ELECTRIC VEHICLE ADOPTION IN NIGERIA: A COMPREHENSIVE REVIEW OF TECHNOLOGICAL, ECONOMIC, AND POLICY TRENDS

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ABSTRACT

Electric vehicle (EV) adoption is increasingly being recognized as a critical pathway for reducing greenhouse gas emissions, improving urban air quality, and enhancing energy security. While global EV rollout has accelerated rapidly in the last one decade, adoption in Nigeria remains incipient and underexplored in scholarly literature. This study presents a comprehensive integrative review of electric vehicle adoption in Nigeria, synthesizing evidence from peer-reviewed literature, policy documents, industry reports, and international databases published between 2010 and 2025, with emphasis on technological, economic, and policy dimensions influencing adoption. The review examines the suitability of different EV powertrain technologies under Nigerian operating conditions. It evaluates battery and charging infrastructure readiness, assesses economic feasibility through cost and market perspectives, and analyzes the evolving policy and regulatory environment through comparative international insights. Findings indicate that hybrid and plug-in hybrid vehicles may provide practical transitional channels under present Nigerian conditions, while large-scale battery electric vehicle deployment remains constrained by grid reliability, charging infrastructure gaps, and high upfront costs. The review further finds that long-term EV economic viability is strengthened in fleet and urban mobility applications, while weak policy coordination, limited incentives, and regulatory fragmentation remain major institutional barriers. The study concludes that scaling EV adoption in Nigeria will require an integrated, research-informed strategy combining infrastructure investment, fiscal incentives, localized industrial development, coherent and implementable governance reform. These findings provide actionable guidance for policymakers, investors, and industry stakeholders seeking to advance sustainable mobility in Nigeria.

Keywords: Electric Vehicles (EVs); Techno-economic assessment; Policy framework; Sustainable mobility; Infrastructure readiness.

1. | Introduction

Electric vehicles (EVs) have become a major movement in the world over the past few years, due to improved battery technologies, ecological issues, and favorable policies by the governments (BloombergNEF, 2025). The International Energy Agency (IEA, 2023) estimated that in 2022, about 10 percent of cars sold in the world were EVs, which is a significant improvement over the numbers of the past years. The shift becomes relevant to developing countries in which EV adoption opens opportunities to solve such urgent problems as urban air pollution, energy security and economic growth (Sierzchula *et al.*, 2014).

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Governments across the globe have adopted policies that encourage the adoption of EVs. According to the reports of the IEA, Global EV Outlook 2023, several support policies on electric vehicles have been established in major markets, contributing to the massive proliferation of electric car models. The sales of electric cars in the world amounted to almost 14 million in 2023, an increase of 35 percent as compared to the year before. This adoption explosion is specifically high in specific countries such as China, Europe, and United States which in total contributed to around 95 percent of EV sales in the world in 2023 (IEA, 2023).

The move towards electric mobility presents a noble opportunity for developing countries. EVs are cheaper to maintain and operate than traditional vehicles with internal combustion engines ICEs. The World Bank (2022) points out that a saving in maintenance costs is enough to save an EV user 5,000 dollars in the lifetime of the car, which surpasses the increased expense of using electricity as fuel. Moreover, gasoline taxation and subsidization of electricity are used in many low- and middle-income nations, which further increases the financial feasibility of EVs.

On the environmental side, EVs can help mitigate the emission of greenhouse gases and air pollution that influence the enhanced health of the population and climate resilience. World Economic Forum (2022) opined that the transition from traditional form of transport to electric vehicles is likely to enhance the air quality in the localities and provide an additional layer of energy security to those countries that are prone to unstable gas and oil prices.

The EV industry has potential employment prospects and economic development socially. The creation of local EV manufacturing and assembly plants has the advantage of creating jobs in the whole value chain, which includes sourcing raw materials to the manufacture of the vehicles. Notably, evolution into a new EV supply chain can build local industries and enhance the chances of competitiveness in the global market (ILO, 2024). Nevertheless, the way of mass EVs adoption in developing countries is full of difficulties. They are high initial outlays, insufficient charging systems, and the ignorance of the population (Gupta, & Rhoads, 2022; Shamsuddoha, and Nasir, 2025). The only solution to overcome such barriers is to engage governments, private sectors and international organization in overcoming these barriers by establishing an enabling environment to adopt EVs.

Nigeria, being the most populous country in the African continent, has critical transportation challenges. Petroleum based transport fuels is a significant contributor to greenhouse gas emission and air pollution. Oluwakoya (2024) suggests that the transportation sector being a significant source of carbon emission in Nigeria, exacerbates the country's environmental challenges. The situation is further complicated by rapid urbanization. The cities of Lagos, Abuja and Port Harcourt are enjoying unprecedented growth which has been resulting in the high demand of transportation services. This growth in urban areas usually exceeds the growth of infrastructure, and thus leads to traffic jams, poor transport network, and a short supply of energy. Inefficient and unsustainable transport services in cities add to the environmental impairment and poor living conditions of people (Oxford Business Group, 2019; ISS, 2023; Reuters, 2024; The Guardian Nigeria, 2025).

Transportation has significant effects on the environment of Nigeria, causing poor air quality and related health issues due to the release of pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, which is caused by the burning of fossil fuels. According to the World Health Organization (2024), air pollution exposure is associated with respiratory and cardiovascular diseases, which are common in urban centres in Nigeria.

Besides, economic impacts of the existing transportation system are high. Nigeria has been suffering a blow to its foreign exchange reserves due to high price of imported fuel and this has contributed to the unpredictability of the fuel prices (Nairametrics, 2024). In 2023, there was a sudden rise in transport prices with the disappearance of fuel subsidies, which impacted the lifestyles of most Nigerians, particularly those in the informal sector who operate within the boundaries of the affordable means of transport (Business Post Nigeria, 2023). Sequel to this, the Nigerian government had undertaken a number of policies aimed at promoting EV adoption and to ensure sustainable transportation, having realized the potentials of EVs to change its mobility landscape. Such efforts involve encouraging the use of compressed natural gas (CNG) cars and the creation of electric vehicles infrastructure (Associated Press, 2024). Tax incentives, the reduction of import duty, and the support of local production with the aim of popularizing EVs are other policies that have been introduced (Energy Transition Office Nigeria & RMI, 2024). Nonetheless, these policies are frequently not effective due to the loopholes in their implementation, the lack of infrastructure, and the inadequate of publicity (Farinloye *et al.,* 2024). These problems need to be tackled in a holistic way, by incorporating technological, economical, and policy factors to design a sustainable and inclusive transport system in Nigeria.

One of the research gaps identified in literature is the absence of combined studies relating techno-economic examination and the policy analysis within the Nigerian context. Although the current literature has examined the different factors behind EV adoption in Nigeria, e.g., infrastructure preparedness (Obele, 2025) and consumer attitudes (Ajao *et al.,* 2024), few studies have conducted extensive analyses that consider technological, economic, and policy factors.

This review, thus aimed at providing an all-inclusive assessment of the technological readiness, economic viability, and policy framework for EV adoption in Nigeria. Explicitly, it seeks to examine technological limitations and prospects, assess the cost benefit dynamics of EV ownership, analyze existing and potential policy measures, and identify the critical research gaps and strategic interventions needed to advance EVs adoption in Nigeria.

2. | Literature Review

The global shift to low-carbon mobility has hardened the study into the adoption of electric-vehicle (EV) especially in the emerging economies whose infrastructural, policy, and economic realities are a stark contrast to the developed ones. The study of EVs in Nigeria between 2010 and 2025 has been conducted in relation to the interaction of technology feasibility, economic viability, the existence of infrastructure, and institutional capacity. The overall results of these articles indicate the tendency of interconnected issues, which should be resolved in order to make EV scale-up a success.

According to a number of techno-economic studies, the price competitiveness of EVs in Nigeria is very vulnerable to electricity charges, import regulations and battery prices. Osedeme *et al.,* (2024) established that EV stability in the grid electricity and reduction of importation duties on EV components is the key to parity with internal combustion vehicles. Likewise, Aba, *et al.,* (2024) used system-dynamics to demonstrate that short-term incentives including tax rebates and duty waivers bring only significant changes in the adoption cases unless long-term infrastructural and policy support. Dioha *et al.,* (2022) reported that integrating EVs into Nigeria's power grid through vehicle-to-grid (V2G) systems can provide benefits such as load balancing and energy storage, yet these benefits require deliberate investments in renewable energy and charging infrastructure. The techno economic and environmental analysis of EVs and ICEVs conducted by Adebayo *et al.,* (2025) in Nigeria indicated that EVs will have lower lifecycle emissions and lower operating expenses by 28-41% as compared to ICEVs, even though their upfront costs are higher in Nigeria. Nonetheless, the adoption is limited by the inadequate reliability of electricity, insufficient charging infrastructure, and high cost capitals. Phased policy incentives, grid readiness, battery and charging system investment are suggestions put forward by the authors as the way to unlock the EV potential of Nigeria.

Parallel research underscores that Nigeria's readiness for EV deployment is shaped not only by economics but also by industrial and infrastructural capacity. Agunbiade and Siyan (2020) investigated new opportunities of EVs in the Nigerian automobile sector. Relying on secondary data, the research identified opportunities in terms of lower emissions and lower maintenance costs. It emphasized inhibitory factors as epileptic electricity supply, absence of charging stations and reliance on imported technologies. Proper policy guidance, research and development, and infrastructural preparation to make Nigeria EV ready were proposed.

According to Sambo and Garba (2023), the lack of charging infrastructure and insufficient technical education is a recurrent issue with EV adoption in Nigeria. Blended financing modalities and collaborations between the government and businesses were suggested by Team EVAfrica (2025) to encourage an initial deployment of infrastructure. These works collectively underscore that a functioning EV market compels coordinated development of grid reliability, charging networks, and human capital.

Policy design and consumer behaviour studies provide further insight into the social and institutional dynamics influencing EV adoption. The research in policy design and consumer behaviour provides light on the social and institutional processes that impact the adoption of EVs. Ajao *et al.,* (2024) consider variables such as trust, performance expectancy, social influence, and network externalities to find out the prominent factors that influence the disposition of Nigerian consumers towards electric vehicles adoption. The article has found that Nigerian consumers focus more on affordability, access to charging points, and ease of maintenance than on the environment, implying that incentive programs and financing would be more effective than awareness programs.

Farinloye *et al.,* (2024) conducted interviews with experts aimed at investigating the problems and opportunities of the adoption of electric vehicles in Nigeria, focusing on infrastructure, affordability, energy access, policy assistance, renewable integration, and localized last-mile solutions to sustainable transport development.

To supplement this, the Rocky Mountain Institute (2024) proposed a phased national strategy involving pilot EV fleets, targeted fiscal incentives, and the establishment of strategic charging corridors to be situated along major highways. Conversely, Okhirebhu *et al.,* (2025) found that lack of policy consistency and institutional fragmentation have been a major factor that has eroded investor confidence hence slowing the growth of the EV market. This poor policy coherence has seen uncertainty in the fiscal incentives, restricted the involvement of the private sector, and no national strategy on EV deployment.

Though the above discussion has concentrated on Nigeria, it is educative to put such findings in the global context. The developed and developing economies have provided comparative studies on the characteristics of technology diffusion, policy efficiency, infrastructure implementation and consumer behaviour, which are applicable to emerging market in Nigeria. Examining global concepts highlights both universal determinants of EV adoption, such as cost affordability, charging infrastructure, and policy incentives, and context-specific strategies that have successfully accelerated uptake in other regions. Consolidating these international perspectives allows for an all-inclusive understanding of the factors shaping EV adoption and offers adoptable lessons for Nigeria's transition toward low-carbon transport.

Nigerian findings are strengthened and supported by global studies. A systematic review conducted by Zaino *et al.,* (2024) reveals that technological innovation, policy design and organizational readiness are key factors that have led to the adoption of EVs in the global world. Dhakal and Min (2021) show that the diffusion of EVs is determined by the alignment of the adoption of vehicles with the expansion of charging infrastructure, which is a tendency that can be observed in various countries. The Global EV Outlook (2017) of the International Energy Agency, focuses on how early adopters used the combination of policy, infrastructure rollout, and fiscal incentives to accelerate adoption and offers a reference point to emerging economies such as Nigeria. According to the World Bank (2022), EVs can be beneficial to developing nations in both economic and environmental aspects in case of the supportive policies as well as the findings of CitiGroup concerning the global market indicate that consumer penetration is highly price-sensitive and infrastructure-dependent. All these studies indicate that the challenges in the adoption of the programs in Nigeria are unique in magnitude and context but the fundamental determinants and policy interventions are consistent with those of the global experiences. All in all the literature reviewed points towards three important insights. To start with, the potential of EV adoption in Nigeria is technologically viable, yet economically weak unless energy prices are stable and the fiscal policy is maintained. Second, technological enthusiasm in infrastructure and industrial preparedness is under-coordinated, which requires coordinated investment and capacity building. Third, clarity of the policy, institutional consistency, and consumer-oriented action are the keys to massive adoption. It is important to note that there are still considerable gaps especially in empirical estimates of total cost of ownership under local driving environment, charging-load behaviour and the commercial feasibility of the public charging in the secondary cities. Addressing these gaps through targeted research, pilot programs, and coherent policymaking remains central to achieving a scalable and sustainable EV transition in Nigeria.

3. | Technological Trends in EV Adoption

Electric vehicles differ fundamentally from conventional internal combustion engine vehicles (ICEVs) in terms of drivetrain architecture, energy storage, and propulsion systems. While ICE vehicles rely on an internal combustion engine, fuel tank, exhaust system, and mechanical transmission components, electric vehicle systems as shown in Figure 1, are characterized by an electric motor, battery pack, power electronics (inverter and controller), and transmission systems.

3.1 | EV Types and Local Suitability

Electric vehicles (EV) technologies represent a continuum of various configurations of the drivetrain structure that varies in terms of energy sources, infrastructural needs, operation features, and environmental effectiveness. The key categories, which include Battery Electric Vehicles (BEVs), Hybrid Electric Vehicles (HEVs), and Plug-in Hybrid Electric Vehicles (PHEVs), have different degrees of technological fit in the Nigerian socio-technical and infrastructural settings.

3.1.1 | Battery Electric Vehicles (BEVs)

Battery Electric Vehicles (BEVs) are equipped only with electric motors with chargeable battery packs (more often, lithium-ion based) and do not have internal combustion engines (IEA, 2023; Rezvani *et al.,* 2015). BEVs do not emit exhausts at all and have a high energy efficiency compared to conventional internal combustion engine vehicles (ICEVs), and such are at the core of global decarbonization policies in the transport sector (IEA, 2024).

Despite these benefits, there are significant limitations to the use of BEVs in Nigeria. Access to electricity is still not as reliable, and the instability of national grids and regular failures are the main obstacles to vehicle charging stability (World Bank, 2022). There is also poor density of public charge infrastructure and it is mostly clustered in pilot or privately led programs in large urban centres like Lagos and Abuja, thus limiting the use of BEVs in peri-urban and rural localities (Ukoima *et al.,* 2025).

The tropical climate of Nigeria makes the adoption of BEV more challenging. High ambient temperatures cause batteries to degrade faster and decrease their effective range when thermal management is not properly performed. This leads to increase in lifecycle costs (Barre *et al.,* 2013; Waldmann *et al.,* 2014). Moreover, the inconsistent quality of road and the lack of transport corridors raise concerns regarding battery pack durability, since under-floor battery location is susceptible to mechanical harm and debris damage (Ahmad *et al.,* 2021). However, in short range, urban commuting where daily commuting range is within contemporary BEVs limits, BEVs are technically feasible because they can recharge at homes or offices. They are most suitable therefore among the high-income users, the corporate fleet users and controlled urban transport systems with exclusive access to charging.

3.1.2 | Enhancing BEV Suitability for the Nigerian Market

Despite these challenges, several technological and institutional pathways could improve the suitability of BEVs within Nigerian context. First, deployment of urban-focused charging ecosystems, particularly at homes, workplaces, and depot-based charging for fleet vehicles, can minimize dependence on extensive nationwide public charging networks during early adoption stages. Second, renewable-integrated charging systems, particularly solar-hybrid charging stations with battery storage, offer a practical means of mitigating grid unreliability while supporting low-carbon electricity supply. Third, improvements in battery thermal management systems, including liquid cooling, tropicalized battery designs, and ruggedized vehicle platforms, can lessen degradation risks which are associated with high ambient temperatures and poor road conditions. In addition, battery leasing models and local assembly of EV components could lower upfront costs and reduce import dependence, thus improving affordability. From a policy perspective, targeted incentives such as charging infrastructure support, reduction of import duties on EV components, and pilot electrification programs for buses, ride-hailing fleets, and delivery vehicles could create early niche markets where BEVs are already technically viable. Collectively, these measures suggest that while large-scale BEV diffusion may face near-term bottlenecks, strategic interventions could progressively enhance BEV suitability in the Nigerian market.

3.1.3 | Hybrid Electric Vehicles (HEVs)

Hybrid Electric Vehicles (HEVs) have an internal combustion engine that is paired with one or more electric motors and a relatively small battery that is charged during regenerative braking and engine operation, with no external charging required (León *et al.,* 2021). This design allows enhanced fuel efficiency and less emissions than ICEVs and can be compatible with current refueling infrastructure.

HEVs are especially fitted to the Nigerian conditions. Their grid-free charging solution eliminates the drawbacks of unstable electric power supply, and the dual-propulsion systems enable them to work in a wide range of driving conditions, such as congested city streets and in the course of the intercity journey (Castillo *et al.,* 2025). Empirical research in developing economies demonstrates that HEVs have the potential to provide a significant fuel savings and emissions reduction even without the presence of the electrification infrastructure and this means they are an effective transitional technology (Ikpe *et al.,* 2025).

The technological perspective is more resilient to the extreme road conditions and other climatic stressors since the battery systems are smaller and not exposed to the environment as in BEVs. Therefore, HEVs will be a sensible in-between transition to EV in Nigeria, especially to individual consumers and commercial transport operators who want to gain the benefits of incremental electrification through HEVs but not rely on infrastructure.

3.1.4 | Challenges and Limitations of HEVs

Despite the noticeable transitional advantages, Hybrid Electric Vehicles (HEVs) also face limitations that may impact their long-term suitability in Nigeria. First, although HEVs improve fuel economy and reduce emissions relative to conventional internal combustion engine vehicles, they still rely on non-renewable energy source and therefore do not eradicate tailpipe emissions, limiting their decarbonization potential compared with fully electrified alternatives. Second, the dual-powertrain architecture increases mechanical and control system complexity, which can raise maintenance requirements and diagnostic challenges, particularly in markets with limited technical expertise in hybrid systems (Lévay *et al.,* 2017). Third, the fuel cost savings associated with HEVs may be sensitive to fuel price inaccuracies and subsidy structures, potentially weakening their economic advantage under certain policy conditions. In addition, because HEVs do not require charging infrastructure, they may reduce immediate pressure for investment in broader electrification infrastructure, potentially impeding longer-term transition toward battery electric mobility. These considerations suggest that while HEVs offer a practical transitional pathway for Nigeria, their deployment should be positioned as a bridge technology rather than a substitute for deeper transport electrification. Consequently, HEVs may serve as a pragmatic near- to medium-term transition option while broader BEV-enabling infrastructure advances.

3.1.5 | Plug-in Hybrid Electric Vehicles (PHEVs)

Plug-in Hybrid Electric Vehicles (PHEVs) have both the characteristics of the BEVs and HEVs, but include larger battery packs that support external charging, and internal combustion engines that offer extended driving range. All-electric mode PHEVs can travel over the short distances that are usually enough to cover daily commuting distance before returning to hybrid mode over the longer routes (TeknoAuto, 2025).

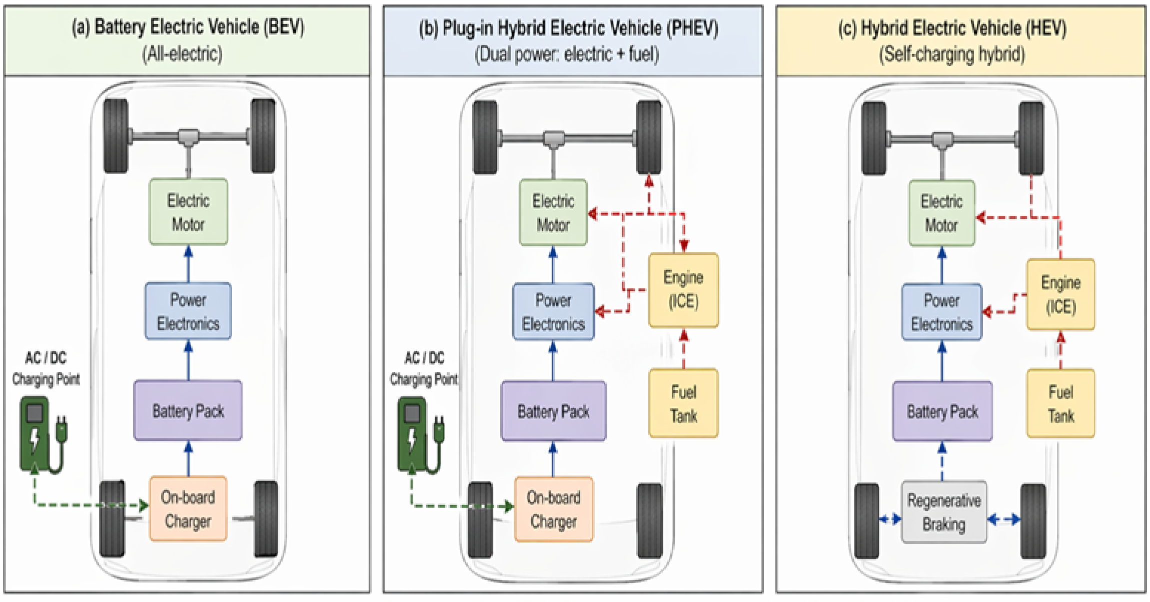
The PHEVs provide a technological trade-off that is flexible in the context of Nigeria. They permit partial electrification in areas where it is possible to be charged, but still enable them to operate without charging infrastructure in the longer contours of travel or during power outages (EV24.africa, 2025). This two-fold feature is especially pertinent in the face of the heterogeneous nature of urban-rural energy environment in Nigeria and long intercity infrastructural distances.

Nevertheless, PHEVs are more costly and complex to maintain mechanically than HEVs, which may reduce their affordability and introduce more service and maintenance difficulties in markets with inadequate technical maintenance (Lévay *et al.,* 2017). Besides, empirical studies indicate that environmental advantages of PHEVs are highly contingent on the frequency of charging behaviour; without frequent charging, emission savings compared to HEVs can be only insignificant (Plotz *et al.,* 2018).

3.1.6 | Improving PHEV Suitability for the Nigerian Market

Despite these constraints, several measures could be implemented to improve the suitability of PHEVs in Nigeria and strengthen their role as a transitional electrification technology. First, scaling of targeted charging infrastructure, particularly residential, workplace, and corridor-based charging in urban centers, would aid more frequent battery use and improve the emissions and fuel-saving benefits of PHEVs. Second, consumer incentives and fiscal measures, including reduced import duties, tax incentives, and concessional financing, could help address the higher upfront costs associated with PHEVs. Third, strengthening technical service capacity, including training for maintenance personnel and development of hybrid powertrain service networks, would help mitigate concerns related to mechanical complexity. In addition, digital energy management systems and user education on optimal charging behavior could improve electric-mode utilization, which is pivotal to achieving the environmental advantages of PHEVs. For fleet applications, particularly ride-hailing, taxis, and commercial transport, PHEVs may also serve as an effective bridging technology while charging infrastructure and grid reliability continue to mature. Collectively, these measures suggest that many of the current limitations of PHEVs can be reduced through coordinated infrastructure, market, and policy interventions.

The schematic diagram of a Battery Electric Vehicle, Plug-in Hybrid Electric Vehicle, Hybrid Electric Vehicle systems are presented in Figure 1.



Feature	BEV (All-electric)	PHEV (Plug-in Hybrid)	HEV (Hybrid)
Primary Energy Source	Electricity (from grid)	Electricity + Fuel (ICE)	Fuel (ICE) + Electricity (self-charging)
External Charging	Yes	Yes	No
On-board Energy Conversion	No engine	Engine + Electric system	Engine + Electric system
Typical Use	Short to medium trips, urban use	Longer trips with charging flexibility	All driving conditions
Key Advantage	Zero tailpipe emissions, high efficiency	Electric driving with extended range	Better fuel economy, no charging needed

Note: ICE = Internal Combustion Engine; BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle; HEV = Hybrid Electric Vehicle.

Figure 1 | The schematic diagram of major electric vehicle system

3.1.4 | Comparative Assessment of Local Suitability

The comparative suitability of BEVs, HEVs, and PHEVs under Nigerian conditions is firmly reflected in existing literature. Several studies opined that Battery Electric Vehicles offer the highest long-term emissions reduction potential, but their suitability in emerging markets remains strongly conditioned by charging infrastructure availability, grid reliability, and battery resilience under local climatic conditions

(IEA, 2023; Ahmad *et al.,* 2021; Ukoima *et al.,* 2025). In contrast, a good number of scholars argue that Hybrid Electric Vehicles presently offer a more results-oriented pathway for developing economies, because they deliver incremental electrification benefits without dependence on extensive charging infrastructure (Sierzchula *et al.,* 2014; Castillo *et al.,* 2025; Ikpe *et al.,* 2025). Similarly, studies on Plug-in Hybrid Electric Vehicles position them as an intermediate solution capable of balancing range flexibility and partial electrification, although their environmental and economic performance depends heavily on charging behaviour and supportive infrastructure (Plötz *et al.,* 2018; Lévay *et al.,* 2017). Drawing from these perspectives, the present review synthesizes the literature to suggest that technological suitability in Nigeria is likely to follow a phased pathway, with HEVs and PHEVs serving as transitional options while conditions for broader BEV diffusion mature.

Technological appropriateness of EV types in Nigeria is an indicator of a trade-off between the environmental performance, infrastructural preparedness, and the resilience of operations. According to Table 1, the considerably maximum reduction of emissions can be achieved through BEVs, but this demands high investment in grid stability, charging systems, and climate-proof design of cars. HEVs come out as the most readily feasible alternative, which does not need infrastructural reliance, and provides efficiency benefits. PHEVs reside between the two extremes, which can be implemented with early adopters in areas with partial access to charging. The association of EV technology options with the current realities of development in Nigeria would require a gradual process, with HEVs and PHEVs taking center-stage in the short and medium run, and BEVs taking on a more realistic role as electricity supply, charging infrastructure and enabling policy frameworks become more established.

The evaluation in Table 1 offers very essential points to the implementation of the policy as well as to the subsequent research. To begin with, infrastructural accessibility becomes an important determinant that dictates the comparative performance of the various electric vehicle technologies. Battery Electric Vehicles are most likely to work best in large urban centres where power supply is relatively more stable and where specially built charging networks can be implemented and maintained. By comparison, Hybrid Electric Vehicles are better suited in grid constrained areas because they achieve significant amounts of emissions reductions and fuel economics without the use of the public charging infrastructure and thus can be more flexible to the current energy conditions in Nigeria.

Second, vehicles are greatly affected by climatic and transport infrastructure features which affect the performance and durability of the vehicles. The ambient temperature and the degradation of the road surfaces exposes battery systems to additional thermal and mechanical stresses that disproportionately impact the BEVs and the Plug-in Hybrid Electric Vehicles. These requirements highlight the importance of context-sensitive engineering requirements, such as improved thermal management, ruggedised vehicle platforms, with tropical climates and rough road networks, should it be decided to have full electrification at scale.

Third, dynamics of adoption continue to revolve around economics involving the total cost of ownership and maintenance capacity. High initial prices, currency risk and a lack of specialised EV service networks imply that HEVs and gradual electrification approaches will have a higher probability of initial market penetration among Nigerian customers. Fully electric vehicles can potentially be economically inaccessible to much of the population without the financial encouragement, localised manufacturing, or explicit investment in technical education and service infrastructure.

Table 1 | Comparative Assessment of EV Technology Suitability in Nigeria

Evaluation Criterion	Battery Electric Vehicles	Hybrid Electric Vehicles	Plug-in Hybrid Electric Vehicles	Implications for Nigeria
Infrastructure Dependency	Highly dependent on grid-connected charging infrastructure and frequent charging access (IEA, 2023).	Do not require external charging infrastructure, as onboard batteries are recharged through regenerative braking and energy generated by the internal combustion engine (Ehsani *et al.,* 2018).	Partial dependence on charging infrastructure; can operate without external charging (Ahmad *et al.,* 2021).	Nigeria's limited and unreliable public charging network constrains BEVs and, to a lesser extent, PHEVs, while HEVs remain unaffected (IEA, 2023; NERC, 2022).
Electric Grid Resilience	Vehicle usability declines significantly during grid outages (Funke *et al.,* 2019).	Fully independent of electricity grid reliability (Ehsani *et al.,* 2018).	Moderate grid dependence due to optional charging (Plötz *et al.,* 2018).	Frequent power interruptions in Nigeria necessitate grid-independent propulsion options, favouring HEVs in the near term (World Bank, 2022).
Operational Range Flexibility	Range constrained by battery capacity and charging availability, especially for long trips (IEA, 2023).	High flexibility for both urban and intercity travel due to ICE support (Sierzchula *et al.,* 2014).	Comparable long-range capability due to ICE backup when battery is depleted (Ahmad *et al.,* 2021).	Long intercity travel distances common in Nigeria favour HEVs and PHEVs over BEVs (Plötz *et al.,* 2018).
Battery Thermal Stress	Large lithium-ion battery packs are susceptible to accelerated degradation in high-temperature environments (Ahmad *et al.,* 2021).	Smaller batteries experience lower thermal loading and degradation risks (Ehsani *et al.,* 2018).	Intermediate thermal exposure due to medium-sized battery packs (Ahmad *et al.,* 2021; Tian *et al.,* 2016).	Nigeria's tropical climate intensifies battery aging risks, particularly for BEVs lacking advanced thermal management (Ahmad *et al.,* 2021).

Road Condition Impact	Under-floor battery placement increases vulnerability to mechanical shock on poorly maintained roads (Ahmad *et al.,* 2021).	Conventional drivetrain layouts are more tolerant of rough road conditions (Ehsani *et al.,* 2018).	Similar under-floor battery exposure as BEVs, partially mitigated by ICE redundancy (Ahmad *et al.,* 2021).	Poor road quality elevates durability and maintenance concerns for BEVs and PHEVs (World Bank, 2025).
Environmental Emission Reduction	Zero tailpipe emissions; lifecycle emissions depend on electricity mix (IEA, 2023).	Moderate emissions reductions relative to ICE vehicles (Sierzchula *et al.,* 2014).	High potential emissions reductions, conditional on regular charging behaviour (Plötz *et al.,* 2018).	BEVs deliver maximum benefits when powered by low-carbon electricity; HEVs offer consistent reductions without charging (IEA, 2023).
Total Cost of Ownership (TCO)	High upfront cost; long-term savings depend on electricity prices and utilisation (Lévay *et al.,* 2017).	Lower acquisition cost and fuel savings yield competitive TCO (Ehsani *et al.,* 2018).	Higher upfront cost than HEVs; savings realised only with frequent charging (Plötz *et al.,* 2018).	Currency volatility and import duties in Nigeria amplify upfront cost sensitivity for BEVs and PHEVs (World Bank, 2022).
Maintenance Complexity	Fewer moving parts but requires specialised EV service infrastructure (IEA, 2023).	Moderate complexity combining ICE and electric components (Ehsani *et al.,* 2018).	High complexity due to dual powertrain architecture (Lévay *et al.,* 2017).	Limited availability of EV-trained technicians in Nigeria favours simpler hybrid technologies in the short term (Dada-Obele, (2025).
Policy Alignment and Incentive Leverage	Strongly dependent on charging incentives and renewable integration policies (IEA, 2023).	Can benefit immediately from fuel efficiency policies without infrastructure rollout (Sierzchula *et al.,* 2014).	Requires coordinated incentives for both vehicles and charging infrastructure (Plötz *et al.,* 2018).	Transitional policies in developing economies often prioritise HEVs and PHEVs before full BEV deployment (IEA, 2023).

The Hybrid Electric Vehicles hold a potentially significant transitional status in the mobility transition in Nigeria. PHEVs are capable of decreasing the reliance on petroleum and emissions in the interim by allowing partial electrification where charging facilities are available, and maintaining operational independence of charging facilities on long-distance travel or power shortages. Their implementation can thus assist in a gradual shift of total battery electrification grid reliability, charging coverage, and supporting ecosystems mature.

3.2 | Battery Technology and Costs

Battery costs remain the single largest determinant of electric vehicle affordability and represent a critical obstacle to EV adoption in Nigeria and globally. Although global lithium-ion battery prices have declined substantially over the past decade, battery packs still account for a substantial share of EV purchase prices. This is often estimated at 30–50% of vehicle cost depending on chemistry and vehicle class (IEA, 2024; BloombergNEF, 2025). This cost structure is particularly consequential in Nigeria, where imported EVs face additional burdens arising from exchange rate volatility, customs duties, and logistics costs.

From a total cost of ownership perspective, battery replacement costs remain a major concern influencing consumer perception and investment risk. In high-temperature operating environments such as Nigeria, rapid deterioration may shorten effective battery life, potentially increasing lifecycle replacement costs where thermal management is deficient. This introduces uncertainty around residual vehicle value and may discourage adoption, particularly among private consumers.

However, falling global battery costs offer significant medium-term opportunities. Continued reductions in lithium-ion battery prices, especially lithium iron phosphate (LFP) chemistries, could improve EV price competitiveness and reduce the premium relative to internal combustion engine vehicles. In addition, localized battery pack assembly, fiscal incentives on battery imports, and battery leasing models may substantially lower consumer exposure to upfront battery costs, which is a critical barrier to adoption. For fleet operators, battery costs can also be amortized over high vehicle utilization rates, improving economic feasibility more rapidly than in low-mileage private ownership models.

These cost considerations suggest that battery economics in Nigeria should be viewed not only in terms of declining global prices, but also through local dimensions of import dependence, climate-related degradation, financing structure, and lifecycle replacement risks.

Electric vehicle (EV) batteries are mostly determined by their performance, cost structure, durability, as well as life-cycle and hence key determinants of EV adoption. In developing markets like Nigeria, battery properties are affected by the local environment of ambient heat, humidity, grid volatility and financial limitations to determine EV feasibility. In this sub-section there is a look at the lithium-ion battery trends, the battery degradation under high temperature and high humidity and the adaptation of the battery on the local scale, such as battery leasing programs.

3.2.1 | Lithium-Ion Battery Trends

Li-ion (Li-ion) batteries continue to serve as the main technology of modern EVs because they have a high energy density and favourable specific energy, as well as because their cost direction is decreasing (IEA, 2024). The availability has been facilitated by both the advancements in materials science and scale of manufacture which have enabled prices to come down immensely in the past ten years.

Sequel to recent analyses, prices of Li-ion battery packs around the world are still decreasing despite the price volatility of strict mineral availability that causes short-term changes. A decrease in the prices of almost 14 percent in 2023 followed the lower key mineral prices, as lithium iron phosphate (LFP) chemistries decreased the cost difference between them and nickel manganese cobalt (NMC) batteries (IEA, 2024). This negative trend is urgent due to the fact that in the past, battery pack prices have been 60-80% of the total price of the EV battery pack and directly affect the price of the vehicle (EV24.africa, 2025). The prices of battery packs may reach as low as \$50-64/kWh in 2030 according to the projections of the optimistic scenarios, which are predetermined by the continuous technological maturity and manufacturing cost-efficiencies (EV24.africa, 2025; IEA, 2024).

Although Li-ion continues to be the workhorse battery technology, alternative technologies (e.g., sodium-ion, solid-state) are coming together with conventional cost and safety benefits, but commercial implementation on EV scales is early (IEA, 2025). The changes indicated that in the future, EV battery systems might be more robust and cheaper, increasing the potential of adoption in the new markets.

With respect to safety challenges and battery risk considerations, despite their technological advantages, lithium-ion batteries also present safety challenges that are relevant to EV deployment, particularly in emerging markets. One of the major concerns is thermal runaway, a condition in which internal cell failure or overheating can trigger uncontrolled temperature escalation, potentially leading to fire or, in rare cases, explosions (Pesaran, 2023; IEA, 2024). Reported incidents globally have drawn attention to risks associated with manufacturing defects, mechanical damage, overcharging, poor battery management systems, and exposure to extreme temperatures. These concerns are particularly relevant in high-temperature environments such as Nigeria, where ambient heat may intensify thermal stress if adequate battery cooling and protection systems are insufficient. Recent advances in battery engineering, however, have significantly improved safety performance. Enhanced battery management systems (BMS), improved cell chemistry such as lithium iron phosphate (LFP), advanced thermal management, and strengthened safety standards have reduced the likelihood of devastating failures (IEA, 2024). For the Nigerian context, these considerations underscore the importance of safety-focused technical standards, battery certification protocols, trained maintenance personnel, and public awareness, that must be put in place to support reliable and safe EV deployment.

3.2.2 | Battery Degradation in High-Temperature, High-Humidity Environments

Looking at climatic performance-impact, Li-ion batteries are environmental sensitive. High temperatures promote internal chemical reactions, which increase side reactions and structural degradation that decrease the capacity, increase internal resistance, and decrease effective life spans (Zhang and Yu, 2025; Pesaran, 2023). The humidity that is typical in most parts of Nigeria contributes to the lithium-ion battery degradation through the rate of capacity fading, impedance increase, and exacerbation of side reactions between electrolyte constituents and absorbed moisture. The specified environmental conditions have a massive impact on the performance and lifespan of batteries, and their negative effects are more evident when the exposure is sustained in a humid environment (Wang *et al.,* 2025).

With respect to thermal stress and effects of operations, hot environment may practically shorten nominal battery life of 12-15 years in temperate climate to 8-12 years in hot climate, a factor which hastens its replacement (Liu *et al.,* 2025). This type of degradation is experienced as a lower driving range and power output with time. Thus, thermal management is a key aspect: enhanced solutions based on liquid cooling, phase-change matter and air-cooling are being combined to ensure that batteries are kept at optimal temperatures and prevent degradation (Liu *et al.,* 2025).

With regards to Nigeria-specific context, Nigeria's tropical climate, typified by high average ambient temperatures and seasonal humidity, heightens these battery stressors. In the absence of strong thermal management and shading infrastructure, battery pack health can deteriorate more rapidly than in temperate markets, increasing lifetime ownership costs and reducing residual resale value.

3.2.3 | Local Adaptation and Potential for Battery Leasing Schemes

Since the initial cost of batteries is very expensive and the operating conditions in Nigeria are more prone to degradation, there is a need to device local adaptation strategy. Two broad strategies can be developed: engineering changes (improved thermal control and ruggedized cells to operate in tropical climates), and economic changes to lighten consumer cost loads.

Battery-as-a-Service (BaaS) or battery leasing is a business model where the vehicle owner rents the battery pack independently of the car, and the cost of the battery does not depend on the purchase of the car, the entry costs are lowered (Shi and Hu, 2022). This model is characterized by regular payment of battery access fees by the users with the leasing operator being in control of battery maintenance and performance assurances. The BaaS model has been previously tested in large-adoption markets like China with the NIO battery subscription and swapping network to reduce range anxiety and reduce the buy price to the consumer (NIO Inc., 2020).In the case of Nigeria, a BaaS model can be harmonized with the local financing models. As an illustration, micro-leasing or subscription plans, which decrease the initial amount needed to purchase EVs.

The possibility of decentralizing the battery replacement risk across larger asset portfolios operated by professional operators is provided in such models, which is an important factor in a high-temperature, high-degradation environment, where the uncertainty about battery life can be discouraging to consumers. Battery leasing can be integrated with the hybrid grid and renewable charging infrastructure (e.g., solar-powered stations) to address the grid unreliability and offer the stable charging environment that can additionally safeguard the battery life and minimize the risk of degradation.

3.2.4 | Policy and Market Implications for Nigeria

The falling worldwide battery prices offer a great chance for Nigeria to integrate EVs into its transportation system with reduced expenses rather than incurring the entire costs of initial-level technologies. Nevertheless, sufficient price parity is not enough; specific fiscal policies include import duty exemption on EV batteries, value-added tax cut on EV parts, and subsidies in the financing process may speed up the process of cost-pass through to customers (IEA, 2024; Lévay et al., 2017). Due to high temperature and humidity which have a significant impact on battery life, Nigeria would gain access to climate sensitive EV battery performance standards. These can be minimum thermal management standards, tropicalized warranties, and certification standards on battery life when operating with high temperatures. These would improve consumer confidence and safeguard long term assets.

The models of battery leasing and Battery-as-a-Service (BaaS) become especially topical policy tools in Nigeria. This is achieved by the leasing plans by dividing the ownership of the battery and the car, thus lowering the cost at the time of purchase and transferring the risk of degradation to the specialized operators. The model is particularly beneficial in the high-degradation setting, where the uncertainty about the battery lifespan can otherwise discourage its adoption (Plotz et al., 2017; Shi and Hu, 2022).

Pilot battery leasing programmes of commercial fleets such as taxis, ride-hailing services, urban delivery vehicles, could be enabled by public-private partnerships, in which predictable usage patterns are favourable to economic viability. It could be integrated with solar-powered or hybrid charging stations to further reduce the unreliability of the grid and stabilize battery operating conditions.

The policy of battery technology must align with energy transition goals of Nigeria. Reuse of batteries, and second-life (e.g., secondary storage used to serve mini-grids), would help optimize resource usage and minimize the environmental footprint of battery disposal, promoting the key principles of a circular economy to the new EV industry (IEA, 2023).

3.3 | Charging Infrastructure

Electric vehicles depend on the availability, reliability and technological advancement of EV charging infrastructure to determine their adoption. In the developing countries like Nigeria, efforts to establish charging networks, both in the public and in private, are still in their infancy and have structural issues that are created by grid instability, investment limitations, and technology deficiencies. The subsection addresses the modern situation of the charging infrastructure, the grid preparedness and the prospects of renewable integration, and the key technological gaps applicable to the faster development of the EV ecosystem in Nigeria.

3.3.1 | Current Status of Public and Private Chargers

The scale and the geographical coverage of the public EV charging infrastructure in Nigeria is still low. Few charging stations are in operation, which are mainly located in large urban centres like Abuja and Lagos, rendering the rest of the country inaccessible to the conveniently located public charging facilities (Ukoima *et al.,* 2025). It is estimated that there are under 100 functioning EV charging stations in the country, which is not enough to meet the expected EV development and is one of the reasons to impress range anxiety in the prospective customers (Research and Markets, 2025). Nevertheless, significant progress has already been made: In Abuja, NNPC New Energies Limited opened the first electric vehicle charging station in Nigeria, which was an early public infrastructure project, and has more plans to install it around the country through public-private partnerships (ThisDayLive, 2024). Startups like Possible EVS have already opened publicly accessible fast-charging hubs with the ability to provide up to 350 kW of power, which can provide 20-30 minute charges to EV users, decreasing the turnaround time significantly (Vanguard Nigeria, 2023).

In addition to flagship state-level projects, charging options are reportedly being implemented by private operators: NEV Electric declared its intention to install 300 charging stations in Lagos and Abuja by the end of 2025, which is the clear evidence of corporate interest in charging infrastructure. (Tech in Africa, 2025). Battery-swapping stations and commuter EV hubs in Ogun state are becoming models, particularly where two- and three-wheelers are involved, where the plug-in charging networks are still sparse. (EV24 Africa, 2024). However, large scale implementation is limited by capital expenses, lack of technical knowhow as well as the lack of standardization of charging specifications.

3.3.2 | Grid Readiness and Renewable Energy Integration

The national electric grid in Nigeria is characterized by irregularities, and the grid is plagued with frequent power outages, and lacks the capacity to serve large-scale charging networks that can run continuously (RMI, 2024). The current generating capacity of the grid is scanty compared to the demand, and the current charging stations cannot be serviced at any reliable rate (Dada, 2025).

The untrustworthiness of grid power does not only make the process of operation more expensive, it adds to the range anxiety and customer resistance to EVs adoption due to the inability to guarantee the availability of charging without significant grid enhancement (Dada, 2025). Due to grid constraints, various charging projects are using renewable energy: Photovoltaic battery-based charging stations can be piloted as Solar-hybrid charging stations that allow constant operation even when the grid is down. The effective combination of distributed renewables with charging infrastructure can be seen with smaller installations of solar power to support EV charging such as the 5 kW solar-powered EV charging facility that was commissioned by the Energy Commission of Nigeria in Abuja (The Nation Newspaper (2025). Such hybrid systems are more reliable, as well as help in achieving national targets of renewable energy and decarbonization, which helps in establishing a cleaner EV charging system (RMI, 2025).

3.3.3 | Technological Gaps in EV Charging Infrastructure

The use of fast-changing technology, and especially high-power DC chargers with a power range of 150-350 kW, is of great importance in shortening charging time, enhancing the convenience of this type of equipment, and allowing intercity travel by electric vehicles (EV). Nevertheless, the installation of such fast-charge infrastructure in Nigeria is very minimal. The current installations are sparsely distributed with a predominance of pilots and are concentrated in a couple of cities, which introduces the initial level of development of the charging ecosystem in the country. Network throughput is limited by the number of high-capacity DC fast chargers, which reduces the degree of bottlenecks in the charging network, as well as the possibility of traveling with an EV over the country (Sunday, 2024).

In addition to this physical charging hardware, there is a lack of smart charging technologies, such as smart meters, dynamic load management systems, and grid-responsive charging in the infrastructure of the EV in Nigeria. Smart charging allows time-of-use charging, demand response charging, and synchronized, synchronized charging that eliminates the peak load burden on the electricity networks. The lack of those technologies is indicative of the larger gaps in the implementation of smart-grids and coordination of the digital grids, and it exposes the possibility of local network overload in high-density EV charger operations. In the literature on electromobility infrastructure, smart metering and intelligent charging are important factors in the efficient management of EV charging loads, although the two features are poorly developed in most of the emerging EV markets, such as Nigeria (Ayoade and Longe, 2024).

Mobile digital platforms are an essential part of an efficient EV charging ecosystem that enables users to find charging stations, start and pay the charge session, and receive real-time data on the availability and operation of chargers. Across the world, applications like PlugShare show how mobile applications that are integrated can boost user confidence and make the process of using a public charging network more usable. Mobile application support of EV charging in Nigeria is disjointed, not well-transparent, patchy, and lacks a unified platform. This disintegration negatively impacts the confidence of users in the reliability of public charging and creates a detriment to the wider adoption of EVs, which is typical in newer EV markets (Ukoima *et al.,* 2025).

More so, there is still a lack of interoperability and standardization in the Nigerian charging environment. As experience in the international field demonstrates, regular charging connector standards (e.g. CCS, CHAdeMO), communication protocols and backend managerial systems are needed to provide scalable and friendly charging networks. Open standards like the Open Charge Point Protocol (OCPP) and the ISO 15118 are used to ensure interoperability between chargers, vehicles, and network operators so that the integration of cross-vendor operation can take place and complex features, like smart charging and plug-and-charge services, can be implemented. Lack of standards in Nigeria on a nationally level makes operations and adoption more complex not only to operators but to end users and this potentially poses a grave barrier to investing in charging infrastructure (OCPP Platform, 2025).

Altogether, the EV charging infrastructure in Nigeria is still in its infancy, with its frontier areas of innovation in the face of existing technological and systemic limitations. The gaps in the fast-charging capacity, integration of smart grids, support of mobile applications, and interoperability standards are critical to develop the reliable and people-centered charging ecosystem. Addressing these gaps, in technological terms and infrastructure, will be essential in building consumer trust as well as minimizing operational wastefulness, and making EV charging infrastructure the core of the long-term sustainable transport and decarbonization policy of Nigeria.

4. | Economic Trends and Feasibility

4.1 | Upfront Cost versus Long-Term Savings

In Nigeria, adoption of electric vehicle (EV) is dependent on economic feasibility. Although EVs often involve more acquisition costs than internal combustion engine vehicles (ICEVs) and lower upfront costs, the long-term economics of operation, which is dictated by reduced fuel and maintenance costs, is a strong argument in their favour, especially in urban and fleet use. These advantages, however, are mitigated by macroeconomic variables like currency instability, dependence on imports and fiscal policy.

4.1.1 | Vehicle Purchase Price (EVs vs ICEVs) Comparison

The prices of buying EVs globally are still not as low as similar ICEVs, which is arise due to battery cost, import logistics, and inadequate local assemblies. These cost differentials are enhanced in Nigeria, where almost all EVs are imported as finished products, with the exchange rate depreciation and customs taxes. Table 2 depicts a demonstrative comparison of purchase prices of internal combustion engine (ICEVs) to those of battery electric vehicles (BEVs) in selected categories of passenger vehicles in Nigeria. The data show the existing upfront cost differentials across the compact sedans, mid-size sedans/SUVs, and commercial vans, indicating the premium now implied by BEVs in the Nigerian market. Such a comparison gives an answer to the price disparity that still affects consumer adoption and investment choices in the dynamic electric mobility environment in the country.

Table 2 | Indicative Purchase Price Comparison of Passenger Vehicles in Nigeria

Vehicle Category	ICEV Purchase Price (USD)	BEV Purchase Price (USD)	Price Differential (%)
Compact sedan	15,000–18,000	22,000–30,000	+35–60%
Mid-size sedan / SUV	20,000–28,000	32,000–45,000	+40–65%
Commercial vans	25,000–35,000	38,000–55,000	+40–60%

Note | Prices reflect imported vehicles under prevailing Nigerian market conditions and exchange rates.

Sources | NADDC (2023); BloombergNEF (2025); IEA (2024)

Although worldwide battery prices have fallen, EV price equality with the ICEVs in Nigeria is limited due to a lack of local production, scarce fiscal stimulus, and foreign exchange threat.

4.1.2 | Maintenance and Fuel Cost Savings

EVs have huge benefits in terms of operational costs because they have less moving parts, regenerative braking, and they do not require oil changes, exhaust system, and complicated transmissions. This savings is notably high in city driving environments that are very congested as is the case with some cities in Nigeria.

Table 3 gives a relative summary of the estimated operating cost of internal combustion engine vehicles (ICEVs), and battery electric vehicles (BEVs) in typical urban driving conditions of about 15,000 km/year. The table reveals some of the key elements of costs, such as fuel or energy spending, regular maintenance, and the wear of the braking system, and demonstrates the potential savings that BEVs will have. The comparison highlights the high cost benefits of electric vehicles in terms of operation even though they have a high initial cost of purchase.

Table 3 | Comparative Annual Operating Costs (Urban Driving, 15,000 km/year)

Cost Component	ICEV	BEV	Savings Potential
Fuel / Energy cost	High (petrol/diesel)	Low (electricity)	50–70%
Routine maintenance	Moderate–high	Low	30–50%
Brake system wear	High	Low (regenerative braking)	Significant
Total annual operating cost	Baseline	40–60% lower	High

Sources | NADDC (2023); BloombergNEF (2025); IEA (2024)

Empirical research shows that EV operating expenses in developing markets can be lower than those of ICEVs by 40-60 percent, despite the partial use of diesel generators or hybrid solutions to electricity supply (Lévay *et al.,* 2017; Plotz *et al.,* 2018).

Nevertheless, not all of these savings may be achieved because of unpredictable grid power in Nigeria, which can partially be used when charging is contingent on self-generation, which makes renewable-based charging infrastructure a critical consideration.

4.1.3 | Sensitivity to Currency Fluctuation and Import Duties

The EV market in Nigeria is very sensitive to macroeconomic aspects. Weak naira has a direct effect of raising the prices of EV purchases, the cost of replacement batteries, and the availability of spare parts. This is more prominent in the case of EVs as compared to ICEVs owing to the high levels of importation content and low aftermarket options.

Cost barriers are caused by importation duties and value-added tax. In contrast to a number of peer economies that provide EV-related fiscal benefits, Nigeria does not have an extensive national system of EV subsidies or tax breaks as of now, but there are plans to discuss the policy (NADDC, 2023).

Table 4 presents some important economic factors of sensitivity that have profound effects on the viability of adopting electric vehicles (EVs) in Nigeria. It shows the influence of macroeconomic variables, fiscal policy, energy pricing and subsidy regimes on the dynamics of upfront and operating

Table 4 | Economic Sensitivity Factors Affecting EV Feasibility in Nigeria

Factor	Impact on EV Economics	Policy Relevance
Exchange rate volatility	Increases vehicle and battery costs	Encourages local assembly
Import duties and VAT	Raises upfront cost	Incentive reform needed
Fuel price subsidies	Weakens EV competitiveness	Gradual subsidy reform
Electricity tariffs	Influences operating savings	Renewable charging essential

Sources | NADDC (2023)

costs. The policy implications to the corresponding policy are highlighted in the table, which indicates that regulatory reforms and coordinated economic actions play a crucial role in enhancing the competitiveness and the long-term sustainability of EVs in the Nigerian market.

4.1.4 | Total Cost of Ownership (TCO) Perspective

In a total cost of ownership model, EVs becomes more economical in terms of medium-term ownership costs (5-8 years) especially in high-use car categories like taxis, ride-hailing fleets, and delivery vans. Evidence provided by other countries indicates that TCO parity is possible at an earlier stage in markets with high fuel prices and high levels of urban commuting, which are increasingly becoming apparent in the Nigerian metropolitan regions (IEA, 2023; BloombergNEF, 2025). However, in the case of the individual user with low yearly mileage and limited access to low-cost charging, high initial prices are a major challenge to its use.

4.1.5 | Implications for Nigeria's EV Transition

Economically, the route to electric vehicle implementation in Nigeria is the most feasible when anchored on fleet-based electrification approaches including those of the public transport networks, logistical operations, and ride-hailing services, in which predictable utilization profiles and centralized charging can boost the cost-efficiency. This transition is also enhanced by the presence of specific fiscal incentives, such as import duty breaks and value-added tax reductions, which would be capable of significantly reducing the initial acquisition expenses and changing the overall cost of ownership performance. Simultaneously, introduction of battery leasing and designed vehicle financing models provide a practical structure of segregating the high prices of the batteries and the cost of the vehicle to make it more affordable and less perceived financial risk among adopters. In the medium- to long-term, expansion of local assembly and component production facilities are the solution to countering exposure to exchange rate volatility and dependence on imports, as well as contributing to the local industrial growth. Without such coordinated actions, the initial expenses of electric vehicles will probably remain high in comparison to long-run costs of operational benefits to a majority of individual consumers, making the mass market adoption of such vehicles a limiting factor.

4.2 | Market Adoption and Consumer Perception

The adoption of the electric vehicles in the Nigerian market can be seen as a product of a complex set of economic, informational, and behavioural factors that cannot be reduced solely to the considerations of cost. This process of supporting the spread of new vehicle technologies is generally considered a socio-technical transition process, where consumer perception, institutional credibility, and experience-based learning are primary aspects alongside technological maturity (Ajao *et al.,* 2024; Kher, 2025). In the developing economies, the exposure to electric mobility is usually low, and the policy lacks the signaling power to accelerate the adoption, even though the technology has proven to have long-term economic benefits (IEA, 2023).

The level of consumer awareness on electric vehicles in Nigeria is relatively low, especially among the individual vehicle owners. The empirical results of emerging markets demonstrate that the insufficient knowledge of the working principles of EV, the duration of battery life, the necessity of charging, and the necessity of maintenance condition makes people less willing to use the new technologies. In Nigeria, informal vehicle markets and the popularity of used vehicle imports contribute to these information gaps, with the decisions being made based on their initial affordability and assumed mechanical simplicity, instead of focusing on the cost of lifecycle (Rezvani *et al.,* 2015; Hardman *et al.,* 2016; World Bank, 2023). Consequently, the readiness to purchase EVs is limited, even among the consumers that note the possible fuel and maintenance benefits.

Behavioral barriers are obstacles to adoption. The existence of the range anxiety is still a significant challenge since there is a limited number of public charging stations, and the reliability of the grid remains unpredictable. This issue is further intensified by the fact that Nigeria has a tropical climate, leading to increased consumer anxiety on the issue of battery degradation and loss of range in cases where the temperatures are high and there is a lot of humidity. There is continuous research on EV adoption indicating that the perceived lack of infrastructure and uncertainty about performance has a more pronounced discouraging effect than objectively constrained factors, especially in the early phases of the market (Egbue and Long, 2012; Li *et al.,* 2017; Neeraja, 2025). These perceptions in Nigeria are status-quo biases entrenched in favour of internal combustion engine vehicles, as they enjoy well-developed refueling infrastructure, and technical expertise is generally widely available.

Another important factor that dictates consumer perception and uptake in the market is financing conditions. Nigeria does not have a nationwide electric vehicle subsidy program, tax credit program, or systematic incentive program in place that it compares to the effect of such programs in early adopting countries. The experience of different countries proves that initial purchase subsidies and tax exemptions have a substantial positive effect on the penetration of the EV market because they help to increase the perception of low financial risk and reduce the payback time (Lévay *et al.,* 2017; Sierzchula *et al.,* 2014). Without these efforts in place, EVs in Nigeria have remained largely the domain of corporate, donor-funded pilot programs, and high-income people that have the ability to absorb increased capital expenses, which has been recorded in recent policy evaluation by national agencies (NADDC, 2023).

The alternative ownership and financing models thus take on the increased relevance in the Nigerian environment. Battery leasing and battery-as-a-service models have been demonstrated to lower the initial costs of the vehicles as well as strive to overcome consumer issues with battery degradation and replacement expenses. This model especially applies well in high temperature set ups where there is uncertainty on the lifespan of batteries and therefore the assurance to the consumer is compromised. Empirical research suggests that battery ownership can be separated effectively with vehicle ownership to increase the level of adoption in cost-sensitive markets by shifting the technical risk to special service providers (Plotz *et al.,* 2018; Shi and Hu, 2022). The use of fleet-based models of financing promotes feasibility through reliance on predictable utilization schedules, an increased annual use, and a faster shift to the cost of ownership evenness.

Availability of green finance and concessional funds is increasingly becoming a factor in the perception of the market. The multilateral development banks and climate finance institutions are becoming more supportive of electric mobility projects in the developing regions by offering low-interest loans, guarantees, and blended finance systems. Experience in sub-Saharan Africa indicates that this type of financing tool can help jump-start new markets of EVs by reducing the cost of capital to fleet operators and mass transit agencies, and at the same time indicates policy commitment in the long term (World Bank, 2022b; African Development Bank, 2023). In Nigeria, the e-mobility initiative and the climate finance frameworks can be strategically aligned to enhance the investor and consumer confidence to a significantly high extent.

Pilot programs and first mover information offer empirical basis of consumer perception as applied to the Nigerian context. Users available evidence of fleet operators points to the fact that electric vehicles provide lower energy bills per kilometer and lower maintenance cost when compared to vehicles powered by internal combustion engines, especially in urban duty cycles where there is a lot of congestion and a number of stop-and-start operations. Analogous conclusions have been made in other African cities with similar EV fleets, which are capable of having operational cost advantages even with the limitation of the infrastructure (IEA, 2023; RMI, 2024). But these advantages are moderated by the fact that it is charged by down time, availability of fast charging is limited and there is ambiguity in resale value, all of which affect the perceived economic risk among potential adopters.

In general, the process of introduction of electric vehicles in Nigeria to the market is expected to follow a slow and staged process, starting with institutional users and commercials fleets and then spread to private consumers. The aspect of consumer perception will continue to be a determinant during this transition basing on observable performance results, plausible finance-providing mechanisms, and consistency in policy cues. The adoption of EV will stay its course among early adopters unless there are specific measures to overcome behavioral resistance, lack of awareness, and financial risk.

4.3 | Industrial and Supply Chain Considerations

The supply chain and industrial aspect of electric vehicle adoption is critical in determining the economic viability in the long term in Nigeria. At the level of the consumer, in addition to the cost and perception of their sustainability, the sustainability of the EV transition relies on the domestic industrial capacity, the resilience of the supply chain, and the possibility to localize the value addition. In emerging markets, immature industrial ecosystems and reliance on imports have been established to hamper the spread of EV by exaggerating costs, exposing them to exogenous shocks, and reducing the opportunity to grow employment and skills acquisition (IEA, 2023; World Bank, 2022b).

The automotive industry of Nigeria has a low level of manufacturing depth with most of the automotive products being assembled domestically out of semi-knocked-down or fully knocked-down parts. This building offers limitations and possibilities of localization of electric vehicles. Current assembly plant, which was formed under the Automotive Industry Development Plan in Nigeria, would be reconFigured to accommodate EV assembly with comparatively low retooling, especially in body assembly, chassis assembly, and low-voltage electrical systems. Practical experience of other countries shows that domestic EV assembly, including, but not restricted to the lack of battery manufacturing, can help to lower the cost of vehicles, speed up the time of delivery, and reduce foreign exchange risk, assuming the involvement of favorable industrial policies and a minimum volume of production (NADDC, 2023; UNIDO, 2020; IEA, 2023).

Nevertheless, localization capabilities are limited at this time because there are no established localized battery production as well as power electronics. Onboard chargers, traction inverters, and lithium-ion battery packs are all completely imported and a high percentage of EV value and cost.

According to the research on EV industrialization in the developing economies, the localization is often limited in terms of low value, early stages battery and semiconductor parts that involve vehicle assembly, wiring harnesses, thermal management parts, and interior systems, whereas high-value battery and semiconductor parts are still sourced internationally (Lutsey, 2015; UNCTAD, 2023). In the case of Nigeria, this will mean that local assembly will be able to provide partial cost as well as employment benefits but will not remove the import dependency in the short and medium term.

Another critical factor of market confidence and market operability is the availability of spare parts. Nigerian automotive aftermarket is highly developed to support internal combustion engine vehicles and has a large network of informal and formal supply networks. Conversely, EV spares ecosystems are in their first infancy, and there are few source options of traction motors, battery modules, power electronics, and diagnostic equipment. Early EV markets show that the lack of spare parts may contribute to higher downtime, higher maintenance costs, and a lack of individual adoption especially in areas with fewer authorized service centres (Hardman *et al.,* 2017; World Bank, 2022b). In Nigeria, the lack of skills in EV diagnostics and repair serves as the addition to this problem, strengthening the use of original equipment manufacturers and foreign technical support.

Import dependency creates major risks in supply chains that have a direct impact on the EV affordability and scalability. The dependence on imported cars and parts means that the EV market of Nigeria is prone to exchange rate volatility, international shipping issues, and geopolitical supply shock. The recent world events, such as the semiconductor shortages or the battery material prices have proven the fragility of the EV supply chains, and its effects are disproportionately felt on the import-based markets (IEA, 2023; BloombergNEF, 2025). Weakening the economic argument behind adopting EVs, the depreciation of the naira in the Nigerian environment has a direct impact on increasing the cost of acquiring vehicles, changing batteries, and the prices of spare parts.

The strategic consequences of flattened supply chain risks to energy transition planning include these risks. Those countries that have limited dominance over EV supply chains might not achieve the rate of scale needed to achieve climate and air-quality goals. The focus of localization strategies towards progressive forms, supplier development models, and regional value chain integration by the international policy is viewed through the prism of minimizing the exposure to external shocks and developing domestic industrial capacity (UNIDO, 2020; African Development Bank, 2023). In the case of Nigeria, regional automotive and battery value chains, especially of commercial vehicles and of two- and three-wheelers, may provide a viable entry point into the market, especially in West Africa.

In all, industrial and supply chain factors indicate that the EV transition will be most cost effective in case of adoption to gradual localization strategies in Nigeria. Although it is not realistic to achieve full supply chain independence in the short term, localized assembly, labor force development and aftermarket capacity building can greatly save costs, increase the resiliency of the system, and investor confidence. In the absence of these measures, the further reliance on imports is bound to augment the affordability issues and decelerate the market growth, regardless of the rising demand cues and the policy concern.

5. | Policy and Regulatory Trends

Policies and regulatory frameworks have a focal role in defining the rate, magnitude, and destiny of electric vehicles adoption. The experience of other countries illustrates that consistent policy formulation, striking long-term signaling, and institutional coordination are some of the factors that ensure a successful EV market development. Poor or dispersed policy environments in emerging economies can lead to slow adoption in case of positive technological and economic conditions (Sierzchula *et al.,* 2014; IEA, 2023).

5.1 | National Electric Vehicle Policies

The policy environment of electric vehicles in Nigeria remains in a formative phase of development where there exists little formal policy execution, but a strategic intent is being formed. At Federal level, EV-related goals are largely incorporated into more liberal energy transition, climate change, and automotive industrialization strategies, as opposed to being enshrined in a national EV policy. The National Automotive Industry Development Plan and current electric mobility policy discussions led by the National Automotive Design and Development Council reflect rising recognition of EVs as a tool for industrial diversification, emissions reduction, and energy security (NADDC, 2023). Nevertheless, the inability to have binding targets, time scales and enforcement mechanisms undermines the effectiveness of such initiatives.

At the subnational level, state and local governments have initiated experimental pilot programs and enabling policies especially in large urban areas like Lagos. Plans and projects concerning electric buses, electrification of two- and three-wheelers and pilots concerning fleets have been initiated as components of overall city transport and air quality policies. According to the comparative studies, this type of intervention at the city level can be a crucial point of entry of EVs in developing countries, especially in those where national policy frameworks remain maturing (C40 Cities, 2021; World Bank, 2022). In Nigeria, however, such endeavors have not been well coordinated and harmonized into an effective national approach. It is well known that fiscal policy tools may be regarded as one of the best instruments to speed up EV adoption, especially at the initial stages of the market. The foreign experience demonstrates that purchase subsidies, tax exemptions, and waiver of import duties greatly lead to a lower initial cost and have a positive influence on overall cost of ownership perceptions (Lévay *et al.,* 2017; Sierzchula *et al.,* 2014). In Nigeria, EVs are however largely subject to the same import duties framework and value added tax regimes as traditional vehicles which undermine their competitiveness. Despite the increased debate on the topic of duty waivers and fiscal incentives, their actual application has not yet been widespread and thus restricts the adoption by the market and investor confidence (NADDC, 2023).

5.2 | International Comparisons

Compared to other emerging and middle-income economies, comparative analysis can provide important information on policy directions that have effectively hastened the adoption of EVs. South Africa offers a very valid point of reference because of the similarity in vehicle market structure and dependence on imports. Though the EV penetration in South Africa has traditionally been small, recent policy changes, including; decreased importation taxes on EVs and encouragement of local assembly, are indicative of a rising conformity between industrial and environmental goals (GreenCape, 2025; The tdic, 2021; Ojo *et al.,* 2025). The above measures emphasize the need to balance the industrial policy of automotive with decarbonization objectives.

The example of EV transition in India shows how the effect of a unified national policy can be realized. The Faster Adoption and Manufacturing of Electric Vehicles (FAME) program had integrated purchase incentives, support of charging infrastructure, and domestic manufacturing conditions which boosted EV sales to a substantial amount and led to local value chain manufacturing. Empirical assessments of India to explain its fast growth in electric two- and three-wheelers is not due to the market-driven factors but to the targeted subsidies and predictable policy assistance (IEA, 2023; NITI Aayog and Rocky Mountain Institute, 2019).

China is the most inclusive representation of state-driven EV adoption in which long-term industrial planning, heavy fiscal support, and strict regulatory requirements have altogether changed the global EV market. Subsidies, license plate quotas on internal combustion vehicles, and massive investment in the charging infrastructure allowed china to realize economies of scale and cost-saving, which redefined the world supply chains (Ou *et al.,* 2018; IEA, 2023). Although Nigeria cannot copy the picture of China directly, the experience shows the significance of consistency and scale of a policy.

A more localized case of Kenya can be used to show the ability of the targeted regulatory reforms to trigger early-stage EV markets. Recent actions, such as lower electricity prices on EV charging, exemption of import duties, and pilot fleet programs have positively affected the market situation, although it has little financial strength. There is initial indication that regulatory transparency and involvement of utility-sectors have played a significant role in facilitating the involvement of the private-sector (World Bank, 2022; AfDB, 2023). These experiences can be used in Nigeria, especially when it comes to electrification of two and three-wheelers and the deployment of fleet.

5.3 | Regulatory Gaps and Institutional Challenges

Although there is increased policy concern, Nigeria has a limited EV transition due to immense regulatory and institutional loopholes. The major challenges include inadequate coordination of the important ministries and agencies such as ministries dealing with energy, transportation, trade, industry and environment. Lack of coherent structures of governance usually leads to duplication of roles, discrepancies in policies, and procrastination, an issue that is prevalent in energy transition projects in developing economies (AfriPoli, 2023; EV World Africa, 2023). In a situation where there is no centralized e-mobility coordination mechanism in Nigeria, the coordination of transport electrification with power sector planning and industrial policy has been hampered.

Regulatory frameworks on the vehicle standards, licensing, and safety have not been completely geared towards the electric mobility either. The current procedures of vehicle homologation are mostly based on internal combustion technologies that put EV importers and operators in doubt. The international standards that concern battery safety, charging interfaces, electromagnetic compatibility, and recycling are still yet to be fully domesticated into the regulatory framework of Nigeria. It has been shown that regulatory uncertainty adds to the costs of compliance and deters the private investment, especially in young markets (IEA, 2023; UNEP, 2021). These gaps underscore the need for targeted policy reforms to support Nigeria's EV transition. Evidence from international best practice recommends active EV policy frameworks, integrated fiscal encouragements, technical advances, infrastructure planning, and industrial development within a unified governance structure. For Nigeria, priority actions should focus on establishing a clear national EV roadmap, introducing time-frame fiscal motivations, matching standards with international models, and consolidating inter-ministerial coordination. In the absence of such reforms, regulatory disintegration is likely to continue limiting adoption, despite favorable long-term economic and environmental gains.

6. | Opportunities, and Future Outlook.

Despite palpable EVs adoption challenges, Nigeria possesses considerable opportunities to leverage electric mobility as part of a broader sustainable development strategy. Ever-increasing urbanization, high population density in major cities, and extreme traffic congestion create favorable conditions for EV deployment, particularly in public transport, ride-hailing services, and last-mile delivery. Verifiable evidence from comparable African cities suggests that electrification of high-utilization urban fleets delivers economic and environmental returns during early adoption phases (IEA, 2023; RMI, 2024). Nigeria's large market size further boosts its potential to achieve economies of scale once adoption advances. The country has remarkable potential to integrate EV deployment with renewable energy expansion. Nigeria's abundant solar resource offers a valuable prospect to disengage transport electrification from fossil fuel–based electricity generation. Findings suggest that solar-powered charging infrastructure, particularly for fleets and depots, can considerably diminish operating costs and emissions while advancing energy security in regions with weak grids (World Bank, 2022; AfDB, 2023). Such integration aligns with Nigeria's broader energy transition objectives and could boost the resilience of the EV ecosystem.

Industrial development presents another major opportunity. Phased localization of EV assembly, supported by skills development and supplier integration, could mitigate import dependence while creating employment and technological learning opportunities. Foreign experience shows that even partial localization can increase accessibility and strengthen supply chain resilience when matched with supportive industrial policy (UNIDO, 2020; UNCTAD, 2023). For Nigeria, concentrating now on commercial vehicles, two- and three-wheelers, and fleet applications may offer the most striking entry points for industrial participation in the EV value chain.

Looking ahead, Nigeria's EV transition is likely to follow a phased and uneven trajectory. Short- to medium-term adoption will likely remain concentrated among fleets, public transport systems, and institutional users, where economic and operational benefits are promptly realized. Over the longer term, broader private adoption will depend on sustained policy commitment, infrastructure expansion, declining vehicle costs, and positive demonstration effects. Longitudinal studies of EV diffusion emphasize that consistent policy signaling, and cumulative learning effects are essential to moving markets beyond early adoption stages (Rogers, 2003; IEA, 2023).

Electric vehicle future of Nigeria is marked by a considerable number of limitations and a high amount of potential. Although infrastructural, economic and institutional obstacles make large-scale adoption of renewable energy unrealized, strategic policy intervention, specific investment and alignment with renewable energy and industrial development agendas might make such process more expeditious and comprehensive. The degree to which Nigeria can leverage on these opportunities will be a major factor that will see the electric mobility emerge as a niche innovation or a cornerstone of the sustainable transport and energy future of the nation.

7. | Conclusion

This review has examined electric vehicle adoption in Nigeria through an integrated appraisal of technological readiness, economic feasibility, policy and regulatory dynamics. From a technological perspective, the analysis indicates that battery electric vehicles, plug-in hybrid electric vehicles, and hybrid electric vehicles each present differentiated suitability profiles under Nigerian operating conditions. Urban congestion, short trip distances, and regenerative braking advantages favour electrified drivetrains, particularly for fleet-based and urban mobility applications, while climatic stress, road quality, and charging availability remain bottlenecks. The economic analysis highlights that, despite higher upfront purchase prices, EVs offer convincing long-term cost advantages through reduced fuel and upkeep costs, particularly under high fuel price volatility and congested driving conditions. From policy standpoint, the review underscores that Nigeria's EV transition is still at an early and fragmented stage, characterized by emerging policy signals rather than a coherent national electrification strategy. Comparative insights from South Africa, India, China, and Kenya demonstrate that rapid EV adoption is rarely driven by isolated incentives; rather, it emerges from coordinated policy packages that combine regulatory certainty, infrastructure investment, industrial policy, and market stimulation. The Nigerian case thus illustrates the need for an integrated governance framework that aligns energy, transport, trade, and industrial development objectives. Collectively, the findings emphasize that scaling EV adoption in Nigeria requires an integrated, systems-based approach that simultaneously addresses technology performance, economic viability, infrastructure readiness, and institutional capacity. As global momentum toward transport electrification accelerates, Nigeria's ability to harness EV technologies will depend not only on technological availability, but on the coherence, credibility, and adaptability of its policy and research ecosystem.

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