WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Impact of Government Subsidies on Automobile Companies Manufacturing Electric Vehicles in the City of Delhi

Aishwarya Goyal[1], Kiran K Choudhary[2], Oshika Sharma[3], Pankhuri Verma[4], Urvi Ketan Joshi[5], Prof. Shankar Prasad[6]

[1,2,3,4,5]Student, Bachelor of Business Administration, Jain University
[6]Guide, Bachelor of Business Administration, Jain University
Doi: https://doi.org/10.55248/gengpi.5.0324.0863

ABSTRACT:

The global conversation surrounding electric vehicles (EVs) and their technology is ongoing. Governments worldwide have been actively promoting EVs to combat emissions and enhance air quality, thus emphasizing the significance of EVs and their advantages. This study aims to provide consumers with a comprehensive understanding of the rise of electric vehicles, aiding in their education regarding the current EV landscape and its benefits compared to traditional vehicles.

Data for this study was gathered through Snowball sampling, involving 123 respondents participating in an online questionnaire. Additionally, a preliminary pilot study was conducted before the main research, offering further insights into the market dynamics. Positive correlations identified among various factors indicate a promising outlook for electric vehicles. Factors such as reliability, smooth driving experience, fast charging capabilities, and environmental sustainability are crucial considerations for consumers when selecting a vehicle. Increasing awareness about EVs and their advantages is deemed essential. Future endeavors may delve deeper into the environmental impact of EVs and technological advancements in this domain.

In Delhi, the EV industry is witnessing rapid growth, resulting in job creation, reduced operational expenses, and technological advancements over time.

Keywords: Electric Vehicles, Delhi, Battery, Cost-effective, Charging Points

1. Introduction:

1.1 Concept

Electric vehicles (EVs) represent a modern form of transportation that deviates significantly from traditional gasoline or diesel vehicles. Unlike internal combustion engine (ICE) vehicles, which rely on burning fossil fuels for power, EVs utilize electricity stored in batteries to drive an electric motor. This technological advancement offers several advantages, including reduced greenhouse gas emissions, decreased dependence on fossil fuels, and quieter and more comfortable travel experiences. With advancements in battery technology, declining operating costs, and environmental benefits, EVs have witnessed a surge in popularity in recent years, becoming increasingly practical and accessible for consumers. In this overview of electric vehicles, we will explore the fundamental features and advantages of these innovative vehicles.

1.2 Components:

• Electric Motors: Serving as the core component of electric vehicles, electric motors transform the electrical energy from the battery into mechanical energy, which propels the vehicle forward. Various types of electric motors exist, including AC induction motors and permanent magnet motors.

• Battery: Functioning as the energy storage system for electric vehicles, the battery comprises multiple lithium-ion batteries or alternative battery types that store electrical energy. The capacity and chemical composition of the battery significantly influence the range and performance of an electric vehicle.

• Power Electronics: This category encompasses inverters and converters responsible for regulating the flow of electricity between the battery and the electric motor. Power electronics manage the motor's speed and torque while converting the battery's DC power into AC power.

• Charging Ports: Charging ports enable electric vehicles to connect to external power sources like home chargers, public charging stations, and rapid charging networks. These ports, categorized into Level 1, Level 2, and DC Fast Charge, may vary in design and charging speeds.

• On-Board Charger (OBC): Integrated within the vehicle, the on-board charger converts alternating current received from the charging source into direct current for charging the battery. The capacity of OBCs determines their charging speed and compatibility.

1.3 Types of EV Vehicle's:

Electric vehicles (EVs) are classified into several categories, each with its own set of characteristics and applications. Electric vehicles are classified into three types:

Battery Electric Vehicles (BEVs), also referred to as all-electric vehicles, operate solely on electricity without any internal combustion engine. They rely on a large battery pack to store electricity, which powers an electric motor to propel the vehicle. BEVs must be connected to a charging station for recharging and produce no tailpipe emissions. Depending on the battery's capacity, they can achieve long distances on electric power alone. Notable examples of BEVs include the Tesla Model 3, Nissan Leaf, and Chevrolet Bolt.

Plug-in Hybrid Electric Vehicles (PHEVs) combine a gasoline-powered internal combustion engine, an electric motor, and a battery. These vehicles offer the flexibility to operate on electricity, petrol, or a combination of both. PHEVs recharge their batteries through a connection, enabling them to travel extended distances on electric power before utilizing the petrol engine. They provide versatility for users needing longer range while also reducing emissions and conserving fuel during local travel. Examples of PHEVs include the Toyota Prius Prime, Ford Escape Plug-in Hybrid, and Mitsubishi Outlander PHEV.

Hybrid Electric Vehicles (HEVs) : Incorporate both an internal combustion engine and an electric motor, but unlike plug-in electric vehicles, they cannot be recharged by plugging them in. Instead, these vehicles utilize regenerative braking and internal combustion engines to generate electricity, which powers the vehicle. While HEVs are not intended for solely electric operation, they offer superior fuel efficiency compared to conventional petrol or diesel vehicles. Serving as a transitional technology, HEVs contribute to pollution reduction and enhanced fuel economy without necessitating charging infrastructure. Examples of HEVs include the Toyota Prius, Honda Insight, and Ford Fusion Hybrid.

1.4 EV Vehicles in India:

Electric vehicles (EVs) are emerging as a promising solution to address air quality issues, enhance energy security, and stimulate economic growth as India's automotive sector expands rapidly. Recognizing the importance of adopting sustainable transportation solutions, the Indian government aims to reduce reliance on imported energy, curb greenhouse gas emissions, and mitigate the adverse impacts of transportation, particularly climate change. Measures to mitigate climate change risks, such as reducing carbon dioxide emissions, are crucial for preserving global biodiversity. India's total greenhouse gas emissions in 2014 amounted to 3202 million metric tonnes of carbon dioxide equivalent, representing 6.55% of global emissions, with the energy sector contributing 68% of these emissions, followed by agriculture, manufacturing processes, land use changes, and waste.

In response to the growing demand for sustainable transportation options, EVs are gaining traction in India, supported by active government promotion through various incentives and policy changes. These efforts include fostering EV research and development, setting ambitious adoption targets, and providing tax incentives for both consumers and manufacturers. The introduction of a range of electric vehicles by both domestic and international automakers, including electric cars, scooters, and rickshaws, caters to the diverse preferences of Indian consumers. Furthermore, the expansion of charging infrastructure in major cities and along highways addresses concerns about EV range, facilitating greater EV adoption.

This concerted push towards electric mobility aligns with India's goals of reducing air pollution, decreasing dependence on imported fossil fuels, and contributing to global efforts towards a greener automotive industry. Government policies aimed at promoting EV usage, alongside environmental and energy security considerations, are driving the growth of India's electric vehicle market.

1.4.1 Government programs and initiatives:

Fame hybrid vehicles is known as the "Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme." FAME-II, the scheme's second phase, aims to stimulate the transition to electric mobility by offering subsidies to electric vehicle manufacturers and buyers.

• GST Reduction: To incentivize the adoption of electric vehicles, there has been a significant reduction in the Goods and Services Tax (GST), making electric vehicles more affordable for consumers. The GST on electric vehicles has been reduced from 12% to 5%, making them more cost-effective compared to conventional vehicles.

• Ensuring the overall quality of finished products, including taste, consistency, and appearance, and making necessary adjustments to meet predefined quality standards. The scheme aimed to enhance the production and distribution of electric vehicles in India, setting ambitious targets for EV market penetration and providing various incentives, including subsidies for EV manufacturing and purchase.

• The government acknowledges the significance of EV charging infrastructure and is actively engaged in its nationwide expansion. Charging stations are planned to be deployed in major cities and along key highways as part of initiatives like the National E-Mobility Program.

• Customs Duty Reduction: Customs duties on EV components such as batteries and electric motors have been reduced to promote domestic production and reduce costs.

1.4.2 Electric vehicle types include:

Electric Vehicles: Numerous domestic and international car manufacturers have introduced electric vehicles (EVs) to the Indian market. Models such as the Tata Nexon EV, MG ZS EV, Hyundai Kona Electric, and Mahindra eVerito are gaining popularity due to their affordability and extended range.

Electric Scooters and Two-Wheelers: The electric scooter and two-wheeler market in India has witnessed significant growth, with companies like Ather Energy, Bajaj, and TVS offering sustainable and cost-effective transportation options. Electric three-wheelers are also becoming increasingly prevalent in Indian cities, particularly for short-distance travel.

Electric Buses: Some Indian cities have incorporated electric buses into their public transit systems to reduce air pollution and greenhouse gas emissions.

Ensuring the overall quality of finished products, including taste, consistency, and visual appeal, and making necessary adjustments to maintain predetermined quality standards, has become increasingly important. Reva (Mahindra), India's inaugural electric car, was introduced in 2001 and has since sold a few units. Toyota debuted the Prius hybrid car in 2010, followed by the Camry hybrid in 2013. Pilot projects involving electric buses and hybrid cars are underway in select cities.

1.4.3 India's proposal to exclusively market electric vehicles by the year 2030.

Phase one focuses on seizing current economic opportunities while preparing for future strategic alternatives. This involves building transportation infrastructure, including both software platforms and physical infrastructure.

In the second stage, efforts will be made to enhance and expand the measures initiated in the initial phase, while also encouraging private sector involvement. The aim is to establish a comprehensive mobility solution across the system.

The final phase integrates electricity into the transportation system, allowing electric vehicles to feed electricity back into the grid. Government incentives, including subsidies for vehicle owners and cities with high EV adoption rates, will be gradually phased out. In the past, the government offered subsidies amounting to Rs 15,000 for cars and SUVs, and up to Rs 30,000 for electric two-wheelers.

1.5. EV Vehicle in Delhi:

Delhi, the capital of India, is notorious for its severe air pollution, often reaching hazardous levels throughout the year. A significant contributor to this problem is the emissions from gasoline and diesel vehicles, with the number of registered private cars in Delhi soaring from 0.28 million in 1988 to an estimated 3.31 million in 2020. Additionally, the influx of thousands of vehicles from neighboring states exacerbates air pollution, particularly with particulate matter (PM2.5 and PM1.0) and other harmful pollutants, leading to prolonged periods of poor air quality index (AQI) readings. India has the highest rate of pollution-related deaths globally as a result, the Delhi government has introduced a range of regulations and incentives to expedite the shift to electric vehicles. Among these initiatives, the incentives provided by the government to electric vehicle manufacturers have been instrumental in transforming the automotive industry.

The introduction of subsidies has had a profound impact on economic growth and job creation in Delhi's electric vehicle sector. These incentives have spurred major automakers and new entrants to invest in research, development, and manufacturing of electric vehicles, leading to the establishment of production facilities, research centers, and assembly plants, thereby creating employment opportunities for the local workforce. Consequently, the electric vehicle industry in Delhi has become a significant economic driver, fostering innovation and contributing to the city's industrial advancement.

Moreover, government subsidies have made electric vehicles more convinient and affordable to a wider audience. By reducing the upfront costs associated with electric vehicle ownership, subsidies have incentivized individuals to transition from traditional vehicles to EVs, thereby not only benefiting the environment but also enabling consumers to save on long-term operational expenses due to the higher energy efficiency and lower maintenance requirements of electric vehicles. As a result, the increasing uptake of electric vehicles in Delhi has resulted in a decline in the transportation sector's carbon emissions and a reduction in harmful pollutants in the air.

Cities such as Delhi stand to benefit significantly from the adoption of electric vehicles (EVs) for several reasons:

Air Quality Improvement: Delhi's longstanding air quality issues, largely stemming from traffic pollution, could be mitigated by EVs vehicles, by producing no tailpipe emissions, effectively eradicate harmful pollutants such as nitrogen oxides (NOx), particulate matter (PM), and carbon monoxide (CO). The transition to EVs offers a substantial opportunity to notably diminish levels of air pollution, consequently enhancing public health and elevating the overall quality of life for inhabitants.

Greenhouse Gas Emissions Reduction: EVs are more energy-efficient and emit fewer greenhouse gases than traditional internal combustion engine vehicles. Transitioning to EVs can help Delhi lower its carbon footprint, contributing to global efforts to combat climate change and meet climate targets and commitments.

Noise Reduction: Electric vehicles operate more quietly than conventional internal combustion engine vehicles, resulting in reduced noise pollution and potentially creating a more peaceful urban environment.

Energy Security: India, including Delhi, heavily relies on imported oil to meet its energy needs. By reducing dependence on foreign oil and promoting the use of domestically generated electricity from renewable sources, the adoption of EVs can enhance energy security.

Economic Benefits: The distinctive aspect of electric vehicle adoption lies in its capacity to foster economic expansion through the generation of employment opportunities in manufacturing, research and development, and the establishment of charging infrastructure. Moreover, consumers stand to gain from reduced expenditure attributed to lower maintenance costs and fuel expenses.

Congestion Management and Urban Planning: EVs can be integrated into smart city planning and transportation management systems, offering solutions for reducing road congestion, particularly when utilized for shared mobility services, and enhancing last-mile connectivity.

Incentives and Policies: Governments, including the Indian government, offer incentives, subsidies, and tax breaks to promote EV adoption. Delhi can leverage these measures to make EVs more accessible and affordable for its residents.

Converting public transportation fleets to electric buses or trains can have a substantial influence on decreasing emissions and costs. Delhi's air quality is being improved. Such an approach can also serve as a model for other cities to emulate.

Technological Advancements: As EV technology progresses, electric car range, performance, and affordability continue to increase. By adopting newer and more efficient EV models, Delhi may profit from these improvements.

In conclusion, the adoption of electric vehicles holds promise for addressing numerous environmental, health, and economic challenges encountered by cities like Delhi. By promoting and facilitating the adoption of electric vehicles, Delhi can play a role in fostering a cleaner, healthier, and more sustainable urban environment.

This analysis addresses the impact caused by government subsidies on automobile firms in Delhi that manufacture electric automobiles. This requires looking into how subsidies affect automakers' strategic decisions, as well as their investments in research and development, production capacity, and market penetration. The project will also investigate how legislative frameworks, market dynamics, and consumer preferences influence the outcomes of government support. This analysis addresses the complicated impact caused by government subsidies on automobile firms in Delhi that manufacture electric automobiles. This requires looking into how subsidies affect automakers' strategic decisions, as well as their investments in research and developmeny, production capacity, and market penetration. The project will also investigate how legislative frameworks, market dynamics, and consumer preferences influence the outcomes of government support.

2. Literature Review

2.1.1 Analysis by the The New India Express – "IS DELHI EV READY?'

According to the report, Delhi's Transport Minister, Mr. Gahlot, has stated that transforming Delhi into an EV capital will take 10 to 15 years due to the city's lack of infrastructure to go fully electric. The government promised to install 20,000 EV charging stations by 2019, but this has yet to be accomplished. The report also states that most electric vehicles are more expensive than petrol and diesel vehicles, and that the average Indian family cannot afford to pay more than Rs. 20,000 for an electric vehicle. The report also states that India does not manufacture its own lithium-ion batteries and instead imports them from China, one of the major lithium-ion battery manufacturers. As a result, if India wants to bring the price of electric vehicles down to the same level as petrol and diesel, it must establish its own lithium ion battery manufacturing plant.

One of the report's interviewees stated, "Vehicle retrofitting will be better, as it will reduce the scrapping burden, pollution, and costs."

According to the report, a survey conducted by Lithium Urban Technologies found that 70% of Delhi's population is willing to switch to electric vehicles if the price is reduced.

One of the report's interviewees stated, "Vehicle retrofitting will be better, as it will reduce the scrapping burden, pollution, and costs."

According to the report, a survey conducted by Lithium Urban Technologies found that 70% of Delhi's population is willing to switch to electric vehicles if the price is reduced.

2.1.2 An Article by Economic Times: Future of EV in India

The article acknowledged that electric vehicles (EVs) are currently gaining popularity, citing a study that shows that by 2022, most Indians will prefer electric vehicles, resulting in an increase in EV sales in India. The article also underscored the significance of the government's involvement in the extensive shift towards electric vehicles.

The article also predicted that battery prices would fall by 30% within five years. Every report that mentions a major segment with the potential for a mass transition mentions two wheels, and the statistics support it. In 2019, 1.56 million electric vehicles, 1.52 million two-wheelers, 3,400 electric automobiles, and 600 electric buses were sold. The reasons for the rise of electric cars in India are falling technology costs, rising pollution, and growing government and public interest.

The government has made notable strides in its endeavors by outlining strategies to expedite the manufacturing and shift towards electric vehicles. As per a report from ET, the overwhelming majority of car owners, approximately 90%, express readiness to transition to electric vehicles provided suitable infrastructure is available.

2.1.3 IRJET:

This literature review delves into the emerging electric vehicle (EV) market in India, particularly focusing on the Delhi-NCR region. It explores the obstacles and initiatives necessary for developing EV infrastructure in this area, along with consumer sentiments towards EVs.

The study employed both primary and secondary data collection methods, with secondary data playing a significant role in shaping the outcomes. Secondary data were sourced from credible publications, journals, research papers, and blogs, among others. Primary data collection involved administering a Google questionnaire, with 60 respondents participating in the online survey.

According to the World Economic Forum (WEF), India's efforts to promote EV adoption are commendable, with potential benefits including substantial energy and carbon emissions savings. The WEF estimates that with a 30% EV penetration rate, India could save approximately 474 million tonnes of oil equivalent and 842 million tonnes of CO2 emissions throughout the vehicles' lifespan. Furthermore, the WEF suggests that 90% of Indian car owners would consider transitioning to EVs if adequate infrastructure were available.

The study underscores the pivotal role of state governments in facilitating the deployment and development of EV infrastructure. It notes that ten Indian states and union territories have formulated or implemented concrete policies to encourage EV usage.

In conclusion, the literature review highlights the significance of EVs for urban economic growth and outlines the challenges and opportunities associated with establishing EV infrastructure in the Delhi-NCR region. The findings indicate a favorable consumer outlook towards EVs, indicating potential for increased adoption in the future.

2.1.4 THE GROWING TECHNOLOGY AS A STEPPING STONE:

With the growing popularity of electric mobility (also known as e-mobility) as a practical and environmentally friendly alternative, the global transportation industry is changing. Electric vehicle (EV) sales have been rapidly increasing in several countries, indicating a shift towards less energy-intensive modes of transportation. This review of the literature investigates how subsidies can encourage the use of electric vehicles by highlighting programmes implemented in various markets and regions.

• China's NEV/EV Policy: China has been at the forefront of promoting electric vehicles (EVs) since its introduction in 2009. With substantial government subsidies for EV purchases, China has become the world's largest EV market, representing approximately half of global EV sales.

• Delhi's Strategy: Delhi, as a state, has embraced international norms across various transportation and e-mobility domains, showcasing its dedication to e-mobility. To incentivize EV adoption, the state has implemented initiatives including exemptions from registration and road taxes, vehicle scrappage programs, and the establishment of affordable EV charging stations.

This literature review highlights the enormous influence that subsidies and purchasing incentives can have on consumer decisions and the adoption of EVs. China's NEV/EV policy is an excellent example of how subsidies helped to expand the EV sector. Delhi's efforts to comply with international norms and use international best practices highlight the importance of a comprehensive and well-thought-out subsidy policy, which includes efficient subvention policies.

2.1.5 The upcoming Electric Vehicle (EV) Policy 2.0 from the Delhi government demonstrates a strong commitment to encouraging the use of electric vehicles. Retrofitting, or converting conventional petrol or diesel vehicles to electric ones, is a major strategy. This green approach promises to use renewable energy and extend the life of conventional vehicles.

Retrofit kits are expensive, costing around Rs 4-5 lakh, and may only be suitable for high-end vehicles. To address the cost barrier, the government intends to implement subsidies or incentives to encourage retrofitting. According to the law, all retrofitting kits must have permission from recognised testing agencies. Furthermore, EV Policy 2.0 faces challenges such as the need for increased funding for R&D and a limited supply of retrofit kits for all car models. For example, because not all refit kit components are manufactured in India, kits for specific car types must frequently be imported.

The Delhi government has already taken steps to facilitate the conversion of petrol and diesel vehicles to electric vehicles. It established a forum for collaboration among customers and retrofitting companies. Despite these efforts, there has been a lack of response. The government intends to encourage more Delhi residents to modify their automobiles by incorporating it into formal policy and increasing R&D expenditures, especially given the strict regulations limiting the operation of olderdiesel and petrol vehicles.

The result of our online survey we conducted to know about people’s view on EV’s

3. Research Methodology

Objectives:

Investigating Barriers to EV Adoption in Delhi-NCR: To begin, identify the barriers to electric vehicle (EV) adoption in the Delhi National Capital Region (NCR). Barriers to adoption include high upfront costs, limited charging infrastructure, range anxiety, and a lack of understanding. Understanding these barriers is the first step towards developing successful EV adoption strategies.

Propose Government Enablers to Remove Barriers: Once the obstacles have been identified, it is critical to propose solutions. This could include recommending that the government take specific actions, such as offering financial incentives, improving charging infrastructure, or providing subsidies to make EVs more accessible. These enablers are critical for breaking down barriers and encouraging people to switch to EVs.

Introducing a New Paradigm to Enable Interdependence: It is critical to recognise the facilitators' interdependence. Improving charging infrastructure, for example, can make EVs more realistic and alleviate range anxiety. A model depicting the interdependence of various enablers can help policymakers make comprehensive decisions.

Analysing Government Subsidies and Incentives for EV Manufacturers: It is critical to look into the government subsidies and incentives provided to electric vehicle manufacturers in Delhi. Tax breaks, grants, and favourable regulations are examples of such incentives. Understanding these metrics is critical to determining their efficacy in encouraging local EV manufacturing.

Subsidies and their Impact on Electric Vehicle Manufacturing and Sales: After understanding the incentives, it is critical to assess their impact. Are these subsidies and incentives effectively driving the growth of Delhi's EV manufacturing sector and increasing electric vehicle sales? This assessment helps to determine the return on investment for government initiatives.

Understanding Automotive Manufacturers' Issues and Opportunities: Traditional automakers face new challenges and opportunities in the production of electric vehicles. Investigate the unique challenges they face, such as the transition from internal combustion engine to EV manufacturing, and look for opportunities, such as entering the growing electric vehicle market.

Making Recommendations to Policymakers and Industry Stakeholders: Finally, based on the results of the preceding processes, it is critical to make specific recommendations to politicians and industry stakeholders. These proposals should be actionable and aimed at boosting the Delhi-NCR electric vehicle market. This could include fine-tuning existing rules, implementing new programmes, or encouraging public-private collaboration to increase EV adoption.

In summary, this comprehensive approach entails identifying barriers, proposing solutions, assessing the interplay of these solutions, evaluating the effectiveness of government incentives, understanding manufacturers' challenges and opportunities, and finally making informed recommendations to promote electric vehicle adoption in Delhi NCR.

3.1.1 Statement of the Problem

The research paper examines the profound impact of government subsidies on the electric vehicle (EV) manufacturing industry, as well as the implications for both automotive companies and consumers, in the context of Delhi, a thriving metropolis facing pressing environmental challenges. This study delves into the complex web of factors that influence important decision-making processes such as research and development, pricing strategies, consumer purchasing patterns, and the overall growth trajectory of the rapidly expanding electric vehicle sector.

This study focuses on how subsidies can encourage all stakeholders to invest in cleaner, more sustainable technology, such as electric vehicles. It seeks to provide a nuanced assessment of the efficiency and effectiveness of these subsidies, as well as to look into the long-term consequences of government intervention in the industry.

Notably, despite the government's significant assistance, this study aims to determine the extent to which these subsidies result in meaningful cost savings for consumers. Understanding how cost reductions affect the financial viability and competitive advantage of electric vehicles over traditional internal combustion engine vehicles is an important aspect of our research. This investigation is critical for determining the true economic and environmental benefits of these subsidies, as well as their role in shaping the future of the Delhi automobile sector.

3.1.2. Experimental Research Design

E Electric vehicles (EVs) have received widespread attention as a sustainable alternative to traditional internal combustion engine vehicles. In Delhi, India's densely populated and heavily polluted urban landscape, promoting EVs is critical to addressing environmental concerns and energy efficiency goals. This experimental study seeks to investigate the concrete impact of government subsidies on automobile companies involved in the production of EVs in Delhi.

Research Objectives

The primary objectives of this experimental research are as follows:

- To determine a causal relationship between government subsidies and electric vehicle production volume in Delhi.
- To determine how subsidies affect electric vehicle pricing and accessibility for consumers.
- To assess the impact of subsidies on electric vehicle market share in Delhi's automotive industry.

Experimental Design

1. Selection of Participants:

a. Sample: A diverse sample of automobile companies involved in EV manufacturing in Delhi will be carefully chosen to ensure industry representation.

b. Random Allocation: To minimize any potential selection bias, the selected companies will be randomly assigned to either the "Subsidy Group" or the "Control Group."

2. Experimental Treatment:

a. Subsidized Group: Entities within this category will be granted governmental subsidies in line with established subsidy initiatives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, GST reductions, incentives under the National Electric Mobility Mission Plan (NEMMP), and reductions in customs duty.

b. Control Group: Companies in the control group will not receive any subsidies and will operate under the market conditions that exist at the time.

3. Data Collection:

a. Large Data Sets: Data on production volume, pricing, and market share of electric vehicles will be collected for both the Subsidy and Control Groups over a set period of time.

b. Setting a Baseline: Data collection will begin with the acquisition of pre-experiment data to establish a baseline for comparison with post-experiment results.

4. Data Analysis:

a. Comparative Examination: Information from both the Subsidy and Control Groups will undergo thorough statistical analysis employing robust techniques like t-tests and analysis of variance (ANOVA). These approaches will be employed to ascertain the impact of subsidies on production volume, pricing, and market share.

b. Regression Study: Sophisticated regression models will be utilized to further explore the intensity and orientation of the correlation between subsidies and interest rate outcomes, providing more nuanced findings.

5. Ethical Considerations:

a. Informed Consent: Prior informed consent will be obtained from participating automobile manufacturers to ensure their willingness and understanding of the research.

b. Data Privacy: To ensure data integrity and confidentiality, all collected information will be anonymized and stored securely.

This experimental research design takes a systematic and comprehensive approach to determining the causal relationship between government subsidies and critical outcomes of electric vehicle manufacturing in Delhi. This design aims to rigorously isolate the effects of subsidies on production volume, pricing, and market share by randomly assigning companies to either the Subsidy or Control Group, resulting in empirical evidence that can significantly inform government policies and industry strategies in the field of electric vehicles. This research aims to enhance our comprehension of the concrete impacts of subsidies on the sector, while also offering valuable insights for long-range urban transportation solutions in Delhi and other similar locations.

4. Data Analysis and Interpretation:

4.1 The Economic Times

Since the implementation of Delhi's EV policy in August 2020, the number of registered electric vehicles (EVs) has exceeded 100,000, with two and three-wheelers constituting 65% of total sales. The Delhi government intends to further encourage EV adoption by offering subsidies and discounted charging facilities for government employees, with the goal of reaching 25% electric vehicle registrations by 2024. Delhi has accounted for 19.5% of total EV sales in December 2023, marking the highest figure for any Indian state thus far. In 2023, Delhi registered a total of 657,312 vehicles, out of which 73,610 were electric.

The EV policy, initially set to expire in December 2023, will now be extended for an additional three months until March 31, 2024. This policy, introduced in August 2020, aimed to increase the proportion of electric vehicles in Delhi to 25% by 2024.

4.1.1 Nation investment promotion

The Production Linked Incentive (PLI) Scheme for the Automotive Sector, launched in September 2021 with a budget of INR 25,938 Cr ($3.1 Bn), aims to stimulate domestic manufacturing of advanced automotive technology (AAT) products and attract investment in the automotive manufacturing value chain. The scheme is divided into two parts: Champion OEM, focused on manufacturing electric or hydrogen-powered vehicles, and Component

Champions, targeting the production of high-value, high-tech components. The scheme has attracted a proposed investment of INR 74,850 Cr ($ 9 Bn), exceeding the target investment of INR 42,500 Cr ($ 5.1 Bn) over five years.

Regarding subsidies for electric cars in the Delhi market, the Indian government has introduced a flat 5% GST on ex-showroom prices for all EVs, which stands in stark contrast to the approximately 29% GST levied on ICE cars. Additionally, the government has rolled out the FAME-II subsidy, which reduces the initial cost of electric vehicles by approximately Rs 1.5-2 lakhs. In tandem with these subsidies, the Delhi government provides an additional Rs 1.5 lakhs for every electric vehicle purchased in the state and exempts new electric vehicles from road taxes. These combined subsidies effectively decrease the initial cost of electric vehicles purchased in Delhi by around 45 percent.

Furthermore, the Indian government offers income tax breaks of up to Rs 1.5 lakhs to individual car owners for interest paid on electric vehicle loans. Additionally, the higher cost of electric cars entitles owners to a refund of tax collected at source (TCS) during the tax filing for the fiscal year of purchase.

Considering all electric car incentives and their impact on total cost of ownership (TCO), which encompasses both the initial cost of purchasing a car and all other operational costs associated with owning and operating the vehicle over its entire lifespan, it's evident that electric cars incur a significantly higher initial cost compared to ICE cars. However, EVs offer lower operating costs, with the 'payback' period serving as one of several methods for comparing the TCO of electric and ICE vehicles.

The availability of subsidies, particularly the FAME II subsidy, combined with increased daily utilization, has positioned EVs as an economically viable alternative to ICE vehicles for commercial use. However, for privately owned vehicles with lower daily utilization and ineligible for the FAME II incentive, alternative policy frameworks may need to be considered to address the higher upfront cost barrier.

4.1.3 The Path Forward

Moving forward, incentives are crucial in bridging the cost gap between electric vehicles (EVs) and internal combustion engine (ICE) vehicles. These incentives will likely need to be expanded to overcome upfront cost barriers and make EVs more attractive to consumers. As EV sales increase and battery technology improves, economies of scale may drive down EV prices, potentially rendering incentives unnecessary. Understanding the relationship between incentives and EV adoption is essential for India to accelerate its shift towards electric transportation.

It's important to recognize that, alongside costs, factors such as consumer attitudes and behaviors, as well as operational considerations like charging infrastructure availability, also influence EV adoption. While all these factors are significant in driving EV adoption in India, achieving cost parity between EVs and conventional ICE vehicles may be the crucial initial step towards achieving broader goals.

The Delhi government, working through the Dialogue and Development Commission of Delhi (DDC) and the Rocky Mountain Institute (RMI), emphasizes the importance of considering the total cost of ownership (TCO) when evaluating the viability of electric vehicles.

4.1.4

Delhi's strategy for incentives in the electric vehicle (EV) sector primarily aims to tackle the higher initial costs of EVs compared to internal combustion engine (ICE) vehicles. The policy includes several measures:

Purchase and scrapping incentives: Delhi's EV Policy provides incentives for purchasing EVs and scrapping older, more polluting vehicles. These incentives, combined with those offered under the FAME-India phase-II scheme, can significantly reduce the cost of electric two-wheelers and three-wheelers.

Encouragement of vehicle scrapping: The policy incentivizes the deregistration of older BS II and BS III vehicles, which contribute to pollution. This initiative aims to address the challenge of scrapping old vehicles and promote the adoption of EVs.

Motor vehicle tax exemptions: All EVs are exempt from road tax and registration fees under the Delhi EV Policy.

Technology-neutral incentive allocation: Up to 50% of the purchase incentive is allocated to battery-swapping operators to support their operations, covering any necessary deposits.

Facilitation of EV financing: To overcome the issue of unattractive loan terms for EVs, the policy offers a 5% interest rate subsidy for EV loans obtained from affiliated agencies such as scheduled banks, NBFCs, or MFIs.

Overall, Delhi's approach aims to make EVs more affordable and attractive for consumers while addressing environmental concerns and promoting sustainable transportation options.

4.1.5

Incentives need to be carefully targeted, going beyond simply subsidizing the cost of electric vehicle supply equipment. It's important to expand incentives to cover other significant expenses related to installing charging and swapping stations. Moreover, incentives should primarily benefit users in priority vehicle segments, while allowing for deregulated prices in non-priority segments. Revenue generated from non-priority segments can then be used by

private operators to offset costs for priority users. For instance, in Delhi, there's an exemption from price regulations for fast charging (power levels exceeding 22kW).

Allowing private operators to explore additional revenue streams through public charging and swapping tenders can be complex. Measures should be taken to minimize the risk of using designated land parcels for other purposes unrelated to charging and swapping. A preferable approach is to allow revenue generation through advertising rather than charging and swapping services. However, if land parcels are combined from different agencies, standardized revenue sharing arrangements need to be established.

5. Conclusions:

In conclusion, there is a positive relationship between electric vehicle infrastructure development, future prospects, environmental performance, and living environment. Expanding infrastructure, including charging stations and battery recycling, is crucial for the transition to electrification. Governments and automakers are investing heavily in research and development to improve electric vehicle performance and affordability, indicating a promising future. Electric vehicles are eco-friendly, producing zero emissions and improving air quality. Creating an electric vehicle-friendly community is crucial as the environment can impact public use and acceptance of electric vehicles. Overall, the positive correlation between these factors indicates electric vehicles have enormous potential as a sustainable transportation option in the future. The study found a positive correlation between vehicle speed, short charging times, low environmental impact, and reliability of electric vehicles, emphasising the importance of these factors in vehicle use. electricity. Research indicates that people are more likely to use electric vehicles that provide a smooth driving experience, are easy to charge, have a low environmental impact, and are reliable. These factors are critical to the widespread adoption of electric vehicles and should be considered by policymakers and industry leaders when encouraging their use. Policymakers can promote the use of electric vehicles by developing fast-charging infrastructure, encouraging their purchase, and investing in research and development to improve battery technology. Industry leaders aim to develop electric vehicles with comparable speed and reliability to conventional vehicles. Stakeholders must collaborate to raise awareness about the benefits of electric cars and promote their adoption. The study found a positive correlation between vehicle speed, short charging time, low environmental impact, and reliability of electric vehicles, indicating that these factors are critical for mass adoption. The findings of the study should be useful. Finally, the study emphasises the importance of understanding consumer attitudes and preferences in driving the adoption of emerging technologies like electric vehicles. Policymakers and industry players can develop and deploy technology that aligns with their target audience's needs and preferences. This will lead to widespread adoption of electric vehicles, achieving their full potential for reducing emissions and improving air quality.

References:

https://journals.sagepub.com/doi/full/10.1177/0972262919875548

https://e-amrit.niti.gov.in/benefits-of-electric-vehicles

https://www.ey.com/en_in/automotive-transportation/electrifying-indian-mobility-accelerating-the-pace-of-electric-mobility

https://aeee.in/electric-mobility-to-play-a-key-role-in-indias-energy-transition/

https://www.ibef.org/blogs/electric-vehicles-market-in-india

https://www.investindia.gov.in/team-india-blogs/electric-vehicle-ev-sector-india-boost-both-economy-and-environment

https://www.ijraset.com/research-paper/electric-vehicles-in-india-future-and-challenges

https://economictimes.indiatimes.com/industry/renewables/ev-registrations-in-delhi-crosses-one-lakh-mark/articleshow/100983263.cms?from=mdr

https://business.outlookindia.com/economy-and-policy/acma-localisation-easier-in-auto-industry-due-to-stable-component-supply-chain

https://ev.delhi.gov.in/blog/expert-review/impact-of-subsidies-on-electric-cars-in-delhi

https://ev.delhi.gov.in/blog/expert-review/impact-of-subsidies-on-electric-cars-in-delhi#:~:text=Impact%20of%20Incentives%20on%20Electric%20Car%20TCOs

https://rmi.org/wp-content/uploads/2019/08/rmi_report_uml_dehli.pdf/