

## Electric Vehicle (EV) Markets: A Comparative Analysis Between India, Nigeria, and Indonesia

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### ABSTRACT

This study aims to provide a comparative analysis of the electric vehicle (EV) markets in India, Indonesia, and Nigeria. The analysis will encompass various aspects of the EV market, including government regulations, charging infrastructure, consumer behavior, and market penetration. The objective is to identify the primary drivers and impediments to EV adoption in these nations. The research employed a mixed-method approach, utilizing both primary and secondary data collection methods. The analysis reveals that economic factors, particularly satisfaction with EVs, significantly impact adoption, with India exhibiting higher average satisfaction than Indonesia and Nigeria. A positive correlation between satisfaction ratings in India and Indonesia suggests commonalities in consumer preferences, although data limitations hinder conclusive insights. Notably, India's policy framework emerges as more conducive to EV adoption, with a statistically significant positive impact. The study implies that economic factors, especially satisfaction, contribute significantly to India's lead in EV adoption, highlighting the crucial role of the policy framework.

**Keywords:** Comparative Analysis; Electric Vehicle (EV); EV Adoption; EV Markets; Sustainability

## **INTRODUCTION**

Environmental preservation stands as a crucial agenda in the pursuit of attaining the 2030 Sustainable Development Goals (SDGs) (Rizki & Hartanti, 2021). Electric powered cars (EVs) are gaining popularity globally as a sustainable alternative to standard gas-powered cars to support SDGs (Mazlan et al., 2024). At some point of the twentieth and early twenty-first century, the environmental effect of the petroleum-based total transportation infrastructure, together with the concern of height oil, caused renewed interest in electric transportation infrastructure. EVs differ from fossil fuel-powered cars in that the power they devour may be generated from a huge variety of resources, which include fossil fuels, nuclear electricity, and renewables such as solar electricity and wind electricity, or any aggregate of those.

The carbon footprint and different emissions of electric cars vary depending on the gas and technology used for the strength era. The power can be saved in the automobile by the usage of a battery, flywheel, or super-capacitors. Cars using internal combustion engines usually derive their strength from a single or a few resources, normally non-renewable fossil fuels. A key gain of electric motors is regenerative braking, which recovers kinetic energy, usually misplaced for the duration of friction braking as heat, as strength is restored to the on-board battery.

This paper aims to offer a comparative evaluation of the EV markets in India, Indonesia, and Nigeria. Those international locations had been selected due to their particular monetary, social, and political traits that have an impact on their EV markets. The analysis will cowl diverse components of the EV market, consisting of authorities rules, charging infrastructure, purchaser conduct, and marketplace penetration. Through comparing these markets, it is aimed to discover the key drivers and obstacles to EV adoption in these countries and offer recommendations for policymakers and enterprise stakeholders.

## **LITERATURE REVIEW**

### **Electric Vehicle (EV)**

Electric vehicle (EV) is a mode of transportation propelled by one or more electric motors (Kumar & Revankar, 2017). EVs can draw power from external sources through a collector system or operate independently using onboard batteries, which may be charged via solar panels or by converting various fuels into electricity through mechanisms like fuel cells or generators. These electric vehicles encompass a broad spectrum, including conventional road and rail vehicles, as well as more unconventional forms like electric boats, submersibles, aircraft, and even spacecraft. Electric transportation is evolving alongside other innovative automotive technologies like autonomous driving, connected vehicles, and shared mobility, culminating in a vision known as Connected, Autonomous, Shared, and Electric (CASE) mobility (Habib & Lynn, 2020).

### **Advantages of EV**

#### *Environmentally Friendly*

Electric vehicles produce zero tailpipe emissions, significantly reducing air pollution and mitigating the impact of climate change (Nanaki & Koroneos, 2016). They help improve local air quality, making them a cleaner and more sustainable choice for the environment.

#### *Lower Operating Costs*

EVs have fewer moving parts than internal combustion engine vehicles, leading to reduced maintenance costs (Riesz et al., 2016). They do not require oil changes, and electricity is typically cheaper than gasoline. Over time, this translates into significant cost savings.

#### *Energy Efficiency*

Electric motors are highly energy-efficient, converting a large portion of electrical energy from the grid into power at the wheels (Albatayneh et al., 2020). This efficiency means that EVs can travel longer distances on a single charge compared to the energy equivalent in gasoline.

#### *Instant Torque*

Electric vehicles deliver instant torque, resulting in quick acceleration and responsive performance (Zhang et al., 2022). This makes them fun to drive and ideal for stop-and-go urban traffic.

#### *Reduction in Dependence on Fossil Fuels*

By using electricity as a power source, EVs reduce the dependence on fossil fuels, enhancing energy security and reducing vulnerability to oil price fluctuations and supply disruptions.

#### *Government Incentives*

Many governments offer incentives for electric vehicle adoption, such as tax credits, rebates, and access to carpool lanes. These incentives can significantly lower the upfront cost of EVs.

#### *Growing Charging Infrastructure*

The charging infrastructure for electric vehicles is expanding rapidly, making it more convenient to charge your EV (Das et al., 2020). With more charging stations available, long-distance travel becomes increasingly feasible, reducing range anxiety.

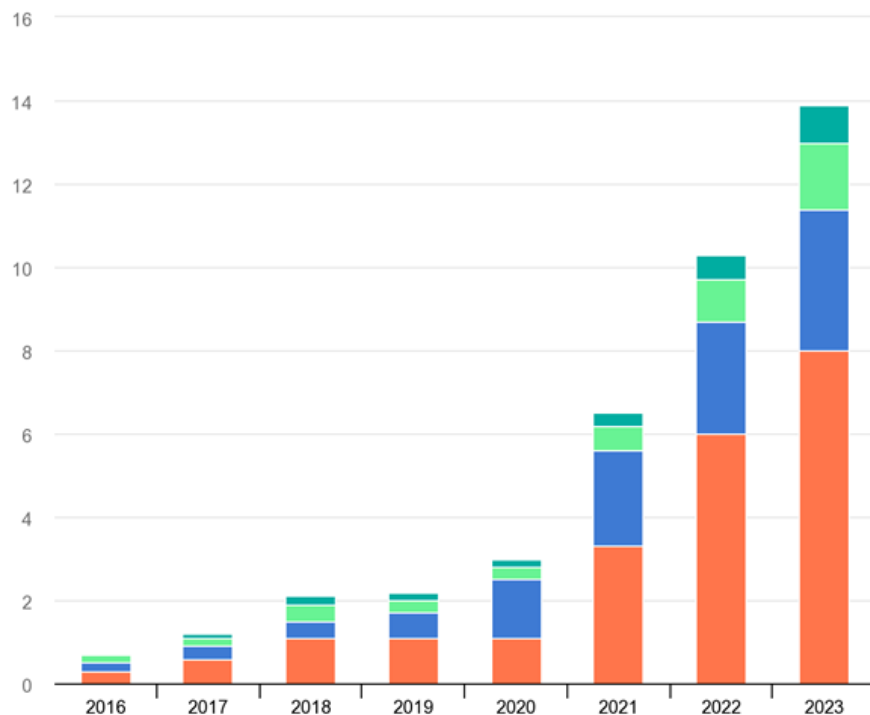
#### **EV Industry**

Electric automobile markets are seeing exponential growth as income surpassed 10 million in 2022. The share of electrical cars in general sales has more tripled in 3 years, from around 4% in 2020 to 14% in 2022. EV sales are predicted to keep over 2. Three million electric powered motors were sold in the first quarter, approximately 25% more than inside the same period closing 12 months. It is assumed to peer 14 million incomes with the aid of the quilt of 2023, representing a 35% 12 months-on-year growth with the new purchases accelerating in the second half of this year. As a result, electric powered automobiles should account for 18% of overall vehicle income across the overall calendar year. Country wide rules and incentives will assist bolster income, even as a return to the notably excessive oil fees seen final year ought to further inspire searching for what you offer.

India's recent electricity improvement has seen incredible success. However, many demanding situations remain, and the Covid-19 pandemic has been a prime disruption. In latest years, India has connected loads of hundreds of thousands of its citizens to electricity, advocated most families to apply rather efficient LED lighting, and induced a big growth in renewable energy, led by way of sun energy. The benefits to Indian residents and their satisfactory of lifestyles are palpable.

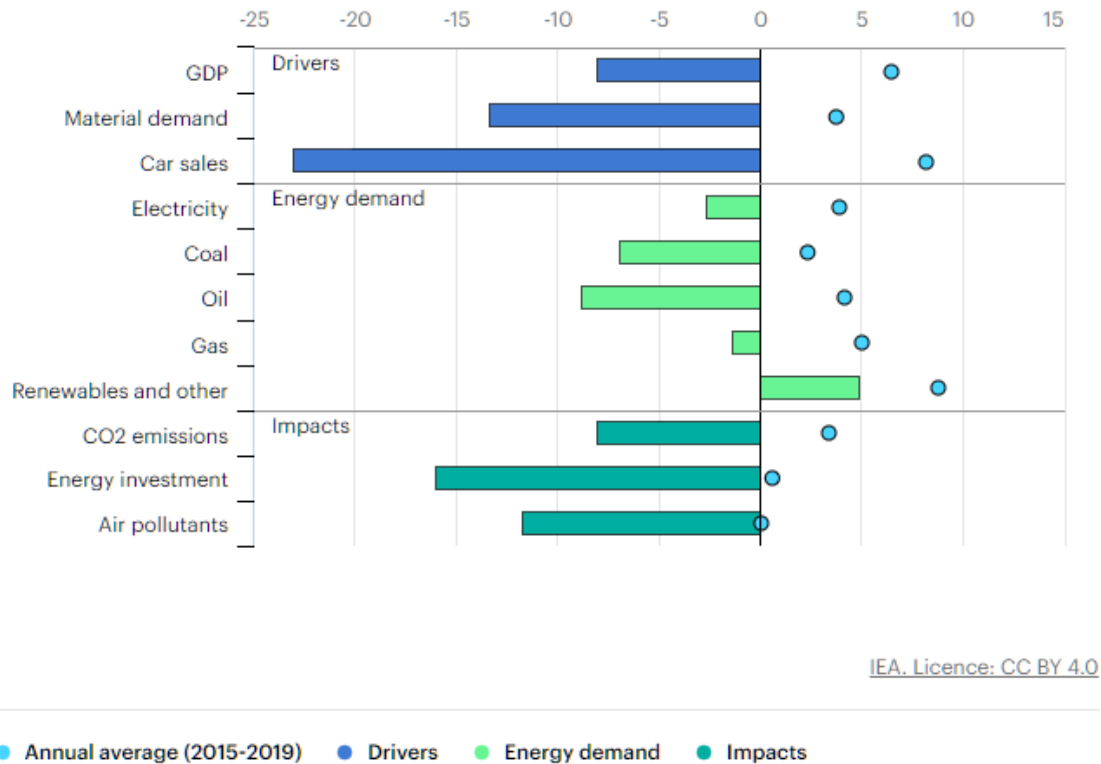
India has passed the targets mentioned in the Paris settlement Nationally Determined Contribution (NDC). The emissions depth of India's economy improves through 40% among 2005 and 2030, exceeding the 33-35% target exact inside NDC. The percentage of non-fossil fuels in electricity technology capacity is above 60%, an awful lot past the 40% assured by India. India's management within the implementation of renewable electricity technologies will force the steps marketplace for sun PV, wind turbine, and lithium-ion battery generation to greater than forty billion dollars by 2040. As a result, India will account for one in each seven bucks spent globally on those three categories of equipment in 2040, up from one in each twenty today. The industrial and commercial potentialities from easy energy are drastically greater in this case, and particularly in the sustainable development, wherein the system market for sun, wind, batteries, and water electrolyzes grows to eighty billion dollars in step with year.

**Figure 1.** EV Market Growth in 2016-2023



**EV Market of the India, Nigeria, and Indonesia**

**Figure 2.** Percentage Change in Key Indicators for India in 2020 Compared with 2019  
 %



Source: International Energy Agency (IEA), 2021

In Nigeria, EV industry is gaining momentum, with notable developments. The government expressed its support for this eco-friendly technology and aims to provide a conducive environment for its advancement. The introduction of electric mobility in Nigeria is seen as a vital response to global concerns about climate change and the need for sustainable, environmentally friendly transportation.

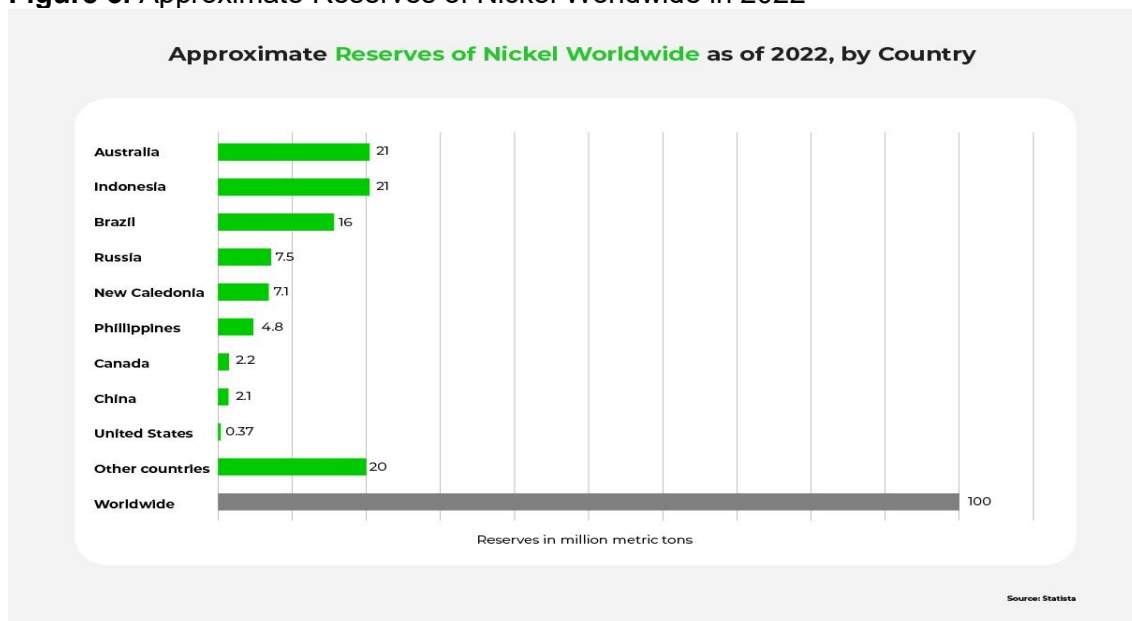
In 2022, Indonesia's EV marketplace become valued at \$533 million. With a projected CAGR growth rate of 20.9%, Indonesia's EV marketplace is predicted to reach a value of \$2 billion by means of 2029. As of October 3rd, 2022, Indonesia had round 28,000 EVs on the street. Indonesia goals to have 2.5 million EV customers. Indonesia is likewise the second one biggest automobile producer in the vicinity, after Thailand.

**EV Landscape in India and Indonesia**

In May 2023, excessive speed e-2Ws have been sold, compared to 42,415 gadgets offered in may also 2022. Sales of the electrical 3W passenger vehicle reached 39,437 units an 82% growth over the same month remaining year. Income of electrical 3W shipment vehicles improved from 2673 devices in May 2022 to 5172 devices in May 2023, while the income of e-4W rose from 2,959 gadgets to 7,414 gadgets over the past 12 months. OLA electric remains the top seller of -2ws in may additionally 2023 also, followed via TVS cars and Ather power. OLA electric powered registered a 207% Y-o-Y growth in income of their electric scooter. Hero electric bought 2,109 e-scooters throughout this month and has visible a decline of 29% Y-o-Y growth.

In 2021, Indonesia produced 760,000 heaps of nickel. It has 21 million metric heaps of reserves of the mineral. It also has the sector's second-largest copper deposit and massive reserves of other minerals which can be required for EV production, e.g., cobalt. The Indonesian government acknowledges this gain and is using it to draw traders to the United States EV market. In 2020, the Indonesian authorities applied an export ban on nickel ore. It created a country-owned preserving agency, thoughts, identity, which have become a primary shareholder in the largest mining groups in Indonesia, Freeport Indonesia and Vale Indonesia. In 2021, the government established Indonesia Battery organization — a joint assignment among country organizations in nickel mining, oil and gas, and strength sectors. This corporation is designed to leverage Indonesia's strategic benefit in the battery zone and facilitate the development of Indonesia's EV marketplace.

**Figure 3.** Approximate Reserves of Nickel Worldwide in 2022



### **Objectives of EV Car Introduction in Nigeria**

Nigeria is on the verge of mass-producing electric vehicles as part of efforts to shift focus away from rising fuel costs. In the coming weeks, the Federal Government will ratify the electric vehicle development plan. The plan aims to position Nigeria as a leader in vehicle electrification while working toward net-zero emissions by 2060.

To encourage EV adoption, federal, state, and local governments, as well as businesses with government contracts, would be required to purchase and use EVs. This would be driven by the need for cost-effective and sustainable transportation solutions due to the higher costs of gasoline and diesel.

### **Government Policies of India, Nigeria, and Indonesia**

Through laws and incentives for EVs, the Indian government has enthusiastically supported eco-friendly mobility substitutes. The FAME Policy (Faster uptake and Manufacturing of Hybrid and Electric Vehicles) was presented in 2 levels to speed up EV acceptance and infrastructure development. Electric Vehicles account for barely three percent of total vehicle sales in India, notwithstanding these efforts. The FAME-II plan has been extended through March 2024, with greater incentives for 2-wheeler and 4-wheeler EVs, in order to speed adoption. Several Indian states have also implemented EV policies. Maharashtra's reformist strategy intends to site the state as an EV investment hotspot by providing incentives, building charging stations, and boosting public transportation electrification.

Nigeria is instituting trial programs, forming regulations and policies, and constructing infrastructure for charging EVs in order to upturn local assembly capacity. In Nigeria, there is an increasing importance in R&D, capacity building, and creative business prototypes. The importance here is also on public transportation and paratransit vehicles, such as mini-bus (known locally as Danfos), buses, and commercial vehicles, to capitalize on movement and emissions savings. This is quite similar to the experience of the larger Global South. Conferring to reports, venture capitalists, investors, and start-ups are increasing their investments and working to launch 1,000 electric vehicles in Nigeria.

In August this year, Indonesia announced a two-year extension for automakers to meet eligibility requirements for electric vehicle incentives. With the newly introduced, more lenient investment regulations, automakers can pledge the production of a minimum of 40% EV components in Indonesia by 2026 to be eligible for incentives. Previously, Indonesia had announced its intention to decrease import duties from 50% to 0 for EV manufacturers contemplating investments in the country. Back in 2019, the government had rolled out an array of incentives targeting electric vehicle manufacturers, transport firms, and consumers.

### **Economic Base of India, Nigeria, and Indonesia**

Transportation area is a critical part of modern civilization. It plays vital position inside the development of economics, provision of residing wages to hundreds, at the side of era of multiple micro and macro-economic advantages (Krishna, 2021). The manufacturing region is also vital for the financial development of any us of a, mainly rising ones like Nigeria. Several industrialization strategies have been embarked upon through various regimes in Nigeria in the direction of leading into the league of evolved nations. Just after political independence in Nigeria in 1960, the Nigerian government recognized this want and embarked on numerous import substitution industrialization techniques. A crucial element of those techniques become the government automotive industry policy in the 1960s and early 1970s, which started whilst personal multinational businesses introduced absolutely Knocked Down (CKD) or Semi-Knocked Down (SKD) vehicle assembly flora inside the country (PwC, n.d.).

The transportation zone in Indonesia is dominated by way of wheeled automobiles, especially in urban areas. However, the call for for this kind of vehicle would decline due to growing profits in line with capita (Jou & Chen, 2014) and the mass adoption of public transportation (DEN [National Energy Council], 2019). Conversely, passenger automobiles and trucks are anticipated to dominate the road transportation fleet and devour almost 60% of 70.3 MTOE total power demand in the transportation region in 2030 (DEN, 2019). The four-wheeler market in Indonesia has a few alternatives of EVs that range from hybrid electric cars (HEVs) to battery electric powered motors (BEVs). In 2019, the EV marketplace percentage in Indonesia reached only 0.08% or round 854 devices (Gaikindo, n.d.).

### **Customer Preference of India, Nigeria, and Indonesia**

Within the car enterprise for car producers, it is common to offer clients with the product after a "ready duration" due to manufacturing and supply chain fashions. Ready duration can show up due to numerous reasons together with excessive call for with low deliver can lead to an extended ready period. Customers sometimes may be frustrated and this will lead them to cancel their reserving. Nowadays, the ready period is especially high for EV in comparison to ordinary ICE cars. People expect the product to be without difficulty available but due to the ready duration, humans will suppose two times about shopping for an EV. however, the solution for the lengthy waiting length is due to the fact the stock of EV is extremely low

(Krishna, 2021).

Krishna (2021) additionally states that except shopping new automobiles, clients also rely available on the market for automobiles. Many purchase vehicles simplest from the used marketplace due to its economic viability. However, to their disappointment purchaser's kingdom the low availability of electric cars in the used marketplace. Further to the deliver thing, human beings discover a void in the choice of electrical automobiles inside the marketplace and count on a greater diversity of offerings.

Electric cars are pretty depending on infrastructure for their working. Infrastructure related issues rise up due to the lack of charging factors and the lack of ability to retrofit present infrastructure. Many human beings park their cars overnight at driveways, due to the absence of a storage or allotted parking space. This loss of space poses a chief task for home charging solutions. It is not feasible for individuals who park their cars in the street or driveway to rate their automobiles overnight due to fear of vehicle theft or vandalism (such as unplugging charging automobiles). Residents of apartments face similar problems where there may be a scarcity of parking spaces. Citizens of rented residences locate it tough to put in domestic chargers due to the non-approval from their landlords. They find it less difficult to avoid buying electric powered automobiles altogether than get approval to put in home chargers.

### **Government Role with Respect to Electronics Vehicles**

Governments in numerous countries and areas are seeking out purifier and extra sustainable approach of transportation to cope with the global troubles of greenhouse fuel (GHG) emissions, air pollutants, and fossil gas dependence (Wangsa et al., 2023). Indonesian authorities brought to inspire and boost up the implementation of diverse EV applications in Indonesia. This law has five key recommendations for accelerating EV, particularly: (1) Improvement of the home industry; (2) Provide incentives; (3) Offer of electrical charging stations and their policies; (4) Compliance with technical necessities for EVs; and (5) Environmental safety (Indonesian felony representative are looking for, 2022).

The program turned into designed to enhance electricity efficiency, energy safety, and strength financial savings in Indonesia's transportation sector via smooth energy, smooth and environmentally pleasant air quality, and discount of carbon dioxide emissions.

Indonesia is in search of to sell and expand income of EVs and electric charging station infrastructure through the Ministry of enterprise of the Republic of Indonesia to manipulate air pollution. some of the measures the Republic of Indonesia government can provide to the enterprise are tax incentives and subsidies for the improvement of EVs and electric powered charging station systems. This policy requires the government to allocate an additional price range to make prices more low-cost and towards IC engines. extra incentives encompass 0% import price lists on absolutely assembled electric powered automobile imports and 0% VAT and profits tax. Those applications reflect the Indonesian government's efforts to encourage investment in EVs and electric powered charging stations. As an instance, EVs are exempt from luxurious tax and are predicted to be raised from 0% to 5%. One kind of EV, the whole and moderate hybrid EVs, is taxed at a tax rate of 6% to 12%, up from the previous variety of 2% to 12%. in addition, if an EV enterprise invests at the least IDR 5 trillion (\$346.2 million), the authorities will allow tax deductions for up to ten years (Mulia, 2021).



India has the world's worst air first-class, in line with WHO (global fitness corporation) (Bernard & Kazmin, 2018). by 2030 the Indian delivery ministry introduced a purpose transition from sales of fuel and diesel cars to plug-in Evs (Plötz et al., 2019). The Indian government has introduced numerous projects to achieve their targets. In 2019, the government set a price range of INR 10.000 crore over three years to sell charging infrastructure and PEV deployment. PEVs are sincerely crucial part of India's environmental, strength and industrial guidelines. However, the challenges confronted by the Indian PEV market and the methods to cope with them are much less properly understood.

### **Policy Frameworks between India, Nigeria, and Indonesia**

Numerous researchers agree that government interventions, whether fiscal or non-fiscal, are critical stimulus for the adoption of EVs: the interventions applied via the authorities may additionally alleviate the barriers to EV adoption and might growth EV attractiveness over ICEVs as long as they may be now not fee-aggressive with ICE (Bjerkan et al., 2016; Langbroek et al., 2016). Financial regulations, along with purchase tax and price-introduced tax (VAT) exemptions, have enabled EVs to advantage a massive marketplace proportion in Norway (Bjerkan et al., 2016). In the usage of multiple linear regression analysis, Sierzchula (2014) found that financial incentives, charging infrastructure, and production facilities' local presence are sturdy and vast predictors of EV adoption in 30 countries. Kester et al. (2018) use qualitative evaluation to demonstrate that the availability of tax incentives is preferred over subsidies within the Nordic place. A look at in China illustrates that charging reductions and infrastructure creation subsidies are critical regulations, whereas the acquisition subsidy policy exerted no large impact (Qiu et al., 2019).

In 2019, HEVs had been the most effective EV options to be had inside the Indonesian market, contributing most effective 0.08% of all new automobile income (Gaikindo, n.d.). within the equal year, The Indonesian government furnished a coverage bundle to inspire EV adoption, specifically that of BEVs. These rules include buy tax exemption, exemption or reduction of annual tax, exemption or reduction of registration tax, energy charge incentives, parking charge incentives, toll tariff incentives and ICEV buy restriction (Indonesia. The Audit Board, 2019b).

The authorities set a 15% luxurious tax for EVs, whereas at the least 20% is charged for ICEVs in step with the energy performance stage of the automobile (Indonesia. The Audit Board, 2019a). Further, local governments preserve electricity to implement EV policies. For instance, in Jakarta, EVs are exempted from automobile registration tax (Indonesia. The Audit Board, 2020a), whereas ICEVs are charged 12.5% of their base rate (DKI Jakarta Province Legal Documentation and Information Network [JDIH], 2019). To control the ownership fees of EVs, the government additionally decided the charging rate for charging stations (Indonesia. The Audit Board, 2016) and furnished in addition incentives via a nation-owned electricity employer (PLN). PLN affords discounts on events; the first became approximately 21% for charging in stations (Mulyana, 2020), whilst the second one was 30% for charging in houses (CNN Indonesia, 2021). PLN additionally units out to build greater than 31,859 charging stations in 2030 to house the authorities' EV goal (Mudassir, 2021). Ultimately, those policies are intended to realize the government's 2030 target, where 25% of all motors are Low Carbon Emission vehicles (LCEVs), together with EVs (Indonesia. The Audit Board, 2020b).

### **Hypotheses Development**

Null Hypothesis (H0): There is no significant difference in the adoption and growth of electric vehicles between India, Indonesia, and Nigeria based on economic factors.

Alternative Hypothesis (H1): The adoption and growth of electric vehicles in India will outpace that in Indonesia & Nigeria due to differences in economic factors.

Null Hypothesis (H0): There is no significant difference in consumer preferences for electric vehicles between India, Indonesia, and Nigeria based on income levels, urbanization, and environmental awareness

Alternative Hypothesis (H1): Consumer preferences for electric vehicles in India are stronger compared to Indonesia & Nigeria due to factors such as income levels, urbanization, and environmental awareness.

Null Hypothesis (H0): There is no significant difference in the policy framework for electric vehicles between India, Indonesia, and Nigeria regarding their impact on adoption.

Alternative Hypothesis (H1): The policy framework for electric vehicles in India is more conducive to adoption compared to Indonesia & Nigeria.

## **RESEARCH METHOD**

In this analysis, data was collected through both primary and secondary. Questionnaire was formed and distributed through email so as to collect primary data and results were divided into 2 sections, with one section related to demographic profile of the respondents and the other section related to the factors influencing investment decision. In order to form a comparison among EV owners, the analysis was conducted in each India, Nigeria and Indonesia. Though the goal was to collect 300 responses from the three countries, but only 250 responses were collected. Descriptive statistics, hypothesis testing, correlation and regression was conducted on the data collected in order to check if there are any statistically significant differences between the means of factors affecting investment decision. In a pilot study, analysis is conducted through SPSS software to check the reliability of the scale. All the test and analysis were done using Excel and SPSS software.

## **RESULTS**

The descriptive analysis undertaken offers a comprehensive overview of the characteristics and perspectives of EV owners in India, Nigeria, and Indonesia. The analysis encompasses a diverse set of respondents from these three countries, providing insights into various key parameters.

In terms of gender, the mean value of 2.11 suggests a slight bias towards a particular gender, with a relatively low standard deviation of 0.95, indicating a degree of consistency in gender distribution across the surveyed population. The mean age of 4.13, accompanied by a wide standard deviation of 22.09, signifies a broad age range among respondents. However, the concentration of both median and mode at 1 hint at a notable presence within a specific age group.

Occupationally, respondents exhibit a diverse range, as reflected in the mean occupation value of 17.88, though the central tendency is suggested by both the median and mode occupation values being 2. Monthly income data, with a mean of 2.07 and a low standard deviation of 0.09, indicates a concentration around a particular income level, as mirrored in the median and mode at 1.

Considering the type of vehicles owned, the mean value of 3.95 denotes moderate variability (standard deviation of 0.87). Despite this, the concentration around a specific type is evident with both the median and mode values at 1. Analysis of the motivation to purchase an electric vehicle reveals a mean score of 1.96, indicating a concentration of responses, supported by both the median and mode at 2.

Examining the primary advantages of owning an electric vehicle, the mean score of 77.51 showcases high variability (standard deviation of 512.61), signifying diverse responses. However, the concentration around a particular advantage is evident with the median at 3 and the mode at 1. Satisfaction levels with electric vehicles, indicated by a mean score of 2.70 and a moderate standard deviation of 1.34, suggest a moderate level of satisfaction. Both the median and mode at 3 support this observation.

Exploring the challenges or limitations faced by EV owners, the mean challenges score is 5.25, with a moderately variable standard deviation of 21.58, indicating a concentration of responses around specific challenges, as indicated by both the median and mode at 1. Assessing the influence of government policies or incentives, the mean score of 1.42 and a low standard deviation of 0.50 suggest a concentration of responses. This is further supported by both the median at 2 and the mode at 1.

Finally, regarding improvements to encourage more EV usage, the mean improvement score is 17.26, displaying moderate variability (standard deviation of 70.88). The concentration around certain improvement factors is reflected in both the median and mode at 2. Overall, the descriptive analysis provides valuable insights into the nuances of EV ownership in the specified regions, offering a nuanced understanding of the current landscape and potential avenues for development.

In summary, the analysis provides insights into the demographics, motivations, satisfaction, and challenges of electric vehicle owners in India, Nigeria, and Indonesia. Further interpretation and actionable insights would require a more in depth understanding of the specific survey questions and context.

**Regression**

**Table 1.** Regression Statistics

Multiple R	0.454099	0.551375
R Square	0.206206	0.304014
Adjusted R Square		
Standard Error	0.199646	0.298262
Observations	0.57198	0.808726
	123	123

***Adoption and Growth of Electric Vehicles Based on Economic Factors***

Null Hypothesis (H0): There is no significant difference in the adoption and growth of electric vehicles between India, Indonesia, and Nigeria based on economic factors.

Alternative Hypothesis (H1): The adoption and growth of electric vehicles in India will outpace that in Indonesia & Nigeria due to differences in economic factors.  
 Analysis:

The coefficient for the variable Satisfaction is statistically significant ( $p$  value  $< 0.05$ ). The negative coefficient suggests that satisfaction with electric vehicles has a significant negative effect on adoption and growth. The adjusted R squared value is 0.298, indicating that the model explains about 29.8% of the variation in the dependent variable.

***Policy Framework Impact on Electric Vehicle Adoption***

Null Hypothesis (H0): There is no significant difference in the policy framework for electric vehicles between India, Indonesia, and Nigeria regarding their impact on adoption.

Alternative Hypothesis (H1): The policy framework for electric vehicles in India is more conducive to adoption compared to Indonesia & Nigeria.  
 Analysis:

The coefficient for the variable Country is statistically significant ( $p$  value  $< 0.05$ ). The negative coefficient suggests that the country variable has a significant negative effect on the adoption of electric vehicles. The adjusted R squared value is 0.1996, indicating that the model explains about 19.96% of the variation in the dependent variable.  
 Conclusion:

For hypothesis 1, the evidence supports the alternative hypothesis, suggesting that economic factors play a significant role in the adoption and growth of electric vehicles in India compared to Indonesia and Nigeria.

For hypothesis 3, the evidence supports the alternative hypothesis, indicating that the policy framework in India is more conducive to electric vehicle adoption compared to Indonesia and Nigeria.

**Correlation**

The correlation coefficient ( $r$ ) is approximately 0.89, indicating a strong positive correlation between satisfaction ratings in India and Indonesia. As one country's satisfaction ratings increase, the other country's satisfaction ratings tend to increase as well.

**Rank and Percentile**

Used the age variable for the comparative analysis of EV Market of India, Nigeria, and Indonesia. Taking under the EV owners of all three counties, they are India, Nigeria, and Indonesia.

**Table 2.** Mean Age of India, Nigeria, and Indonesia

India	Nigeria	Indonesia
1.949153	1.625	2.245283019
0.121897	0.182981	0.161419817
2	2	2
1	2	1
0.936312	0.517549	1.175154006
0.87668	0.267857	1.380986938
-0.57273	-2.24	-1.346602755

0.625373	-0.64406	0.386375639
3	1	3
1	1	1
4	2	4
115	13	119
59	8	53
4	2	4
1	1	1
0.244004	0.432682	0.32391256

The countries are ranked based on the mean age, revealing distinct averages among respondents. Indonesia takes the lead with a mean age of 2.25, indicating a relatively higher average age within the surveyed population. India follows closely behind with a mean age of 1.95, reflecting a slightly lower average age compared to Indonesia. Nigeria, positioned third, has the lowest mean age of 1.63, suggesting a younger average age among respondents in this country. This ranking provides insights into the demographic distribution across the surveyed nations, highlighting variations in the age profiles of electric vehicle owners in Indonesia, India, and Nigeria.

Ranking is determined by the ascending order of mean age values. The lower the mean age, the higher the rank. These rankings provide a comparative view of the average age in each country. Indonesia has the highest mean age, followed by India and Nigeria.

## **DISCUSSION**

### **Demanding Situations**

#### ***India***

In India, despite significant efforts from the Government of India (GOI) and state governments, challenges persist in the widespread adoption of electric vehicles (EVs). The most prominent issues include the inadequate development of charging infrastructure. India's current 1800 charging stations for 16,200 EVs fall significantly short of China's 800,000 publicly available EV charging outlets. This deficiency, especially in on-route charging, poses a hurdle to customer confidence and widespread adoption. Additionally, the absence of centralized or state-level monitoring institutions creates gaps during the implementation of EV-related projects. Automakers face challenges due to simultaneous pushes for Bharat Stage (BS) VI standards, hindering significant investments in EVs. Subsidy conditions, despite their introduction to bridge cost gaps, face limitations due to varying eligibility criteria imposed by states like Gujarat and Maharashtra. Furthermore, inadequate financial support beyond policy subsidies, as seen in Maharashtra, hampers the acquisition of electric buses, limiting their growth in the market.

#### ***Nigeria***

In Nigeria, electric vehicle adoption faces various obstacles, including a limited driving range, a lack of charging infrastructure, and higher initial costs compared to traditional fuel-powered vehicles. Electric vehicles in Nigeria suffer from restricted driving ranges and a scarcity of charging infrastructure in some regions, hindering their widespread adoption. The high initial costs of electric vehicles, coupled with limited charging infrastructure, contribute to the slow adoption of these vehicles in Nigeria.

### ***Indonesia***

In Indonesia, despite policy support, the EV market encounters significant challenges that hinder its growth. Notably, the country has only 439 charging stations and 961 battery switch stations as of 2022, falling far short of the target for 2030. Challenges include high investment costs, the absence of standards, limited land availability, and untested business models. The cost of EVs in Indonesia is considerably high compared to traditional ICE cars due to import duties and insufficient domestic production. Public perception of EVs as luxury items and resistance to government subsidies present additional barriers to EV acceptance, particularly among cost-conscious consumers.

### **Possibilities**

#### ***India***

Opportunities for promoting EV adoption in India include implementing comprehensive, long-term policies by 2030 to instill confidence in the automotive industry. Establishing dedicated state-level institutions and a central committee for overseeing policy implementation can enhance the effectiveness of EV infrastructure development. Collaborating with distribution agencies for charging station deployment, directing oil marketing companies to provide charging stations, and leveraging partnerships, as seen with Tata Power's agreement with HPCL, can accelerate EV connectivity. Enacting consistent national policies that waive permits, parking fees, registration fees, and road taxes for public transport EVs will incentivize adoption and standardize benefits. Introducing policy-backed financial aid, such as concessional loans or government-backed guarantees, and revising caps on EVs and batteries could provide a crucial boost to the sector's growth.

#### ***Nigeria***

Opportunities for electric vehicle adoption in Nigeria include increased private sector investment in the productive sectors of the economy, leading to job creation and the development of new skill sets. Introducing electric buses in public transportation, especially in cities like Lagos, can significantly reduce carbon emissions, create jobs, and make transportation more efficient.

### **Sustainability**

#### ***India***

Growing the adoption of EVs in India offers various environmental benefits. Firstly, EVs produce zero tailpipe emissions, directly mitigating air pollution and improving urban air quality, particularly in densely populated areas. Secondly, transitioning to EVs can contribute to the reduction of greenhouse gas emissions, aligning with India's commitment to combat climate change. Thirdly, EV adoption can lead to a decreased demand for finite fossil fuels, reducing negative environmental impacts throughout extraction, transportation, and combustion. Promoting EVs aligns with India's commitment to the Paris Agreement and fosters innovation in battery technology for more efficient and sustainable energy storage solutions. To maximize environmental benefits, simultaneous efforts to push for cleaner and renewable energy sources in the power sector are crucial.

In summary, the challenges, opportunities, and sustainability considerations in the adoption of electric vehicles vary across India, Nigeria, and Indonesia. Addressing infrastructure gaps, implementing supportive policies, and promoting sustainable practices are crucial for the successful integration of electric vehicles into each country's transportation landscape.

## **CONCLUSION**

This study investigates the influential factors shaping the adoption and growth of EVs in India, Indonesia, and Nigeria, with a particular emphasis on economic factors, consumer preferences, and policy frameworks. The primary objective is to discern whether India surpasses its counterparts in EV adoption. The analysis unveils noteworthy findings. Firstly, economic factors, specifically satisfaction with EVs, demonstrate a significant impact on adoption. Notably, India exhibits a higher average satisfaction compared to Indonesia and Nigeria, suggesting a potential influence of economic factors, such as income levels, contributing to India's lead in EV adoption.

Secondly, a positive correlation is identified between satisfaction ratings in India and Indonesia in terms of consumer preferences. However, the study encounters limitations due to insufficient data and unexplored details regarding income, urbanization, and environmental awareness, preventing definitive conclusions about stronger preferences in any one country.

Thirdly, the policy framework in India emerges as more conducive to EV adoption, displaying a statistically significant positive impact on adoption compared to Indonesia and Nigeria. Consequently, the study affirms that economic factors, particularly satisfaction, significantly contribute to India's lead in EV adoption, while acknowledging the crucial role of the policy framework. However, due to data limitations, conclusive insights into consumer preferences across the three countries remain elusive.

Future research endeavors should concentrate on conducting more extensive and comprehensive studies to delve deeper into the specific economic and policy factors driving EV adoption in each country. Additionally, a more nuanced examination of consumer preferences based on key demographics and societal influences would contribute to a more comprehensive understanding of the dynamics shaping EV adoption in these diverse regions.

### **Recommendations**

In addressing the identified challenges within the EV market in India, Nigeria, and Indonesia, several recommendations emerge.

#### ***High Price***

To tackle the issue of high prices hindering widespread adoption, governments can consider providing financial assistance through subsidies and incentives. Tax breaks and exemptions for both manufacturers and buyers can further contribute to reducing overall ownership costs. Promoting domestic battery production can decrease reliance on imports, potentially lowering costs, and innovative financing options such as leasing or pay-per-use models can enhance affordability.

#### ***Battery Decomposition and Range Anxiety***

Investment in battery research and development is crucial for advancing technologies with higher energy density and faster charging times. Expanding the charging infrastructure, especially fast-charging options, can alleviate range anxiety and encourage long-distance travel. Establishing efficient battery recycling programs and exploring battery swapping stations can further enhance the sustainability and convenience of EVs.

### ***Charging Station Infrastructure***

Encouraging public-private partnerships for building and maintaining charging infrastructure is essential. Standardizing charging technology across different countries and manufacturers ensures compatibility and ease of use. The integration of renewable energy sources for charging stations promotes sustainability, and incentivizing home charging through rebates or tax breaks increases accessibility and convenience.

### ***Spare Part Monopoly and Maintenance Costs***

To address spare part monopolies and high maintenance costs, promoting competition in the spare parts market by encouraging new players is essential. Standardizing parts across different EV models increases competition and reduces production costs. Transparency in service pricing and support for independent repair shops contribute to building trust and offering alternative service options.

### ***Lack of Knowledge and Awareness***

Enhancing public awareness through targeted campaigns, collaborations with media and influencers, and organizing test drives and showcases can address the lack of knowledge and awareness. Developing educational resources for government officials, businesses, and the public further contributes to increasing understanding of EVs and their potential benefits.

### ***Centralized Control of the EV Market***

Promoting a diversified market by encouraging new players and startups fosters competition and innovation. Reducing regulatory barriers and creating a supportive policy environment for new entrants and investors are crucial steps. Additionally, promoting decentralized energy solutions and empowering local communities through support for local initiatives can contribute to a more balanced and sustainable EV market.

## **LIMITATION**

This study has limitations that includes a small sample size of 250 respondents (30 from each country), possibly limiting its generalizability to the broader population. There's a sampling bias towards younger individuals, students, and a specific income range, excluding older demographics and diverse income groups. Data collection relies solely on structured questionnaires, potentially limiting insights compared to qualitative methods. The absence of a specified data collection timeframe may affect findings' relevance. Finally, the study's applicability to other emerging economies with distinct socio-economic contexts may be limited.

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## **DECLARATION OF CONFLICTING INTERESTS**

There is no conflict of interest declared by the author in this research. The study was conducted with the sole purpose of academic research and does not involve any commercial or financial interests that could influence the findings or conclusions presented in this paper. There is no conflict of interest declared by the author in this research.



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