVS buses. These electric buses are designed and built in Uganda, showcasing the potential for African countries to become e-bus manufacturing hubs. Kiira's buses are also an example of homegrown innovation, with the company aiming to scale up production to meet both local and regional demand.

Leasing Models: To address the high upfront costs of electric buses, companies are introducing leasing models. For example, BasiGo in Kenya allows transport operators to lease e-buses rather than buy them outright, making the transition more financially feasible[23].

Charging infrastructure development: The successful deployment of electric buses requires the development of charging infrastructure, and African cities are beginning to invest in this critical element. However, the rollout of charging stations is still limited, and significant investment is needed to scale up.

Depot-based charging: In cities like Nairobi and Kampala, depot-based charging stations are being built to service electric bus fleets. These stations allow buses to charge overnight, ensuring they are ready for operation during peak hours.

Solar-powered charging: To reduce dependence on unreliable electricity grids and promote clean energy use, some cities are looking into solar-powered charging stations. In countries with abundant sunlight, such as Kenya, Uganda, and Rwanda, this offers a sustainable way to charge electric bus fleets while lowering the overall carbon footprint.

3. Challenges facing by Africa's e-bus programme

Despite the potential and opportunities, African countries are facing several challenges in implementing e-bus programmes across the continent.

High initial cost of e-buses: One of the biggest barriers to electric bus adoption in Africa is the high upfront cost of the vehicles and charging infrastructure. Many African cities lack the financial resources needed to invest in electric bus fleets without external support. Governments must explore innovative financing models, such as public-private partnerships (PPPs) and international climate funding, and demand aggregation models to overcome these barriers.

Energy access and grid reliability: Although some African countries have access to clean, renewable energy, many others struggle with unreliable electricity grids. Frequent power outages can disrupt the operation of electric buses, making them less practical in cities with poor energy access. To address this, countries must focus on improving the reliability of their electricity grids and exploring decentralized energy solutions, such as solar-powered charging stations.

Limited charging infrastructure: The lack of adequate charging infrastructure is another challenge that limits the expansion of electric buses in Africa. In many cities, there are few, if any, electric vehicle (EV) charging stations. This challenge is particularly significant for electric buses, which require specialized high-capacity chargers. African governments need to invest in charging infrastructure alongside vehicle procurement to ensure the successful deployment of e-buses.

Technical knowledge and upskilling the existing workforce: The shift to electric buses requires a skilled workforce capable of maintaining and operating electric vehicles and their associated infrastructure. African cities will need to invest in training programs for drivers, mechanics, and technicians to ensure the successful operation of e-bus fleets. Capacity building is essential to the long-term sustainability of e-bus programmes.

Policy and regulatory frameworks: While some African countries have made progress in drafting e-mobility policies or strategies, many still lack comprehensive frameworks that support the adoption of electric buses. Clear and supportive

policies, including incentives for operators and manufacturers, are essential to encourage investment in electric bus technology. Governments must develop regulations for charging infrastructure, battery disposal, and vehicle safety standards.

4. India's e-bus programme — the learning curve

As African countries are developing their respective e-bus deployment programmes, it will be beneficial to tap the lessons from the other parts of the Global South. India's e-bus journey is a valuable learning curve. This began as a response to the growing need for greener public transport alternatives, driven by a combination of national climate commitments to reduce carbon emissions and public health concerns emerging from chronic air pollution concerns. Recognizing the pivotal role that the transportation sector plays in both energy consumption and emissions, India has steadily moved towards electrifying its public transport fleet, with electric buses being a core component of this transition.

Initiation through policy action

Since the beginning of India's electric mobility programme, buses have been considered as one the key sub-segment for electrification. As it provides a unique opportunity to decarbonize a sizable share of daily travel trips in cities and reduce toxic exposures.

In 2015, the scheme called Faster Adoption and Manufacturing of Electric Vehicles (FAME) was introduced. The FAME stage -1 was introduced by the central government to push electrification by providing purchase or demand incentives. This was further modified as FAME 2 in 2019 with a modified scope. These schemes have provided demand incentives for different segments of vehicles including two/three wheelers, commercial vehicles, and buses. This segment focuses on the bus segment and some of the learnings related to bus procurement bus cost management strategies.

E-bus procurement model — evolves in stages

As the electric bus technology was new and cities lacked experience in operating them, the scheme concentrated on supporting the public transit authorities (Government operated State Transport Undertaking — STU or Special Purpose vehicles — SPV) to build e-bus fleet.

The scheme provided the flexibility to the STUs to choose their own modus operandi to introduce the electric buses during the stage one of FAME. The scheme offered an incentive amount up to 60 per cent of total purchase cost or 0.85 to 1

crore, whichever is higher, depending upon their localization factor from 15 to 35 per cent. It also provided a 10 per cent additional subsidy on installing charging infrastructure for the buses.

Around 425 electric buses were introduced under FAME-1 funding in nine big cities of India, including Mumbai, Kolkata, Hyderabad etc. As the majority of these cities used to operate buses (earlier diesel buses) on their own, seven out of nine cities procured the electric buses under the out-right purchase model — they purchased the buses directly from the manufacturers.

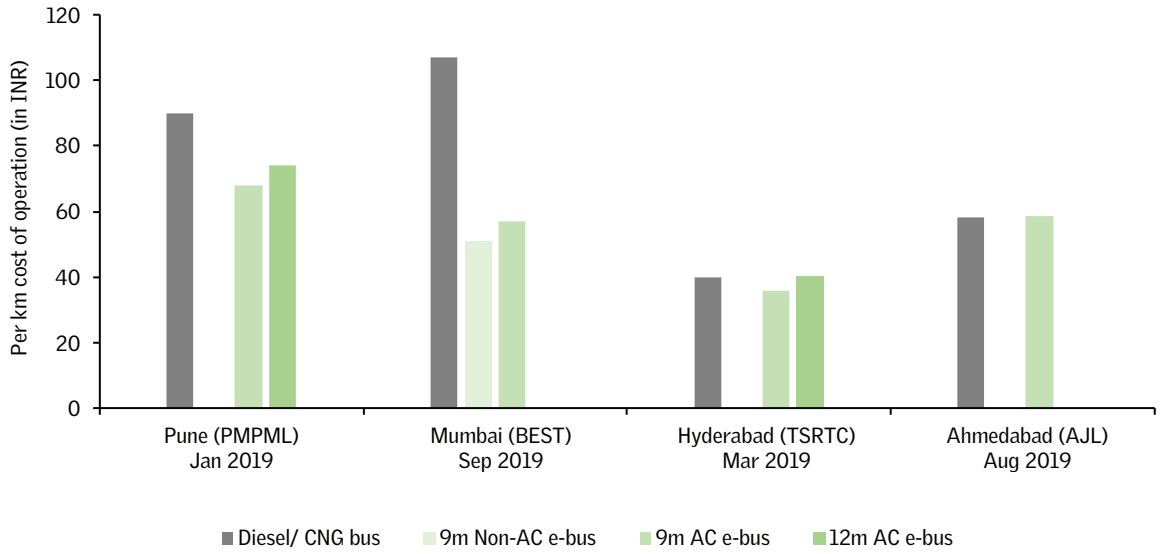
However, cities like Hyderabad chose to go with a gross cost contractual (GCC) model of operation, Mumbai that had procured the initial few electric buses under out-right purchase model, moved to GCC model for the subsequent batches of buses. A "gross cost contract" is an agreement between a public transport authority and a bus operator where the authority pays the operator a fixed amount per kilometer to operate bus services, while retaining ownership of all fare revenue collected by the operator. The authority takes the financial risk of passenger numbers, while the operator is responsible for providing the service at a set cost.

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, soon public transit authorities started experiencing several challenges related to operating e-buses under the out-right model. This was due to their inexperienced staff, and immature technology that led to poorer performance than the targets committed by manufacturers, limited or poor supply of spare parts etc. This affected the e-bus operations and service quality.

However, cities with GCC models were performing much better and cost of operation was also quite comparable with internal combustion engine (ICE) buses and in some cases, even lower. (see *Graph 1: Cost comparison between ICE and Electric bus under GCC*).

It is important to highlight that, generally in the case of diesel or compressed natural gas (CNG) buses, bus operators used to join as private partners to operate buses under GCC. But in the case of electric buses the original equipment manufacturers (OEMs) were given the additional responsibility of operating the buses as well. This is largely because the STUs were not equipped to address e-technology maintenance and technology performance.

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



Source: Multiple sources, complied by CSE

Uncertainty around the technology, confusion around the selection of the business model for operations, and costs, made a few cities like Bengaluru and Delhi to scrap the deal even after going through several rounds of procurement process. They were apprehensive that any wrong decision would lead to lock-in for 10–12 years.

Change in strategy - concentrated and targeted approach

The lessons from the stage one of FAME, helped the policymakers to formulate the second phase of FAME, or FAME-2. in a much better and effective way. The FAME-2 commenced on April 1, 2019, with much more concentrated push and targets towards electrification.

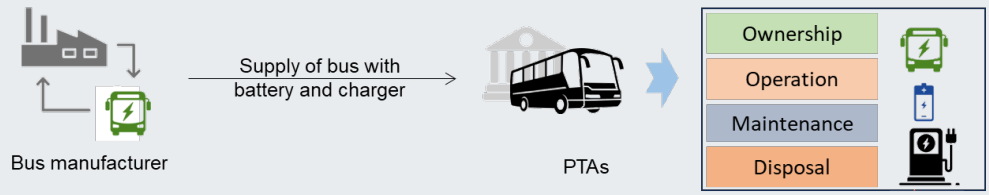
To achieve economies of scale, coverage of the FAME-2 incentives was extended to 40 cities with planned deployment of 7,000 e-buses, almost 8 times more than the FAME-1 scheme.

This time the GCC model was made mandatory for all the public transit authorities to avail the FAME-2 subsidy for procurement of e-buses. The subsidy amounted to 40 per cent of the cost of a bus. For standard size buses — INR 55 lakhs (5.5 million); midi bus — INR 45 lakhs (4.5 million); mini bus — 35 lakhs (3.5 million),

GLIMPSE OF EXISTING ELECTRIC BUS OPERATION MODELS IN INDIA[24]

Out-right purchase model

In this model, manufacturer supplies electric bus along with battery and chargers to public transit authorities (PTAs). PTA directly own, operate and maintain 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.

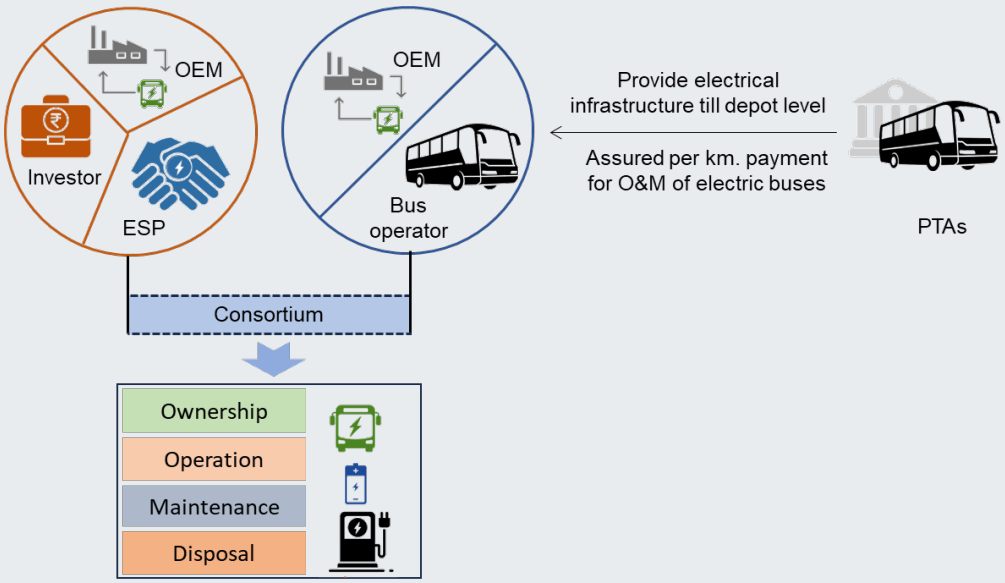


Due to lack of knowledge about electric bus operations PTAs are facing lot of difficulties including battery failure, range issues, issues with availability of spare parts etc., while operating electric buses under this model.

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

Gross cost contract model

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



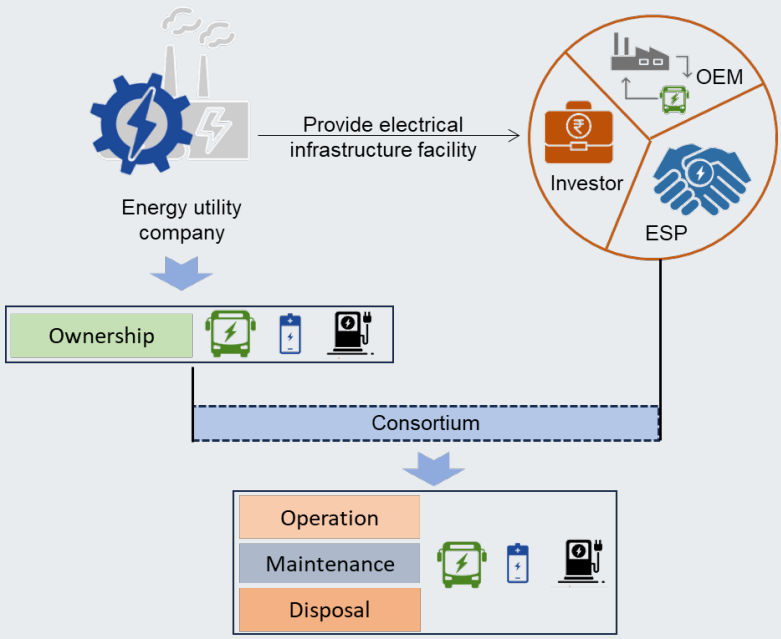
GCC model is mandatory to get purchase incentive under FAME 2 scheme. Even recent CESL procurements under national electric bus programme has also floated two tenders in GCC model.

Pune, Ahmedabad, Navi Mumbai, Mumbai among others are presently operating electric buses in GCC.

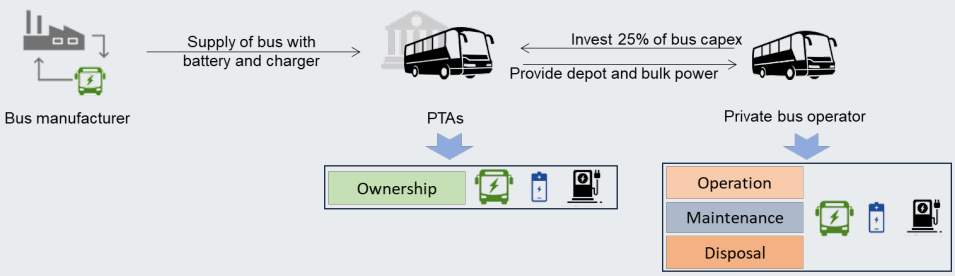
Other than out-right and GCC model, Indian cities have also explored two additional models to operate electric buses.

Utility provider led model:
Here, energy utility company is the key stakeholder owns the assets including electric bus along with battery and chargers and create 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 plying in this model of agreement. In NCC, both PTA and private bus operator invest (i.e., 75:25 ratio) in procuring buses along with battery and chargers. In exchange all the responsibility of operating and maintaining buses is vested on private bus operator. They also bear all the revenue risk. To support private bus operator, PTA provide depot and bulk power for operation.

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

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

This time, in addition to operation and maintenance of electric buses, the GCC partners (who were largely the OEMs) were given additional responsibilities of creating necessary electrical infrastructure (below the meter) including charging points and related matters. However, public transit authorities 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.

In the meantime, the central government has taken further 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.

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

Graph 2: 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

Mandating GCC helped in terms of reducing the operational risk and the total cost of ownership. However, during the procurement stage, city authorities realised that even after following a similar procurement model, cost of buses (e.g., similar type of 12m or 9m buses), varied widely and there was considerable price disparity and significant variation in tender rate. The lowest quotes were in the range of ffl 15 to 30 per cent, with higher variation observed in the 12-meter bus category. Some cities even received bids of INR 80 to 85 per km — much higher than operating diesel/ CNG buses. This raised the question about scaling up the services of e-buses.

However, it was further noticed that in the case of combined bids with large contracts, cities received much better prices. For example, 11 cities in the state of Uttar Pradesh had gone for a combined bid of close to 800 electric buses, which helped to achieve better prices for all 11 cities, irrespective of their bus numbers. As a result, operating 25 electric buses in the town of Jhansi in that state costs around INR 62.55 ?? - unit, whereas operating a similar number of buses in Patna city in another state required INR 79.83 (??).

However, the public transit authorities with a large human power base in terms of drivers, conductors and other maintenance staff are not keen to engage private partners under the GCC model, as this would impact their own human resource and systems negatively. Thus, many of them distanced themselves from taking subsidies under FAME 2.

Eventually, the GCC model has prevailed for most as this helps to de-risk against the uncertainties around the new technology and the associated operational challenges.

Aggregating demand to provide scale and reduce costs

However, even after two years of commencement of the FAME 2 programme and funding, not more than 3500 electric buses were introduced. In view of this slow progress, the FAME-2 scheme was further amended in June 2021, and the demand aggregation concept was introduced to reduce the cost of operation. The idea was to aggregate the demand for e-buses for which the incentives were provided to build scale and do joint bidding to reduce the costs.

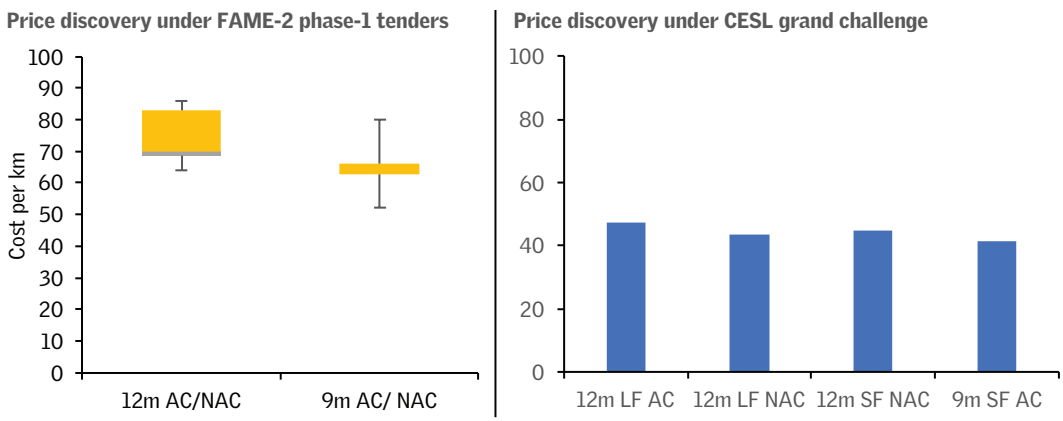
The primary objective of the demand aggregation model was to aggregate the electric bus demand from various cities with a common framework of bus operation. And procure all the e-buses together through a single consolidated bulk procurement tender. This bulk procurement strategy needs to provide the desired scale and margin to play with. This is meant to reduce the cost of operation for

e-buses. The idea for bulk procurement came from an earlier practice of procuring diesel buses in bulk for states by Association of State Road Transport Undertaking (ASRTU) - an apex coordinating body working under the aegis of Ministry of Road Transport & Highways Govt of India — which had previously resulted in more competitive pricing of buses.

To enable this the Central Government created an entity named Convergence Energy Solution Limited (CESL), which is 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. This body was given the mandate 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 can help in providing the scale it requires. This can also help to develop an adequate eco-system for electric buses.

To roll out this demand aggregation programme 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 3: Comparative price discovery with and without demand aggregation*).

Graph 3: Comparative price discovery with and with demand aggregation



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

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).

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, it was still far below that of diesel and CNG bus operations.

It is helpful to note that wet-lease and dry lease tenders are two different forms of GCC tender model. Under wet-lease tender, a private partner/ OEM is responsible for providing buses with drivers. In dry-lease private partners the private partner/ OEM provides only buses and not drivers. In both cases, all other conditions of GCC are similar.

The demand aggregation model, helps to reduce the price of operation even less than the internal combustion engine (ICE) technology powered buses, yet such a large deployment of electric buses and associated charging infrastructure require huge capital investment from the bidders' side.

This created another challenge. When the bidders or OEMs were fully booked to deliver orders there was an additional problem of lack of timely payments from the cities. The cities started showing disinterest in taking on 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 size cities including the hilly cities, could not participate and deploy electric buses under this programme.

The next stage - Payment guarantee scheme for e-bus procurement

To address the challenges faced by India's e-bus sector, another e-bus scheme called PM e-bus sewa scheme was launched in August 2023 to deploy 10,000 electric buses in around 169 small and medium size cities in India. Cities with 4 million plus population did not qualify for this scheme.

As this scheme is meant for the smaller towns, the scheme relaxed the procurement criteria considerably. These criteria include minimum number of bus orders, and minimum number of assured km to be fulfilled by smaller and medium size cities. According to this new PM e-bus sewa scheme minimum order for less than 5 lakh (0.5 million) population cities is 50; for cities with 5 to 20 lakhs (0.5-2.0 million) population it is 100; and for cities with 20 to 40 lakh (2.0-4.0 million) population, it is 150 buses. Minimum assured km for 7meter (m) buses is 160km, 9m buses are 180km and 12m buses are 200 km.

This scheme has taken further steps to address long term sustainability of electric bus operations. This scheme now provides for continuous support (i.e., operational viability gap funding) for the entire project duration and to ensure payment guarantee to the bus service providers (i.e., OEMs).

Recovery ratio of urban bus operations in India is around 50 per cent, which makes sustained operations over time financially challenging for the transit authorities. This requires huge cash flow. Thus, continuous support in the form of operational viability gap funding (on a per km basis) allows transit authorities to bridge the gap in operating costs.

Additionally, payment security mechanism (PSM), ensures timely payment to the bus operators, who are otherwise cash trapped in this business that requires high intensity cash flow for smooth operations of buses and also to service the debts. It is important to note that bus operation in India is mostly financed through commercial debts which are often backed by the corporate guarantees of the parent company. Thus, timely servicing of debts becomes critical. Otherwise, as per the existing resource backed lending (RBL) structure — in case of default, the lender is allowed to pursue additional assets beyond project collaterals or pursue the corporate guarantees of the parent company. This further limits the operator's capacity for taking up new projects. Ensuring timely payment will help in building positive market sentiment and encourage wider participation of operators in the bidding process.

Under this PSM mechanism, the central government has created a dedicated payment security fund or capital reserve that provides interest free working capital to beneficiaries in case of a default event. If the Authority defaults on fixed payment, the operator can raise a call along with a deemed invoice and other required documents to the PSM cell. Once this call is generated by the operator, an alert message will be sent to respective authorities (both public transit authority and state department). In case, authorities want to raise any issue related to payment

then they have to inform the PSM cell about it within a couple of days of receiving the message received.

Otherwise, the PSM cell will evaluate the documents and release the payments from the PSM fund to escrow for the operator's payment. Once the payment is released from the PSM fund, the transit authority or state will get a stipulated time (i.e., 90 days) to refund the payment amount back to the PSM fund (beyond 14 days authority has to refund the amount with interest). Failing to refund the amount to the PSM fund, the PSM cell will request apex body to initiate a direct debit mandate (in which the state, the private partner (operator) and Government of India will have a legal binding through which the state will be liable to make the payments in a timely manner or else money shall be deducted by Reserve Bank of India (RBI), so that similar amount shall be deducted by RBI from states current account. This innovation is an encouragement and also builds confidence for the e-bus operators to participate in the e-bus programme more effectively.

In summary, India's electric bus journey is a compelling example of how a nation can leverage technology, policy, and collaboration to transform its public transportation system. As India continues to evolve its e-bus programme, it provides a learning curve to other countries, including those in Africa to develop a viable business model and a procurement strategy.

5. Lessons for Africa

Africa can draw several key lessons from India's e-bus procurement and financing program as it looks to develop its own strategies. Here are some key takeaways.

Continuous support, policy initiatives and evolving strategies: Most of India's e-bus development has been driven by constant government support. It has evolved through the successive stages since the launch of the stage one FAME scheme during 2017-19, followed by the FAME 2 during 2019-2023. This has been succeeded by the ongoing PM e-bus sewa scheme for less than 4 million cities for the period 2023-25 and the PM e-drive scheme for more than 4 million cities for the period 2024-26. All these schemes have succeeded each other in a continuum and together these are planned to support deployment of around 32,000 e-buses in India by 2026.

Innovative models and demand aggregation: The programme has been innovated continuously to improve the bus procurement, bus operations and cost management. Diverse strategies have been adopted over time. India has experimented with various financial models, including wet leasing of e-buses instead of outright purchase to reduce upfront costs. This allows public transport operators to spread out the financial burden over time. In addition, aggregation of demand of several cities together while tendering has reduced the e-bus cost by more than 20 per cent even without subsidy. This has reduced the differential with ICE buses. For the most recent schemes, payment guarantee scheme has been adopted that enables support for long term financing of bus operations.

Leveraging public private partnership: India's e-bus program has leveraged public-private partnerships to ensure long-term sustainability of projects and large scale deployment of buses in cities. Since the FAME-2 scheme, the gross cost contract has become mandatory to receive any financial assistance from the central government. As a result, several state transport agencies have partnered with private companies for initial capital financing, technology transfer, and operational expertise.

Localized manufacturing and supply chains have enabled the transition: India's push for local manufacturing of electric buses and components has helped to reduce costs and ensure a stable supply chain for maintenance and parts. Now all the tenders for e-buses are compiled according to the Ministry of commerce and

Industry order no P-45021/2/2017-PP(BE-II) dated 4th Jun 2017. This provides more weightage to class 1 local suppliers who provide equal to or more than 50 per cent of the local content.

Developing charging infrastructure: India has focused on building bus charging infrastructure alongside the deployment of e-buses. Cities have set up dedicated bus depots with overnight charging facilities, as well as exploring opportunities for fast-charging stations. Each scheme has separately allocated funds for developing charging ecosystems including highway charging. And for city buses, subsidy is available on total cost of e-bus operations and for the entire project period operations, including the cost of installation and maintenance of charging infrastructure.

Ensuring grid reliability: Ensuring a reliable electricity supply for charging has been crucial to India's e-bus success. Cities are connecting their e-bus depots with high-capacity dedicated power lines to ensure lower power outage and unstable supply. Some cities have explored renewable energy sources such as solar power to mitigate the pressure on the national grid and reduce the carbon footprint.

Upscaling from pilot programs: Initially, India began its e-bus programme with small-scale pilot deployment to test the feasibility of electric buses and then they gradually scaled it up after successful trials. Cities like Mumbai, Bengaluru and Delhi started with a few dozen buses and expanded as they learned from their experiences.

Capacity building and training: The bus providers have invested in training for drivers, maintenance staff, and city planners to ensure the smooth operation of e-buses and their infrastructure.

Africa can take advantage of India's e-bus experience by adopting a comprehensive and tailored approach to its unique challenges, including financial constraints, energy infrastructure, and urbanization rates. By focusing on a blend of supportive government policy, public-private partnerships, infrastructure development, African nations can expand their e-bus journey from mere pilots to mainstream e-buses in their urban transport systems.

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