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IMPACT OF ELECTRIC VEHICLE IN 21ST CENTURY DEVELOPING COUNTRIES

EFEMWENKIEKIE U. KELVIN, BABALOLA O. PHILIP, DIRISU O. JOSEPH& OYEDEPO O. SUNDAY

Department of Mechanical Engineering, Covenant University, Ota, Nigeria

ABSTRACT

An electric vehicle has been around for several decades. Still, the advancement in Internal Combustion Engines (ICE) further relegated it to the background, but due to the environmental implication of fossil fuel sources as a means of powering ICE vehicles. The world is focusing on sustainable and renewable energy, as efforts are made to diversify into other fuel sources. The electric vehicle has shown the tremendous potential of been an alternate means for the transportation industry. Despite the successes thus far, there remains a significant challenge of Electric Vehicles, which is the cost of purchase and charging infrastructure in the developing countries. However, the benefits are numerous and thus outweigh the challenges. The accrued benefits are connected with the environmental condition, human state of health, negligible CO_2 and harmful emissions, economic growth, and development. This study gives an insight into the impact assessment of Electric Automobiles, identifying the challenges and opportunities and the benefits.

KEYWORDS: Electric vehicle, Internal combustion engines, Renewable energy, Fossil fuel, CO_2 emission

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Original Article

1. INTRODUCTION

The challenges of global warming, climate change, and the Emission of Green Housegas (GHG)resulted to the alternate technology of electric vehicle since eighty percent of GHG emission is traceable to the usage of fossil fuel in the transportationsegment. The overview of marginal vehicle knowledge, as a response to the transport sector burden concerning fossil fuel reliance, models inquiries with respect to their effects on movement and driving conduct and the environment. Concerning driving behaviour, motion, luxury, charging schedules, interface with charging structure, some researches have been carried out to assess user gratification and adaptation to electric vehicles(E.V.) [1].

Hanke [2] asserted that hybrid and electric vehicles (E.V.) play a significant part in a technology selection directed to dwindling greenhouse gas emissions along with the reliance on oil by financing the development of renewable energies, initiating new movement idea. E.V.is becoming progressively common round the globe.It is estimated that several of such automobiles will rovethrough nations of the world in the future and, as an eco-friendly transportation means,also make available stored energy and additional services to the forthcoming gridAl-anbagi[3].

Alvaro [4] agreed that the Earth's climate is changing. Leaderships of developed nations adopt various strategies to alleviate the impact of GHG emissions and mitigate their effects on the environment.Environmental concerns have been a significant concern throughout the world, in particular greenhouse gas emissions and air pollution. E.V.,as a groundbreakingeco-friendly transportation substitute, has been evolving answersin meeting these upsets in present-day and can enhance the air qualitythroughplummeting emissions [5]. Besides, in a smart

energy supervision system, E.V. can be used as a circulated energy-storing space, which is beneficial to make steady the load curve by charging the battery at low cost and setting off to the network at peak time[6].

Redgate [42] suggested that E.V. is the best eco- friendly prototype for a transport scheme. The notion hinges on currentknow-how that could encompass the use of zero-emissions electric vehicles fused with a very efficient electric drive method and an electric storage system that can be stored using renewable energy origins. Over a decade, the transport sector has been regarded as the main energy consumption sector in the European Union, accounting for one-third of the final energy consumption. However, this sector accounts for 25% of all CO_2 emissions. Road emissions, as an example, generatesover 91 percent of emissions [7].

Sakka [8] claimed that various automobiles usedin developed nations have caused and continue to cause serious harm to the surroundings and social life. Global warming, airborneaffluence, and the rapid decrease in Earth's abundance are now severe challenges. Most E.V. use bi-storage energy appliances, one with colossal energy storage ability, called the "main energy system," and the other with high power capacity and reversibility, called the "rechargeable energy storage system."

There is an increment in the use of an electric vehicle,as shown in Fig. 1, which projects its probable widespread use by developed and developing countries. Fig. 2 shows that the use of electric vehicles is more prominent in developed countries than in developing countries. The crash in oil price, as experienced in the CONVID 19 pandemic, brings anindirect welcome of the electric vehicles [9,10].

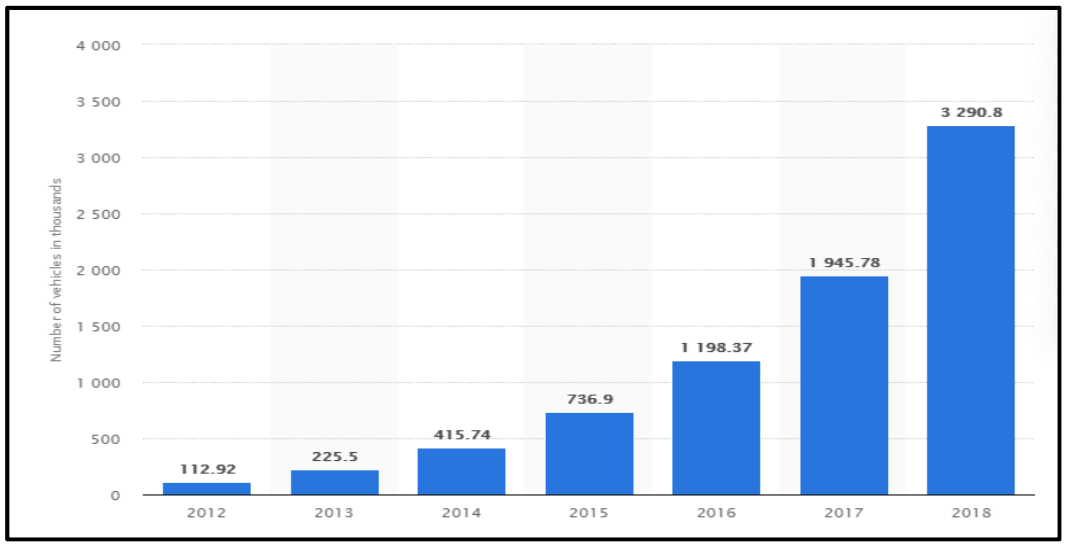

Figure 1: Worldwide number of Battery Electric Vehicles in use from 2012 to 2018(in 1,000s) [9]

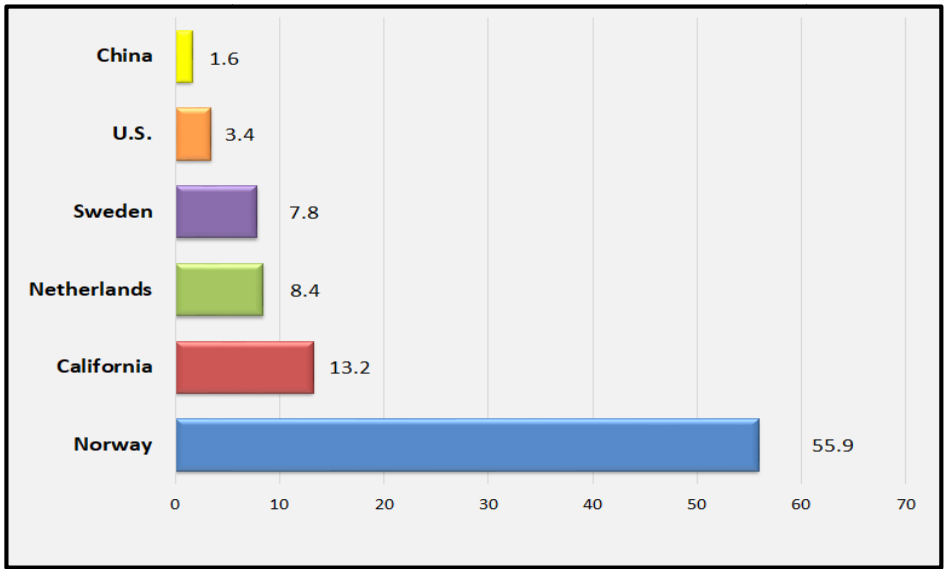

Figure 2:Electric Car ownership in Selected top-selling Countries [10]

1. History of Electric Vehicles

Since the nineteenth century, E.V.s had been in existenceand seen as an alternative to ICE vehicles.E.V.s became popular in 1900. At the time, steam and gasoline-powered vehicles had limitations of range, and a handful of times as required,which as well involve a great effort to start [11]. However, ICEs development and improved availability of gasoline put an end to the short-term eminence of E.V.s. As these advances in technology continued, the E.V. was no longer a competitive option[12, 13]. According to the peripheral target market for E.V.s, production for individualusage became necessary decades later, indicating that the suburbs of the U.S. metropolitan areas have the greatest prosperity and proportions of garages and multi-vehicle homes. Fig. 3 shows a typical electric car charging station.

2. Brands of Electric Vehicles

Battery Electric Vehicle: BEVs use battery as a central power source. Nonetheless, certain BEVs use additional systems to support batteries, e,g, ultra-capacitor. The BEV includes a battery, an electric motor, and electronics. Some battery technologies provide various functions for electric vehicles.

Plug-in Hybrid Electric Vehicle: Hybrid electric vehicle uses two or more energy supplies/sources to drive the vehicle, one of which is an electric energy engine, when an HEV-related model is developed with the prospect of linking it to the electrical system.

Fuel Cell Vehicle: Power is being generated through the fuel cell unit, either to supply the electric motor or to supply the energy in the battery. Fuel Cell Vehicles are unlikely to be viable shortly compared to other types of electric vehicles, as fuel cell units are currently very costly [14].

Figure 3: Outlook of Electric Vehicle Charging Station [15]

3. Battery/Charging System

Al-anbagi [3] observed that the grid must meet the request by increasing or reducing its power creation to lessen the frequency instabilities. E.V.s can partake in this maneuver by charging their batteries from the grid through frequency regulation-down and by discharging their batteries from the grid during frequency regulation-up. Partaking E.V.s have the privilege of benefitting from the bidirectional flow of energy with the smart grid in answer to frequency adjustment.Analysis of energy data in the U.K. showed significant use of plug-inn hybrids ' fast charging facilities [16].

Observations of uncontrolled charging situations afford an avenue of assessing the effect of PEVs on the worth and strength of the power system and of designing approaches to disruption alleviation[17, 18]. The large decrease in energy costs to be paid by users who's E.V.s require recharging during the day to carry out their regular scheduled tours and also to reduce the effect of charging on the electricity grid. Moreover, there is a chance of transferring excess energy in their batteries, among other E.V.s, which require charging throughout their regular tours [4,19].

Battery-powered E.V.s can operate silently and pollution-free, providingthe answer for the forthcoming generation of automobiles. Electric Vehicles,in contrast to internal combustion engine vehicles, use autonomously equipped motors to propel each wheel. The self- sufficient, equipped motors provide greater power/weight density, greater safety reliability, and improved dynamic performance [20]. Quantifying the driving or braking forces between the tires and road surfaces in real-time becomes easy, which provides a great deal for the use of new traction control approaches based on road conditions assessment [21].

The battery management system(BMS) is one of the core components of electric vehicles(E.V.s). It was used to observe and manage a battery system(or pack) in E.V.s. BMS guarantees the safety and reliability of the battery system, increases its efficiency, prolongs its useful life, and improves the driving range of E.V.s [22].Conti [23] indicated that focus on vehicle design and battery and energy management in electric and plug-in hybrid electric vehicles(EV / PHEV) is crucial. E.V. users express concern about the durability of the electric battery and, consequently, the life cycle, which adds up to a key part of the cost and price of the vehicle.

4. CO_2 Emission

Electric Vehicles(E.V.) and Hybrid Electric Vehicle (HEV) were seen as an essential part of a technology set aimed at

reducing GHG emission and relying on fossil fuels by financing the development of a renewable source of power, the emerging new mobility idea, e.g., for public transport, or supporting technological advances [24].Mclaren [25]presented a detailed investigation of expected releases from both an electric battery and PHEV for four charging states and five electricity grid synopses. A situation where drivers can charge E.V.s at work producesthelowestamount of emissions for the mainstream of electricity grid details.

Conversely, vehicle emissions are reported to be very reliant on the proportion of fossil fuels in the grid mix, with different vehicle types and charging situations resulting in lower emissions when the grid carbon concentration is above a defined level. Checking off-peak charging results in higher total emissions for all types of vehicles than for other charging situations. Battery degradation is one of the major factors that can affect indirect emissions, as batteries are the sole source of energy for electric vehicles, and battery degradation will have a direct impact on vehicle performance [26]. Furthermore, the battery is one of the major components in an electric vehicle, and their substitutes do have a strong influence on indirect emissions. The deviation of energy efficiency by battery degradation was examined by driving tests with an E.V. The timing and impact of battery alternation on indirect CO_2 emissions were assessed by the Li-ion battery cell test [27].

1. Impact of Electric Vehicles

Messagie&Brussel [28] stated that life cycle assessment (LCA) is an approach, customarily used for the environmental valuation of vehicle product/system. LCA review investigates all the environmentally relevant practices all through the life cycle of vehicles, ranging from the extraction of raw material, components production, assembly, transport, vehicle use to end-of-life treatment. Studies of various LCA reviews as shown that there are divergence outcomes and interpretations observed. Observed divergence is explained by the following:

- Systems boundaries variations,
- Allocated average or marginal electricity mixes differential and
- Real-life monitoring tailpipe emissions for comparisons.
- Life Cycle Inventory of the glider and the lifetime of the vehicleassumptions. The choice of a shorter lifetime of the vehicle enhances the comparative importance of the vehicle production phase.
- As battery production has a significant impact on the impact of a BEV, battery life selection is also of crucial importance in conjunction with battery chemistry.

*The impact of E.V. system operating costs and the power request curve on an allocation network with large infiltration of distributed generation(D.G.) units.*Because of a multi-objective optimization setback, a competent management method for charging and discharging E.V.s is suggested [14].It provides financial subsidies via time- of- use rates and appear to positively shift demand to off-peak hours, thus avoiding an increase in peak system demand. Besides, a sizeable number of users schedule charging to start immediately at midnight, which is the beginning with the off-peak time. At the beginning of the off-peak period, low diversity in charging start time produces an unplanned demand point, and this presents a variety of difficulties for electricity utility [29].

2. Charging Infrastructure

Charging infrastructure creates severe challenges for the distribution system of such facilities.The most significant hitches

are generated by charging mono- phase vehicles, which intake comprises a large amount of the third harmonic, forcing the neutral drivers and supply transformers to subvert peak currents and overheat the supply system [30].Appropriate charging infrastructure is one of the critical features required to sustain the assumed mass of battery electric vehicles(BEVs), and it is noteworthy that publicly available fast chargers could play an essential role in this infrastructure [16,31].Fast charging is a unique technology with a scarcity of data that addresseslife data sets. It is crucial in determining the actual use of battery electric vehicles. It will be of benefit to stakeholders toenable her to plan on this novel technology [16].

3. Challenges and Opportunities

The need for new breeds of vehicles that uses a better non-polluting form of fuel sources should not be underestimated, owing to the numerous outcries from relevant stakeholders in the automobile industry. Due to these outcries, there have been continuous efforts by researchers to reduce the use of fossil fuel or even possibly eliminates its usage in the nearest future. These effortshave meant its brick end, in the work of Chan [32]; they asserted and submitted that the challenges of turning E.V.s from concept to reality could be achieved if the battery life is longer, safer, cheaper and more convenient andeasy for consumers. Several charging schemes have been proposed to improve convenience and increase charging efficiency: home charges, regenerative charges, solar charges, parking and charges (PAC), and moving and loading (MAC) [33].Johnson [34] also stated that though the battery had been a significant source of concern in the transit from fossil powered vehicles to electric-powered vehicles, however, there is a need to play more importance to the electrical energy storage has ability.

The transition from E.V.s to ICVs will be possible if sufficient and cheap new sources are made available. However, the complete transition will not be so rapid in developing countries. Recent battery development has been progressive but not sufficient. E.V.s are very expensive compared to ICVs, more so that their applications are irreplaceable with specific constraints.Developed nations have introduced motivational funds for H.V. and E.V. that have yielded positive results [35]. There are precise reductions in price for the purchase of E.V. as a form of incentives, tax exemption, and free parking lot for owners of E.V.s. Also,the development of battery recharging stations, which is of great importance, has been a challenge in developing countries due to financial implications [36].

Cost of electric vehicles andrecharging infrastructure is a challenge in developing nations, several efforts are being made to ensure low cost of manufacturing, for long-distance driving ICEVs are often used. To address the challenge of recharge infrastructure, various research and development are undertaken. If the concerns are addressed effectively, the E.V.s have the possibility of replacing ICE vehicles in developing countries [37].

9. Benefits and Limitations

Gatten&Ieee [38] revealed that electric vehicles are of great interest. They provide a promise of a vehicle to vehicle transfer of battery charge in transit, traffic congestion reduction, substantial driving time spent, decrease in the required number of heavy-duty vehicles, and noteworthy energy efficiency gain.In terms of dynamics, E.V.s provide improvement in torque control via the electric motor, which is an added advantage to the traction control system.The individual wheel motor of E.V.s also includes torque vectoring to boost stability and handling of the vehicle, unlike the ICEVs counterpart [39].Replacing ICEVs with E.V.s will have a cumulative effect in terms of fuel usage and carbon dioxide gas emissions, taking into account the generation of power and the transportation sector [40].It is evident that there is a pronounced market shift towards E.V.s in developing nations of the world due to the crucial effect on the total energy cost of

generation and growth of renewable energy via utilization of E.V.s [41].

10. CONCLUSIONS

Energy remains a major concern for the developing countries, and these challenges are expected to continue with the exponential increment in population been forecasted to double in major parts of developing countries, Africa is the highest hit in terms of the continent [43,44]. Nigeria happens to be the largest country in the continent with over 201 million in population according to United Nations Population Fund (UNFPA) in its 2019 world population reports; the country's population is forecasted to hit 400 million by 2050. The country's highest power generation is between 4000-6000 megawatts. The majority of Nigerians stills lives in perpetual darkness, little wonder while the country is the world poverty of the world. Though been the largest exporter of crude oil in the continent, it's striving for self-sufficiency has continuously meant it's a dead end. For a nation where electricity is yet to be a right for its citizens, the future seems to be blink for electric vehicles safe the reliance on personal generators. Corruption remains the causative hindrance to the advancement of this nation. It is a known fact population increment is directly proportional to energy needs and demands. If this country planto join the wagon, it is expected that the country fixes its energy industry. This paper gives an overview of Electric vehicles in the 21st century; the challenges are enormous, ranging from the high cost of E.V.s, the cost of charging infrastructure, and electrical storage facilities, among many. E.V.s havea great prospect in the developing nations of the world if the above-stated issues are properly addressed. Several kinds of research are ongoing in solving the various challenges of the impact of electric vehicles, which will significantly yield a positive result. CONVID 19 pandemic will encourage more customers to opt for an electric vehicle compared to the ICE.

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