

# Electric Vehicle: Prospects and Possibility in Nigeria

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**Abstract** – The rate at which the global automotive industry advances in technology with its attendant benefits in eco-friendliness has become a wake-up thought to Nigerian automotive industries. With the available resources and technical know-how in Nigeria for the production of internal combustion engine (ICE) automobile, there should be nascent interest and political will to produce Electric Vehicles (EVs) as well in Nigeria. However, the challenges of insufficient, unstable electricity supply, good road network, procurement of batteries and provision of charging facilities critical for the EVs will have to be tackled to realise the vision as elucidated in this study. It is hoped that the recommendations prescribed would be a good roadmap for a promising country like Nigeria to compete favourably with other developed countries in EV production.

**Keywords** – Battery costs, companies, distance range, electric vehicle, energy storage, market

## I. INTRODUCTION

An Electric Vehicle (EV), commonly referred to as a 'Plug-in' Electric Vehicle (PEV), is any vehicle that is power-driven partly or fully by a battery which source of charging is direct connection to the mains. It is operated on an electric motor(s) instead of an internal-combustion engine (ICE) that generates power by burning a mix of fuel and gases [1].

The electric vehicle can be classified according to its average distance and mechanical or electrical composition [2]. Thus, various types of electric vehicles that trended over time are Battery Electric Vehicle (BEV), fully powered by electricity; Hybrid Electric Vehicle (HEV), which uses both the internal combustion engine and the battery-powered motor. A combustion engine is used both to drive and charge when the battery is empty; Plug-in Hybrid Electric Vehicle (PHEV) uses both ICE and battery. However, the battery is charged by its plug with electricity from an external socket; Fuel Cell Electric Vehicle (FCEV) uses electric energy produced from chemical energy [3], [13]. However, the BEV or PEV is usually discussed, perhaps, due to ease of usage with minimal pollutants and maintenance.

In spite of the uptake in the production of EVs in developed countries, concerted efforts are made to introduce EVs that will maintain distance range of 100 to 300 kilometres (km) per recharge which at the moment has been a challenge. Furthermore, high battery costs translating into the high production cost of each EV have prominently triggered researchers' interest in possible payback substitutes compared with the cost of ICE vehicles. BEV has a considerable advantage of environmental friendliness in terms of air pollutant emissions. Fortunately, the enactment of credible policies and constant cost reductions of batteries have significantly accounted for EV growth globally (see Table 1). The rapid growth of EV sales over the past five years, has reached almost 600, 000 and 800, 000 globally in 2015 and 2016 respectively. Of course, China is noted to have made nearly half of the sales in 2016, though EV sales and market share in different countries differ. In 2015, Norway has EV market share of over 20%, Netherlands has nearly 10% and California 3%, while below 2% is allotted to other major markets. The quest to reduce carbon emission that is directly linked to ICE, has led to the mass production of electric trucks and buses as well as electric two-wheelers in China, with over 100 million sold through 2015. High cost of battery has been a constraint to the steady and rapid rise of sales of EV. But at recent time, significant cost reduction of batteries and higher distance-range of EVs have made sales to skyrocket through 2020 and beyond [4].

Table 1: Global markets for EV sales by countries.

S/N	Countries	Est. Total PEVs. Feb 2016	Est. PEV Sales 2015	PEVs as % of market 2015	Total LDV market 2015
1	USA	>415000	>115000	0.6%	17500000
2	California	>189000	>62000	3.1%	2100000
3	China	300000	207000	0.8%	22000000
4	Japan	150000	25000	>1.0%	4200000
5	Netherlands	91000	43000	9.6%	420000
6	Norway	90000	34000	>20%	170000
7	France	>70000	27000	1.5%	2000000

8	Germany	>50000	24000	0.75%	3500000
9	UK	>38000	>28000	>1.0%	2700000
10	Europe		>193000		
11	World	>1100000	>450000	0.5%	88000000

Source: UC Davis market data

### A. DISTANCE RANGE ANXIETY OF ELECTRIC VEHICLES

The challenge of the costs of building charging stations at strategic points in many cities of our countries is snowballing the incidence of range anxiety. But with the enactment of anticipated policy of Infrastructure Investment and Job Act, it is believed that this should be a gateway for improvement and availability of fund by the Federal government to provide many more EV charging Stations [11]. Although, there is always fear about the distance an EV can drive, which may not be enough to reach its destination. Interestingly, it was observed that the average individual journey in the UK is less than 16 km, though, in Europe, longer distances have been achieved with some varieties of EVs in recent times [5], [15]. Suffice to say that the adequate driving range of EVs and their maximum performance hinge on a suitable energy storage facility available. Over time, some of these energy storage facilities have been developed by unceasing efforts in research, ranging from batteries (i.e., storing energy using a chemical reaction) to ultracapacitors (i.e., storing energy by employing an electric field). And these batteries are charged at some designated corridors of charging stations across the country, Figure 1, when the need arises.



Fig. 1: Public Charging Station.  
Source: Blinkcharging.com [11]

### B HIGH ENERGY STORAGE CAPACITIES FOR EFFICIENT ELECTRIC VEHICLES

The amount of energy that can be delivered to the transmission driven-train of an EV is of paramount importance. Since the cost and time of charging an EV

depends on the capacity of the battery, then the internal resistance of the battery should be minimal, having a low-charge current, lower state of charge, higher cyclic life and lower temperature in order to obtain a highly efficient battery. Figure 2 compares the battery capacity to the driving range of BEVs and PHEVs. Amongst the highly efficient batteries characterized by relatively high energy density, high specific energy and good cycle life, Lithium-ion batteries offer optimum energy output. Little wonder, the high patronage of the battery by many EV manufacturing companies for the optimal performance of EVs. Consequently, the cost of producing it becomes high, invariably escalating the cost of EVs. However, by the impact of strong policies, cost reductions of these batteries have been enforced to enable rapid EV sales growth. Figure 3 shows the estimated costs of lithium-ion batteries used in EVs.

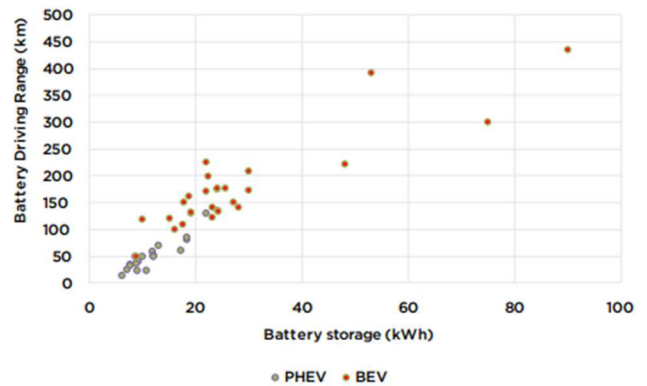


Fig. 2: Comparison of the battery capacity versus driving range for BEVs and PHEVs.

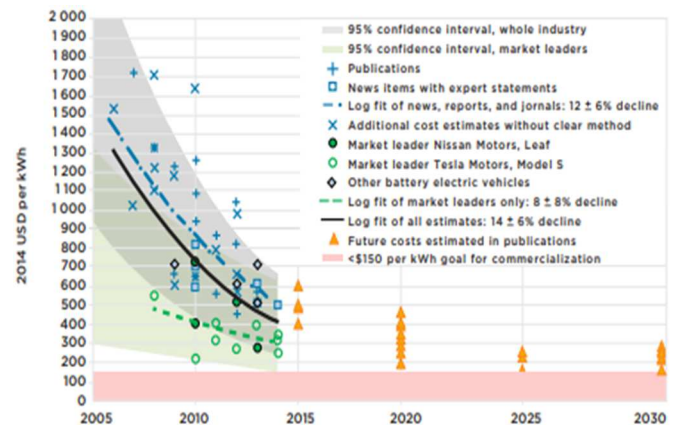


Fig. 3: The estimated costs of lithium-ion batteries used in EVs.

### C CHARGING SPEED

Considering the rate at which the electric car is fully charged unlike the fossil-fuel car that can be served with fuel within few minutes, many drivers have the difficulties of

adjusting to the charging process of electric vehicles in charging stations as shown in Figure 4.

EV charges are categorized into three phases as stated below:

Phase 1: Here, 120V standard plug is being used to charge the vehicles overnight. Vehicles with extra-large batteries might take twenty (20) hours or more to charge fully.

Chargers installed in some residential areas are mostly classified under Phase 1.

Phase 2: 240V plugs are used in Phase 2 with SAEJ1772 connections. Public commercial charging stations are in Phase 2. Phase 2 chargers are known by their fast rate of charging at the minimum of three (3) hours and maximum of twelve (12) hours to charge fully depending on the size of battery. With recent advancement in technology, EV battery can be charged to 80% within 30-60 minutes. Improvement in battery technology reduces the charging time and enhances service delivery to owners of electric vehicles. Suffice to say that many EV manufacturers, like Porsche has already achieved DC charging speeds of 23 minutes for 88% for its Taycan model and claims 62 miles of range at 5 minutes. Tesla's model S has also achieved 130 miles of range with just 15 minutes of direct current charging.

Phase 3: This Phase affords the quickest possible charge at 480V direct current (DC) by fast chargers [11].



Fig. 4: The charging stations with varying speed charging  
Source: *Governing.com* [11]

#### E DEARTH OF MECHANIC

At the instance of break down of the vehicle, it is more expensive to engage the service of the dealers than using a qualified mechanic equipped with modern tools meant for repairs and maintenance of EVs. Although, these mechanics are relatively few that have acquired skill in repairing or servicing the electric vehicles, more vocational centres saddled with organizing workshops and training programmes should be established to train more skilled personnel. The sophistication of EVs demands that only trained technicians can fitly service or repair them as it will be risky for untrained technicians (see Figure 5).

Fortunately, EVs need less maintenance, though the cost of

replacing damaged or malfunctioning components is very high.



Fig. 5: Repairs on the EV damaged components.  
Source: *GreenCarReports.com*

This paper is organised into four sections: the first section presents the introduction that includes distance range anxiety of EVs, energy storage capacities required to drive EVs, charging speed and dearth of EV technicians; the second section describes the prospects and possibility of EVs in Nigeria, the third section discusses the potential setbacks in EV production in Nigeria and the last section gives the conclusion and recommendations deserved in EV production in Nigeria.

## II. PROSPECTS AND POSSIBILITY OF EV IN NIGERIA

Since 1960 when Nigeria had her independence, the government recognised the necessity to expand or grow its economy through industrialisation. Subsequently, policies leading to the establishment of the automotive industry were enacted in the early 1970s. The bid to implement these policies allowed private multinational companies, like Leventis, UAC, R. T. Briscoe and SCOA, to introduce automobile assembly plants in the country [6]. Later, the European Original Equipment Manufacturers (OEMs), in alliance with the government of Nigeria, established state-owned automobile plants such as Steyr Nigeria Limited, Peugeot Nigeria Limited, Leyland Nigeria Limited, Volkswagen of Nigeria Limited and Anambra Motor Manufacturing Company (ANAMMCO) [7].

Although these plants were short-lived and could not thrive for poor capacity utilisation, local companies like Innoson Vehicle Manufacturing (IVM), and Stallion Motors Nigeria Limited, were determined to resuscitate the industry since it is critical for the economic development of any country. Therefore, there is a high expectation that with time cars running on Electric drive for use in Nigeria will be produced, taking cognisance of technical know-how in the production of fuel-powered vehicles as evidenced in the existing automobile plants owned by these companies. However, political will and credible policies are required for

the actualisation. The government should make concerted efforts through huge investments in the power sector to ensure an adequate power supply that is critical for EVs. Moreover, the architecture of ICE vehicles is not at much variance from the EVs to deter or prolong the production of EVs. In view of the foregoing, Nigeria has the requisite knowledge, capacity and capability to kick-start manufacturing Electric Vehicles (EVs).

Recent technological advancements have made EVs viable alternatives to fossil fuel-driven vehicles, but eco-friendly feat whose production is vigorously and competitively pursued globally. Statistics reveal that from more than 1,000 sampled global automotive leaders, average estimates of 52% of EVs will comprise the markets of US, Japan and China while remaining 48% is for Western Europe. So, the significant uptake of the global market slightly less than 10%, now will be driven by battery-powered models, thereby achieving cost parity to vehicles driven by ICE. However, the adoption of EV in many markets has been inhibited by the prolonged charging times and the limited number of models available. The good news from the recent stride in automotive industries has significantly reduced charging times from 3 hours to 30 minutes, and there is a strong pipeline of new EV models that will be launched soon to create more options for consumers [8], [14].

Therefore, Nigeria should not be left out of the league of developed nations producing these Electric Vehicles. However, it is speculated that by 2030 in view of the growth rate of electric vehicles and as the sticker prices reach parity with gasoline-fuelled cars, the ICE vehicles will have exited the market. Kudos to a homegrown firm, Nigus Enfinity that attempted to introduce electric vehicles into the Nigerian automobile market in 2018, while its local assembly plant for EVs was hoped to be operative by 2020 [9].

### III POTENTIAL SETBACKS IN MASS PRODUCTION OF EVs IN NIGERIA.

Despite the advocacy and attempt to produce electric vehicles in Nigeria, it is worthwhile to discuss factors perceived as potential setbacks in the mass production of electric vehicles in Nigeria. Factors such as:

- *Insufficient and unstable Electric Power Supply:* Nowadays, frequent power outage has become the order of the day in Nigeria; rarely will one notice a constant supply of electricity in a day. Nigeria is often bedevilled with grid collapses despite supposed government intervention in the power industry. Moreover, even when electricity is available, the quality of electricity supplied becomes another issue to be tackled.

- *Government reluctance to ensure depletion of fossil fuel:* The inability of the government to legislate immediate policy action debilitating the sources of carbon emissions through fossil-fuelled vehicles could be a potential threat to the production of EVs.
- *Issue of battery acquisition:* Since the battery is critical in the operation and performance of EVs, its importation will certainly pose some challenges, particularly in the costs, design and models of EVs, unlike when it is locally produced.
- *Installation of smart recharging infrastructure:* The alleged fear of optimal driving range and performance of EVs that hinge on the capacity of the battery can be assuaged by an efficient battery-charging station. Of course, the station should be smart in its design in order to recharge EVs with 250 to 400 kilometres range within the shortest reasonable time. However, the cost of installation of smart recharging infrastructure is high as much energy is needed.
- *Environmental issue:* Although the production of EVs will reduce carbon (IV) oxide (CO<sub>2</sub>) and carbon monoxide (CO) emissions, the manufacturing and disposal of batteries used in driving these EVs are made of toxic chemicals, which should be an area of concern [12].

## IV CONCLUSION AND RECOMMENDATIONS

### A. CONCLUSION

Nigeria, though the largest economy in Africa, ironically has many of its citizens in abject poverty. The level of poverty prevalent in the country elicited some challenges in security, absolute reliance on crude oil, electric power supply, infrastructure and industrialisation. Of course, these challenges have threatened the prospect of electric vehicles being mass-produced in Nigeria.

Notwithstanding, great possibilities of manufacturing EVs in Nigeria have been identified, and therefore required political will and funding for its actualisation. EVs will definitely add value to Nigerians not only on the environmental concerns but cost reduction and recreational activities that require mobility. So, with credible policies and commitment to implementation, it is believed that the prospect and possibility of EVs in Nigeria will be a reality.

### B. RECOMMENDATIONS

EV production would not have been without some challenges; however, these challenges should have been addressed if the following recommendations were considered.

- *Credible policies*: There should be an enunciation of a bill seeking the legislation of fossil fuel depletion that invariably will necessitate the mass adoption of EVs. Of course, this will strengthen the work of all relevant stakeholders in the automotive industry to make significant input for our economic viability.
- *Research and Development*: Investment in research and development should be reinvigorated to provide leeway for innovation of EVs and the mechanisms required for achieving it.
- *Empowerment of the National Automotive Design and Development Council (NADDCC)* [10]: The role of NADDCC should be enhanced by a government empowerment scheme to promote local content, as most of the EVs' components are imported. They are only being coupled together in the Nigerian assembly plants.
- *Stable and sustainable Electric Power Supply*: Electricity is critical for the production of EVs in Nigeria. Therefore, more commitment is expected from the government to improve the availability of electricity and ensure its constant supply.

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