International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Socio-Economic Dynamics and Policy Implications for Electric Vehicle Adoption: A Micro-Level Study in NCR

ARJUN KUMAR

RAKESH KUMAR DAS

RISHAV RAJ

Dr. BLESSY SARAH MATHEW

LOVELY PROFESSIONAL UNIVERSITY

MITTAL SCHOOL OF BUSINESS

Abstract

Electric vehicles reduce pollution only if a high percentage of the electricity mix comes from renewable sources and if the battery manufacturing takes place at a site far from the vehicle use region. Industries developed due to increased electric vehicle adoption may also cause additional air pollution. The Indian government has committed to solving New Delhi's air pollution issues through an ambitious policy of switching 100% of the light duty consumer vehicles to electric vehicles by 2030. This policy is based on vehicle grid interaction and relies on shared mobility through the electric vehicle fleet.

1. Background of the Study

The Indian automobile industry is the 5th largest in the world and is expected to become the third largest by 2030, with a total of 8.7 lakh active EVs on Indian roads (December 2021). As the population rises and demand for vehicles grows, dependence on conventional energy resources is not a sustainable option as India imports close to 80% of its crude oil requirements. According to information aggregated by India Energy Storage Alliance (IESA), the consumption of batteries is expected to be more than 36 GWh by 2025. During the 2020-2027 period, the EV sector is assessed to consume around 250 GWh of batteries. Over the last three years, 0.52 million EVs were registered in India. NITI Aayog further aims to achieve EV sales penetration of 70% for all commercial cars, 30% for private cars, 40% for buses and 80% for two and three-wheelers by 2030. This is in line to achieve net zero carbon emission by 2070. As per IESA, the Indian EV industry is expected to expand at a CAGR of 36%. The electric vehicle market is estimated to be INR 50,000 crores Global Passenger EV Sales (in millions) / % EV Market Share Page 5 of 30 7.09 billion) opportunity in India by 2025. Total charging stations in India increased by 285% YoY in FY22. The EV industry in India is likely to create 5-crore jobs by 2030. Investment flow into EV start-ups in 2021 touched an all-time high, increasing nearly 255% to reach INR 3,307 crore (US$ 444 million). In 2021, spending on electrical architecture development, such as battery development, electrification, e-motors and power electronics, came up to INR 48,215

crores (US$ 6.39 billion). The Government of India has taken multiple steps to tap the potential in the EV Industry. NITI Aayog aims to achieve EV sales penetration of 70% for all commercial cars, 30% for private cars, 40% for buses and 80% for two and three-wheelers by 2030. Several schemes have been taken to promote faster EV adoption, creation of charging infrastructure and manufacturing ecosystem. The key initiatives of the Union Government includes - 1) Govt of India for EV is Faster Adoption & Manufacturing of (Hybrid &) Electric Vehicles (FAME) in 2015 for promoting growth and early adoption of hybrid and electric vehicles in the country. In its phase-2, the scheme was launched with a budget outlay of US$ 1.3 billion (INR 10,000 crore) to support 1 million e-two-wheelers, 0.5 million e-three -wheelers, 55,000 e-passenger vehicles and 7,000 e-buses. The Government extended the scheme until 2024, as announced in Union Budget 2022-23. Other initiatives taken up by Government of India for faster adoption of EVs include reduction in 'Custom duties' on EV and related component (2019), reduction in GST rates on EV from 12% to 5%, rebate in Income Tax upto Rs 1.5 lakh announced to customers on interest paid on loans to buy EV. 3) Production-linked incentive (PLI) scheme for advance chemistry cell (ACC) was launched in June 2021 to promote indigenise battery manufacturing in India. The scheme provides Incentives on sales and domestic value addition made by the investor. It was a tender based selection scheme, wherein total of 10 bids for manufacturing ACC battery with capacity of 130GwH was received. 4) Production Linked Incentive (PLI) Scheme for Automobile & Auto Components was launched in September 2021 which includes promotion of indigenize manufacturing of Battery Electric Vehicle & Hydrogen Fuel Cell Vehicle Components. The scheme provides incentive on sales to Original Equipment Manufacturers (OEMs). In phase-1, 115 applications have been filed and by March 2022, 95-applicants have been approved. 5) Several guidelines and strategy documents have been notified by the Union Government which includes, the National Electric Mobility Mission Plan (NEMMP) 2020, Model Building Bylaws 2016 (Amended in 2018) & Urban Regional Development Plans, Guidelines and Standards for Charging infrastructure for EVs, National Mission on Transformative Mobility & Battery Storage, Scrapping Policy, etc

2. Review of literature

In this section, the need of EVs is stated, followed by a discussion of related previous works in the domain. The transportation sector is the third-largest CO2 emitter in India, which accounted for around 11% of the total CO2 emissions in 2016 (Janssens-Maenhout et al., 2017). In the last decade, electric vehicles (EVs) have emerged as the potential alternative to internal combustion engine vehicles (ICEVs) to curb fossil fuel consumption (Abouee-Mehrizi et al., 2020). However, there are many barriers to the consumer adoption of EVs, such as high upfront cost, lower driving range, and lack of trust in EV technology. These challenges become even more pronounced in emerging economies like India due to lower disposable income of consumers, poor charging infrastructure, and lack of awareness about EV technology. (Government of India, 2019a, Government of India, 2019b; Vidhi and Shrivastava, 2018)

To create effective policies for the spread of electric vehicles (EVs) in India, consumer preference elicitation is essential. According to a recent study on EV demand in India, typical utility calculation methods do not yield willingness to pay estimates that are as realistic as those obtained by accounting for reference reliance. According to our findings, Indian buyers are prepared to shell out an extra $10–34 to shorten the fast-charging time of one minute, $7–40 to increase the driving range of EVs to 200 km, and $104-692 to save $1 per 100 km in operating costs. (Bansal et al., 2021)

There are a number of reasons why electric vehicles (EVs) are becoming more popular, such as their lower cost and increased awareness of environmental issues and climate change. This study examines the developments in electric

vehicle (EV) technology with respect to battery trends, charging techniques, and novel research opportunities and difficulties. More precisely, an examination of the state of the global EV market and its prospects is conducted. Since batteries are a key component of electric vehicles (EVs), this article provides an extensive overview of battery technologies, ranging from lead-acid to lithium-ion. In addition, we go over the various standards that are available for EV charging as well as suggestions for power control and battery energy management. (Sanguesa et al., 2021)

Many nations have hastened the development of electric vehicles in an effort to lessen their reliance on foreign oil and their contribution to environmental pollution. Using EVs—especially battery electric vehicles—is seen as a way to address the environmental problems and energy dilemma. For the purpose of their potential future applications, this article offers a thorough analysis of the technological advancements made in EVs and upcoming technologies. A summary of the main technologies pertaining to electric motors, batteries, charging infrastructure, and control of EVs is provided. As an additional contribution, this study also discusses the technological obstacles and new developments that will need to be addressed in order to increase the efficiency, dependability, and safety of EVs in the future. (Sun et al., 2019)

Numerous alternative energy sources are being researched for hybrid cars in an effort to supplement the world's depleting petroleum supply. Because fossil fuels have negative consequences on the environment, there is growing concern over their usage in automobiles. For use in vehicles, sources such as batteries, fuel cells (FC), super capacitors (SC), and photovoltaic cells, or solar cells, are being researched. The next generation of transportation, the hybrid electric vehicle (HEV), can be powered by combinations of various renewable energy sources. This study examines a number of HEV-related topics and methodologies related to the propulsion system, power conditioning, and energy management system (EMS). Included are further HEV-related fields including DC machines and vehicle systems. Detailed explanations of a variety of type models and algorithms built from experimentation and simulation are provided. The table provides a summary of the various HEV system combinations' performances along with pertinent references. This study offers a thorough analysis of hybrid electric vehicles, including models, energy management systems (EMS), and source combinations created by different researchers. After a thorough evaluation, it was found that while current technologies are largely capable of handling hybrid electric vehicles (HEVs), their dependability and intelligent systems still need improvement. As a result, numerous aspects, difficulties, and issues related to sustainable next-generation hybrid vehicles have been highlighted in this research. (Hannan et al., 2014)

The world is becoming more and more polluted, despite efforts to cut CO2 emissions and preserve the environment. The introduction of electric vehicles (EVs) is one such endeavor. Since the transportation industry is one of the largest emitters of CO2, turning it into a green industry is crucial. The Indian government has devised ambitious plans to bring EVs to the Indian market and stay up with the global EV development. NEMMP 2020, the National Electric Mobility Mission Plan, has released a comprehensive analysis on EVs. (Kumar et al., 2019)

Environmental pollution is a major challenge on a global scale right now. One of the main sources of air pollution is the toxic emissions produced by internal combustion engines. Electric vehicles (EVs) are being actively pushed worldwide in an effort to solve environmental concerns (ECs) and lessen the consequences of fossil fuel emissions. Governments all over the world are enticing people to convert to electric vehicles by offering incentives. According to earlier research, customer adoption of electric cars is hampered by their high cost, lack of infrastructure for charging, and concern related to time and range. By 2030, the Indian government wants to see "only Electric Vehicles" on the road. This modern piece looks at the various aspects that influence a consumer's decision to acquire an electric vehicle. The study's respondents are Indian car owners who currently possess vehicles. Structured Equation Modelling was used to analyze the data (SEM). One significant mediator that has an impact on the uptake of electric vehicles is attitude, or ATT. (Khurana et al., 2019)

Encouraging the widespread use of Battery Electric Vehicles in developing nations such as India is a challenging task, despite its necessity. The drivers, obstacles, and support systems necessary to ensure the success of this transformation are all examined in this qualitative study. 41 in-depth interviews with a variety of stakeholders were carried out, including government representatives, academicians, suppliers, BEV owners, and manufacturers of automobiles. The government's propensity to fund R&D and to provide both monetary and non-monetary incentives were noted as important motivators. Major obstacles included inadequate infrastructure, a high manufacturing cost resulting from the importation of raw materials, frequent technical problems with the product, and a lack of legislative backing for customer incentives. Support strategies could include effective government and industry awareness and promotion efforts, improved industry-academia collaboration, ongoing testing, and vehicle performance improvisation. (Chhikara et al., 2021)

Since 1828, electric vehicles have been well-known yet as internal combustion engine technology advanced, they have fallen from favour. The idea of a sustainable and environmentally friendly future has come up again in the last ten or so years, but there are many obstacles in the way of its effective application in urban areas. India's reliance on fossil fuels, its dearth of lithium sources, its difficulties integrating the grid, the high weight of its electric vehicles, and the absence of infrastructure for charging stations in urban areas have all contributed to the country's difficulty in embracing electric vehicles. This addresses the obstacles to the widespread use of electric vehicles in urban areas. To remove these obstacles, India must strengthen and implement an appropriate regulatory framework, as well as focus on raising public and consumer knowledge.(Panwar et al., 2019)

As part of the EV30@30 Campaign, India hopes to reach a 30% electric vehicle (EV) share by 2030, given the significant connections between electric vehicles and several sustainable development targets. According to projections, the shift to electric vehicles (EVs) would reduce the amount of petroleum fuels currently used for road transportation, shift consumer demand from internal combustion engine-based automobiles to EVs and necessitate the installation of additional electricity and a charging infrastructure network in order to power EVs. Numerous stakeholders will be impacted by these changes in various ways. This article is a humble attempt to document India's anticipated electric vehicle (EV) transition and its implications for stakeholders. The impact assessment conducted by stakeholders under different scenarios indicates that while the power sector is projected to benefit from new investment and commercial prospects, the petroleum, automobile, and federal and state governments would find the transition difficult. This report suggests reforming the automotive sector, fostering stakeholder collaboration, and imposing green/pollution fees on ancillary goods and services in order to facilitate a seamless transition to electric vehicles. (Chaturvedi et al., 2022)

Today's globe depends heavily on Electrical Vehicle (EV) technology because of its low operating costs, net zero emissions, and environmental friendliness. In major countries, the use of electric cars (EVs) may have lessened reliance on automobiles with internal combustion engines (ICEs) and alternative mainstream transportation systems. When comparing fuel economy from tank to wheel and well to tank, the EV has an overall efficiency of 77%, whilst the ICE only has 13%. It can be seen from this that EVs are six times more efficient than ICE cars. But because of the EV's short travel range, as well as other significant problems with charging infrastructure and high cost, the world was unable to adopt it. This essay examines the need for further development in the field of electric vehicle technology and lists the drawbacks of existing EV innovations. This study primarily focuses on the Indian market because EV sales there have treble recently. It also identifies some significant barriers to EV growth. The report also covers current research and creative business initiatives in the fields of energy management, battery energy storage, and charging infrastructure. These areas need to progress to match the ease and affordability of internal combustion engine (ICE) vehicles. The report concludes with predictions regarding the development of various electric car technologies. In order

to promote sustainable development, the work's debate aims to pinpoint the requirements and create an advanced EV technology model that best serves the Indian populace. (Hema et al., 2022)

India lacks a specific policy or strategy, which has caused it to lag behind other nations in the deployment of electric vehicles (EVs). In contrast, in order to reduce air pollution and the use of fossil fuels, the USA, China, Norway, and Germany have provided significant subsidies and incentives for the conversion to electric vehicles. This paper's primary goal was to examine the tactics, policies, and technological factors involved in creating EVs by examining the development of EVs worldwide as well as the Indian market. The development and state of EV research in India was also considered in this study. A SWOC (strength, weakness, opportunity, and challenges) study was also conducted, and the present state of EV deployment in India, as well as the potential and difficulties within this industry, were investigated. In order to lower greenhouse gas emissions in India, this study will motivate companies, the government, and policy makers to provide incentives for the adoption of EVs. It was determined that greater research funding for the advancement of EVs and the infrastructure necessary for charging them should be made available by the Indian government. In order to assist the developing Indian EV sector, the central government may also have a significant role to play in coordinating the efforts of the state and EV-related companies. (Singh et al., 2021)

To far, there is little information available about the possible effects of EV deployment in poor nations. Although EVs are encouraged nationally in India, a nation that is fast industrializing, there isn't the infrastructure in place to handle battery trash. Based on a model analysis conducted for India, we estimated that sales of two-wheeler EVs will reach a high of around 20 million units in 2030, while sales of four-wheeler EVs will climb gradually to 10 million units by 2050. The amount of trash from lead-acid batteries is expected to peak in 2027, while the amount of waste from lithium-ion batteries from four-wheelers and two-wheelers will surpass 500 kilotons in 2050 and 500 kilotons in 4044, respectively. In light of these forecasts, it is critical to establish a national battery waste crime tracking system, an extended producer responsibility (EPR) system, and a safe working and community environment. (Ashokan et al., 2023)

India's road transportation industry is about to switch from internal combustion engines (ICEs) to battery electric vehicles (BEVs). The Indian government, or GoI, has declared a number of policy initiatives aimed at promoting the use of electric vehicles (EVs). On the other hand, EVs have higher initial expenditures but reduced ongoing expenses. As a result, the economics of EVs in comparison to ICE cars rely on how often they are used. In turn, the daily use can differ greatly depending on the situation. This study presents a model to compare the total cost of ownership (TCO) of an electric vehicle (EV) with that of its internal combustion engine (ICE) counterparts that run on gasoline, diesel, or compressed natural gas (CNG). It is discovered that, for the normal average daily usage of the vehicles in Indian cities, the TCO per km of electric two-wheelers (e-2Ws) and electric three-wheelers (e-3Ws) is less than that of their ICE equivalents. The total cost of ownership (TCO) of electric cars, or e-cars, is greater for sedans and hatchbacks than for internal combustion engine vehicles. Due to their greater initial purchase cost, electric buses (also known as e-buses) have a higher TCO per kilometre than diesel and CNG buses. To increase the economic sustainability of EVs, policymakers must investigate novel business models and strategies for high vehicle use. The adoption of EVs in India will also be accelerated by the efficient design of the infrastructure for charging and the availability of rapid charging options. (Kumar et al., 2020)

The transportation sector in India, which runs on fossil fuels, is principally to blame for serious problems like greenhouse gas emissions, reliance on foreign fuels, economic hardship, and long-term health consequences. In an attempt to lessen these serious problems, electric cars (EVs) are promoted as a clean, green alternative that may make it possible to preserve natural resources and make the transition to a low-carbon transportation system more smoothly. The variety of potential elements that interact with one another has resisted the spread of electric vehicles (EVs) in

various nations, even in spite of the announcement of favourable legislative measures to boost their use. Despite the identification of essential components, the topic of how these factors interact with one another has not been adequately addressed in empirical study. Manufacturers and legislators will be better able to plan strategically and create appropriate controls for the factors if the relationships between the factors are understood. This research's main objective is to conduct a thorough analysis and provide a concise overview of the numerous elements contributing to the EV market's sustainable growth in India. The past scholarly literature and expert interviews are used to identify factors. Study provided additional empirical support for the factors found. The interrelationships and hierarchical structure of the factors have then been illustrated using the integrated Decision-Making Trial and Evaluation Laboratory (DEMATEL) – Interpretive Structural Modelling (ISM) approach. The current study will help manufacturers and policymakers concentrate on the gray areas in order to accelerate the growth of electric vehicle deployment in India. (Digalwar at al., 2022) Based on the literature review, we identified the barriers that have impeded the adoption of EVs globally.

3. Objectives of the Study

1. To identify the socio-economic factors that determine consumer preferences towards electric vehicles
2. To assess the willingness of non-electric vehicle owners to consider purchasing electric vehicles in the future
3. To evaluate factors influencing electric vehicle adoption

4. Methodology of the Study

Study Area: Delhi NCR
Source of Data: Primary data (structured questionnaire) and Secondary data
Sample Size: 200
Sampling Technique: Non-random sampling – Quota sampling
Strata – Individual owns e-vehicle and Individual does not owns e-vehicle - 100 each

5. Discussion and Analysis

Table: 5.1. Socio-Economic Characteristics of Sample Units (Willingness to Purchase E-Vehicle)

Category		Value	Asymptotic Significance (2-sided)
Age	Pearson	8.519[a]	.385
	Likelihood Ratio	10.269	.247
	Linear-by-Linear Association	.030	.863
Education	Pearson Chi-Square	2.996[a]	.935
	Likelihood Ratio	3.628	.889
	Linear-by-Linear Association	.500	.479
Income	Pearson Chi-Square	11.487[a]	.853
	Likelihood Ratio	11.974	.873
	Linear-by-Linear Association	.197	.657
Place of	Pearson Chi-Square	1.009[a]	.604

Residence	Likelihood Ratio	1.045	.593	
	Linear-by-Linear Association	.000	.985	
Marital Status	Pearson Chi-Square	5.099[a]	.344	
	Likelihood Ratio	3.057	.903	
	Linear-by-Linear Association	.000	.632	
Nature of Employment	Pearson Chi-Square	7.487[a]	.342	
	Likelihood Ratio	7.974	.053	
	Linear-by-Linear Association	.605	.687	

*at 5% significance level Source: Compiled from primary data

The present study finds that income of the potential consumers significantly influences their purchasing decision on electric vehicle. There's a statistically significant association between the variables at a 0.003 significance level. The present also study finds that age, education, place of residence are not significantly influencing consumption decision of potential consumers to adopt electric vehicle, as the p-values for all tests (Pearson, Likelihood Ratio, and Linear-by- Linear) are (>0.05) high. Therefore, there's not enough evidence to conclude a statistically significant association between the variables.

Interpretation: Similar to cases 1 and 2, there's no evidence of a statistically significant association. The low expected counts again raise concerns about the test's reliability.

Table: 5.2. Correlation Outcome of Willingness to Purchase E-vehicle with different categories of sample units

Category			Correlation	Significance
Pair 1	Owing Electric vehicle	Willingness to Purchase electric vehicle	.199	.166
Pair 2	Owing Vehicle	Willingness to Purchase electric vehicle	.145	.123
Pair 3	No Vehicle	Willingness to Purchase electric vehicle	.065	.096

The results of the paired samples correlation for this case indicate a weak positive correlation between owning an electric vehicle currently and the willingness to consider purchasing one in the future.

Here's a breakdown of the results:

- The correlation coefficient, or correlation coefficient, between the two variables expresses the degree and direction of the linear link. It is 0.199. 0.199 is a weakly positive correlation in this instance.
- Sig. (Significance): 0.166 - This p-value indicates the likelihood that this correlation was observed by accident. Statistical significance is commonly defined as a value less than 0.05. This indicates that the observed association may be the result of chance, as 0.166 is not statistically significant in this instance.

Interpretation: There is a slight tendency for people who currently own electric vehicles to also be more likely to consider buying one in the future. However, this correlation is weak and statistically insignificant. This suggests that owning an electric vehicle currently has little influence on the decision to purchase one in the future for this sample.

Table: 5.3. Challenges for E-Vehicle Adoption

This

	Mean	**Std. Deviation**
Environmental Challenges	1.3600	.48487
Infrastructural Challenges	2.1800	.49857
Government policies and incentives	1.3600	.68309
Operating Cost	3.3600	.88487
Technology_advancements_ in_electric_vehicles	1.2200	.41845
Likelihood_to_recommend_e lectric_vehicles	1.6600	.82338

table shows the average (mean), standard deviation (Std. Deviation), and number of responses (N) for each survey item.

- Mean: The average rating participants gave on a scale of 1 (least important) to presumably 5 (most important) for each factor related to electric vehicles (EVs).
- Cost_of_the_vehicle (3.36): This suggests cost is a moderately important factor on average.
- Environmental_concerns (1.36): Similar average score to cost, indicating environmental concerns are also moderately important.
- Availability_of_charging_infrastructure (2.18): This has the lowest mean, suggesting it might be the least important factor (on average) for participants.
- Government_policies_and_incentives (1.36): Average score similar to cost and environmental concerns.
- Technology_advancements_in_electric_vehicles (1.22): A bit higher average score than availability of charging infrastructure, but still indicates moderate importance.
- Likelihood_to_recommend_electric_vehicles (1.66): This has the highest mean, suggesting participants are most likely to recommend electric vehicles to others on average.
- Std. Deviation: This represents the variability in the responses for each item. A higher standard deviation indicates more spread-out responses (some people find the factor very important, while others don't).

Conclusion

This study has shed light on many aspects of consumer behaviour in the electric vehicle (EV) market. Through a thorough analysis of the financial implications, environmental factors, and scientific advancements, we have gained a substantial comprehension of the factors that encourage and impede the uptake of electric vehicles. The research has

highlighted how important it is to understand how consumer preferences, attitudes, and decision-making processes impact the direction of sustainable transportation. Furthermore, our findings emphasize the significance of economic elements, such as production costs, incentives, and pricing dynamics, in encouraging the adoption of EVs. Environmental factors are also quite significant; however, they affect different types of EVs differently.

Technological advancements are also essential for overcoming adoption barriers and accelerating market penetration, particularly in the fields of battery and charging infrastructure.

Researchers, industry participants, and legislators might use these findings in the future to develop targeted policies and interventions that promote the usage of electric vehicles. This calls for developing effective incentive programs, modernizing the infrastructure necessary for charging, and increasing consumer awareness and education. By tackling these problems, we can promote the widespread adoption of EVs and facilitate the transition to a more sustainable and environmentally friendly transportation system.

Reference

Labeye, E., Adrian, J., Hugot, M., Regan, M.A., Brusque, C.: Daily Use of an Electric Vehicle: Behavioural Changes and Potential for ITS Support. IET Intelligent TransportSystems 7, 210–214 (2013)

• Neumann, I., Cocron, P., Franke, T., Krems, J.F.: Electric Vehicles as a Solution for Green Driving in the Future? A Field Study Examining the User Acceptance of Electric Vehicles.In: Proceedings of European Conference on Human Centred Design for Intelligent Transport Systems, pp. 445–453 (2010)

• Li, L., Wang, Z., Chen, L., & Wang, Z. (2020). Consumer preferences for battery electric vehicles: A choice experimental survey in China. Transportation Research Part D: Transport and Environment, 78, 102185.

• Secinaro, S., Calandra, D., Lanzalonga, F., & Ferraris, A. (2022). Electric vehicles' consumer behaviours: Mapping the field and providing a research agenda. Journal of Business Research, 150, 399-416.

• Zhao, X., Ma, Y., Shao, S., & Ma, T. (2022). What determines consumers' acceptance of electric vehicles: A survey in Shanghai, China. Energy Economics, 108, 105805.

• Forsythe, C. R., Gillingham, K. T., Michalek, J. J., & Whitefoot, K. S. (2023). Technology advancement is driving electric vehicle adoption. Proceedings of the National Academy of Sciences, 120(23), e2219396120.

• Muzir, N. A. Q., Mojumder, M. R. H., Hasanuzzaman, M., & Selvaraj, J. (2022). Challenges of electric vehicles and their prospects in Malaysia: A comprehensive review. Sustainability, 14(14), 8320.

• Delmonte, E., Kinnear, N., Jenkins, B., & Skippon, S. (2020). What do consumers think of smart charging? Perceptions among actual and potential plug-in electric vehicle adopters in the United Kingdom. Energy Research & Social Science, 60, 101318.

• van Heuveln, K., Ghotge, R., Annema, J. A., van Bergen, E., van Wee, B., & Pesch, U. (2021). Factors influencing consumer acceptance of vehicle-to-grid by electric vehicle drivers in the Netherlands. Travel Behaviour and Society, 24, 34-45.

• Morton, C., Schuitema, G., & Anable, J. (2011, January). Electric vehicles: Will consumers get charged up. In Universities's Transport Study Group Conference January (pp. 1-13).

• Khalid, A., & Anwar, A. (2024). Pro-environment consumer behaviour and electric vehicle adoptions: a comparative regional meta-analysis. Applied Economics, 1-25.

• Carlucci, F., Cirà, A., & Lanza, G. (2018). Hybrid electric vehicles: Some theoretical considerations on consumption behaviour. Sustainability, 10(4), 1302.

• Bansal, P., Kumar, R. R., Raj, A., Dubey, S., & Graham, D. J. (2021). Willingness to pay and attitudinal preferences of Indian consumers for electric vehicles. Energy Economics, 100, 105340.

• Lai, I. K., Liu, Y., Sun, X., Zhang, H., & Xu, W. (2015). Factors influencing the behavioural intention towards full electric vehicles: An empirical study in Macau. Sustainability, 7(9), 12564-12585.

• Kangur, A.,Jager, W., Verbrugge, R., & Bockarjova, M. (2017). An agent-based model for

diffusion of electric vehicles. Journal of Environmental Psychology, 52, 166-182.

• Schaumann, H.: Development of a Concept for Inner-City Delivery & Supply UtilisingElectromobility. In: Efficiency and Logistics, pp. 121–127. Springer, Berlin (2013)

• Sourkounis, C., Ni, B., Broy, A.: Pollution of High Power Charging Electric Vehicles in Urban Distribution Grids. In: 2011 7th International Conference- Workshop onCompatibility and Power Electronics (CPE), pp. 34–39. IEEE (2011)

• Solar, A., Bolovinou, A., Heijenk, G., Lasgouttes, J.M., Giménez, R.: Mobility 2.0: CoOperative ITS Systems for Enhanced Personal Electromobility. In: 27t International

Electrical Vehicle Symposium & Exhibition, EVS27 (2013)

• Von Radecki, A.: Transition Management towards Urban ElectroMobility in the

StuttgartRegion. In: Evolutionary Paths towards the Mobility Patterns of the Future, pp.

203–223.Springer, Heidelberg (2014)

• Winter, M., Kunze, M., Lex-Balducci, A.: Into a Future of Electromobility. German

Research 32, 20–24 (2010)

• Werther, B., Hoch, N.: E-Mobility as a Challenge for New ICT Solutions in the Car

Industry. In: Bruni, R., Sassone, V. (eds.) TGC 2011. LNCS, vol. 7173, pp. 46–57.Springer,

Heidelberg (2012)

• Yusof, J., Singh, G., & Razak, R. (2013). Purchase Intention of Environment- Friendly

Automobiles. Procedia - Social and Behavioral Sciences, 85, 400- 410.

http://dx.doi.org/10.1016/j.sbspro.2013.08.36

• NITI Aayog. NITI Aayog and World Resources Institute India Jointly Launch 'Forum for

Decarbonizing Transport' in India. Available online:

https://pib.gov.in/PressReleasePage.aspx?PRID=1748514

• Tarei, P.K.; Chand, P.; Gupta, H. Barriers to the adoption of electric vehicles: Evidence

from India. J. Clean. Prod. 2021, 291, 125847.

• Kumar Satyam. How Better Financing Options Can Help Drive Electric Two- Wheeler

Adoption in India. Available online:

https://www.financialexpress.com/auto/electric-vehicles/better-financing- options-tohelp-drive-electric-two-wheeleradoption-in-india-heres- how/2308807/

• Society of Indian Automobile Manufacturers (SIAM). Domestics Sales Trends. 2021.

Available online:

https://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=14

• Brar, L.; Burgoyne, B.; Eriksson, L.; Likhari, R.; Skoufa, T.; Williams, L. The India

Electric Vehicle Opportunity: Market Entry Toolkit; Catapult Connected Places: Leeds,

UK, 2021

• JMK Research. E-Two-Wheeler India Market Outlook. 2021. Available online:

https://jmkresearch.com/electric-vehiclespublished-reports/electric- two-wheeler-indiamarket-outlook-2/

• Chen, Y. & Chang, C. (2012). Enhance green purchase intentions. Management Decision, 50(3), 502-520.

• Claas, B., Marker, S., Bickert, S., Linssen, J., Strunz, K.: Integration of Plug- In Hybrid and Electric Vehicles: Experience from Germany. In: 2010 IEEE Power and Energy Society General Meeting,

27 | P a g e

pp. 1–3. IEEE (2011)

• Ehrler, V., Hebes, P.: Electromobility for City Logistics: The Solution to Urban Transport Collapse? Procedia-Social and Behavioral Sciences 48, 786–795 (2012)

• Frischknecht, R., Flury, K.: Life Cycle Assessment of Electric Mobility: Answers and Challenges. International Journal of Life Cycle Assessment 16, 691–695 (2011)

• Hoffmann, C., Hinkeldein, D., Graff, A., Kramer, S.: What Do Potential Users Think About Electric Mobility? In: Evolutionary Paths towards the Mobility Patterns of the Future, pp. 85–99. Springer, Heidelberg (2014)

• Kley, F., Lerch, C., Dallinger, D.: New Business Models for Electric Cars: A Holistic Approach. Energy Policy 39, 3392–3403 (2011)

• Lévay, P.Z.; Drossinos, Y.; Thiel, C. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. Energy Policy 2017, 105, 524–533

• Lai, I.K.W.; Liu, Y.; Sun, X.; Zhang, H.; Xu, W. Factors Influencing the Behavioural Intention towards Full Electric Vehicles: An Empirical Study in Macau. Sustainability 2015, 7, 12564–12585.

• Wang, S.; Wang, J.; Li, J.; Wang, J.; Liang, L. Policy implications for promoting the adoption of electric vehicles: Do consumer's knowledge, perceived risk and financial incentive policy matter? Transp. Res. Part A Policy PR. 2018, 117, 58–69

• Wadhwa Nilesh. More Electric Two-Wheelers Sold in H1 2021 Than All of 2020. Auto car India. Available online: https://www.autocarindia.com/bike- news/more- electric-twowheelers-sold-in-h1-2021-than-all-of-2020-421361

• Chéron, E.; Zins, M. Electric vehicle purchasing intentions: The concern over battery charge duration. Transp. Res. Part A Policy Pr. 1997, 31, 235–243

• Lashari, Z.; Ko, J.; Jang, J. Consumers' Intention to Purchase Electric Vehicles: Influences

of User Attitude and Perception. Sustainability 2021, 13,6778

• Chirag, M.; Sonali, Y. Environmentally Conscious Consumers and Electric Vehicle Adoption Behaviour: Moderating Role of Perceived Economic Benefit. Acad. Mark. Stud. J. 2021, 25, 1–16. 40.

• Javid, M.A.; Ali, N.; Abdullah, M.; Campisi, T.; Shah, S.A.H. Travelers' Adoption Behavior towards Electric Vehicles in Lahore, Pakistan: An Extension of Norm Activation Model (NAM) Theory. J. Adv. Transp. 2021, 2021, 7189411.

• Tu, J.-C.; Yang, C. Key Factors Influencing Consumers' Purchase of Electric Vehicles. Sustainability 2019, 11, 3863.

• Han, L.; Wang, S.; Zhao, D.; Li, J. The intention to adopt electric vehicles: Driven by functional and non-functional values. Transp. Res. Part A Policy Pract. 2017, 103, 185–19