WWW.IJRPR.COM

International Journal of Research Publication and Reviews

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

An Analysis of Electric Vehicle Technology Adoption in the Automobile Industry

Manish Kumar

School of Business, Galgotias University Email: manish11ox@gmail.com

ABSTRACT-

The transition to sustainable mobility has emerged as a global imperative, with Electric Vehicles (EVs) positioned at the forefront of efforts to mitigate climate change and reduce dependence on fossil fuels. In India, the adoption of EV technology is not only an environmental necessity but also a strategic response to rising fuel costs, urban air pollution, and the nation's broader energy security goals. This paper critically examines the evolving landscape of EV adoption in the Indian automobile industry, identifying key drivers, challenges, and the prospects for future growth. The study adopts a mixed-methods approach, integrating insights from industry experts, engineers, sales professionals, and users to provide a comprehensive understanding of the current state of EV adoption. The findings indicate that environmental awareness and long-term economic benefits are the primary motivations for consumers, while factors such as high upfront costs, inadequate charging infrastructure, range limitations, and battery performance concerns remain significant barriers to widespread adoption.

The Indian EV market is largely shaped by the dominance of two- and three-wheelers, reflecting the need for affordable and practical solutions in dense urban environments. While multiple EV categories are gaining traction, smaller vehicles with limited range are particularly favored due to their lower costs and ease of use in city settings. This paper concludes that achieving India's vision of a clean and electrified transportation future will require coordinated efforts from government agencies, industry stakeholders, and consumers. It contributes to the broader discourse on sustainable transportation by offering insights into the current challenges and opportunities shaping the future of EV adoption in India.

Keywords- India Auto Market, Sustainable Mobility, Charging Infrastructure, Policy Frameworks, Electric Vehicles.

INTRODUCTION

The automotive industry worldwide is undergoing a fundamental transformation as it shifts away from traditional internal combustion engines toward electric propulsion. This transition is primarily driven by the urgent need to reduce greenhouse gas emissions, combat climate change, and address the growing public demand for cleaner, more sustainable transportation options. As countries strive to meet international climate commitments and reduce their dependence on fossil fuels, electric vehicles (EVs) have emerged as a promising solution that offers significant environmental benefits.

Governments around the globe are playing a pivotal role in accelerating this shift by implementing a range of policies and incentives aimed at promoting EV adoption. The European Union, for example, has committed to a comprehensive plan that mandates the sale of only zero-emission vehicles by 2035, reflecting a strong regulatory push to phase out petrol and diesel cars. Similarly, the United Kingdom has set a target to end the sale of new gasoline and diesel vehicles by 2030, underscoring its dedication to clean transportation. In the United States, federal and state governments have introduced financial incentives, including tax credits and rebates, to encourage consumers to transition to electric vehicles. China, the world's largest automobile market, has adopted a strategic approach by setting ambitious targets for new energy vehicles to constitute the majority of vehicle sales by 2035, backed by subsidies and rapid expansion of charging infrastructure.

Technological progress has been instrumental in overcoming several of the challenges that once hindered EV adoption. Battery technologies, particularly lithium-ion batteries, have seen remarkable improvements in terms of energy density, cost reduction, and lifecycle durability. These advancements have contributed to increased driving ranges and lowered the overall price of electric vehicles, making them more competitive with traditional cars. Furthermore, the global deployment of charging infrastructure has expanded significantly, alleviating concerns about range anxiety—a common barrier to EV acceptance. Public and private investments have facilitated the installation of millions of charging points worldwide, with innovations such as ultra-fast charging and wireless charging further enhancing convenience.

Market data indicate a substantial rise in the sales of electric vehicles and plug-in hybrids in recent years. By 2024, EVs accounted for over 20% of all new passenger vehicle sales globally, a figure that highlights growing consumer interest and confidence in electric mobility. China leads the market by a considerable margin, capturing the majority of global EV sales, followed by Europe and North America, where adoption is also accelerating rapidly. The automotive industry has responded by committing significant resources to electrification strategies, with many legacy

manufacturers planning to transition their entire fleets to electric models in the coming decade. Meanwhile, new entrants specializing exclusively in EVs continue to gain market share and drive innovation.

India's EV market has witnessed remarkable growth in recent years, driven by supportive policies, increasing environmental awareness, and advancements in battery technology. In 2024, India's EV sales reached approximately 1.95 million units, marking a 27% increase compared to the previous year. Electric two-wheelers continue to dominate the market, accounting for nearly 60% of total EV sales, followed by electric three-wheelers and electric cars. Leading domestic manufacturers such as Tata Motors have played a significant role in shaping the market, with Tata commanding over 60% of the passenger EV segment. At the same time, the development of charging infrastructure remains a critical challenge. While the number of public charging stations has grown, with over 25,000 stations installed by the end of 2024, the EV-to-charger ratio remains high, indicating the need for continued investment to alleviate range anxiety and promote confidence among potential buyers.
Despite this momentum, several challenges remain. The higher upfront cost of electric vehicles compared to conventional cars remains a significant obstacle for many potential buyers. Although the cost gap is narrowing due to declining battery prices and government subsidies, affordability continues to influence purchasing decisions. Additionally, concerns about charging infrastructure, vehicle range, and battery performance persist among consumers. However, as technology continues to advance and infrastructure expands, these concerns are expected to diminish over time. Countries with strong policy support and robust infrastructure development, such as Norway, demonstrate how coordinated efforts can dramatically accelerate EV adoption, with electric vehicles comprising nearly 90% of new car sales.

In summary, the adoption of electric vehicle technology is reshaping the global automotive landscape. This shift is fueled by technological innovation, supportive policy environments, and evolving consumer preferences. The future of transportation hinges on sustained collaboration among policymakers, manufacturers, and consumers to address existing barriers and enable the widespread transition to cleaner, electrified mobility solution.

LITERATURE REVIEW

The global automobile industry is undergoing a transformative shift as electric vehicles (EVs) emerge as a pivotal solution in addressing environmental concerns, energy security, and technological advancement. The adoption of EV technology has gained substantial momentum across various regions, yet it faces persistent challenges that require in-depth examination. This literature review explores key theoretical frameworks, global trends, barriers, and the current state of EV adoption across diverse markets.

Understanding the Theoretical Foundations of Electric Vehicle Adoption

The transition to electric vehicles (EVs) has been explored through various theoretical frameworks that seek to explain the factors influencing technology adoption. Central to these discussions is the understanding that consumers' decisions to adopt EVs are not solely based on technological merits but are shaped by a blend of personal perceptions, external conditions, and socio-cultural influences. The Technology Acceptance Model (TAM) emphasizes the importance of perceived usefulness—such as the environmental and economic benefits of EVs—and perceived ease of use, which relates to the practical aspects of owning and operating such vehicles, including charging convenience and driving range. Additionally, the Diffusion of Innovations Theory (IDT) underscores how the adoption of new technologies is influenced by relative advantages, compatibility with existing systems, and ease of trial and observation.
While EVs offer clear environmental benefits and potential cost savings, complexities around charging infrastructure, battery technology, and limited availability in some markets can slow their diffusion. The Unified Theory of Acceptance and Use of Technology (UTAUT) expands these insights by including factors such as social influence, facilitating conditions, and user demographics, recognizing that adoption is a complex process shaped by both personal and societal factors. These theoretical perspectives together provide a nuanced lens through which to understand the evolving dynamics of EV adoption across the globe.

Persistent Challenges in Electric Vehicle Adoption

Despite the growing enthusiasm for electric vehicles, several challenges continue to limit their widespread adoption globally. One of the most significant barriers is the high upfront cost of EVs, which, while decreasing over time, still makes them less accessible to lower-income consumers. The lack of widespread and reliable charging infrastructure creates practical difficulties for users, particularly in rural areas and developing markets where investment in such infrastructure is lagging. Range anxiety, driven by concerns over how far an EV can travel on a single charge, remains a key psychological barrier for potential buyers, especially those who regularly travel long distances. Additionally, uncertainty regarding battery performance, degradation over time, and the costs associated with battery replacement further complicate consumer decisions. The environmental impact of battery production and disposal, along with limited availability of skilled technicians capable of maintaining and repairing EVs, also raises concerns about the long-term sustainability of the EV transition. Cultural factors, such as the attachment to traditional vehicles and skepticism toward emerging technologies, can also slow down adoption, particularly in markets where consumers have limited exposure to EVs. These challenges highlight the need for a coordinated approach involving governments, industry players, and consumers to address the practical, financial, and perceptual barriers to EV adoption.

Global Drivers Fueling the Electric Mobility Revolution

The global push toward electric mobility is driven by a combination of environmental, economic, technological, and policy-related factors. Heightened awareness of the impacts of climate change and air pollution has motivated individuals, corporations, and governments to seek alternatives to internal combustion engine vehicles. As a result, electric vehicles are increasingly viewed as a critical solution for reducing greenhouse gas emissions and improving air quality, particularly in urban areas where traffic-related pollution is a major concern. Financial incentives offered by governments, such as tax rebates, purchase subsidies, and grants for charging infrastructure, have played a pivotal role in lowering the entry barrier for consumers and businesses alike.

Technological advancements, including the development of higher-capacity batteries, faster charging solutions, and extended driving ranges, have further improved the feasibility and attractiveness of EVs. The growing affordability of EVs, coupled with the rising cost of fossil fuels, has also made them an economically viable option for many consumers. Additionally, the emergence of new business models, such as battery swapping and shared mobility services, has further diversified the EV ecosystem and encouraged adoption. Major automakers and startups alike are contributing to the momentum by launching a wide range of EV models tailored to different market segments, from luxury vehicles to mass-market, entry-level options. These combined factors are shaping a global landscape where the shift toward electric mobility is increasingly seen as both necessary and inevitable.

The Role of Policies and Regional Disparities

Government policies have been a crucial driver in shaping the global trajectory of electric vehicle adoption. Financial incentives such as purchase subsidies, tax reductions, and exemptions from road taxes have helped stimulate demand in many markets. Regulatory frameworks that set clear targets for phasing out internal combustion engine vehicles, coupled with investments in public charging networks, have further accelerated the transition. However, the effectiveness of these policies varies widely across regions. Countries with comprehensive, long-term EV strategies and consistent policy support have seen higher adoption rates, while regions with fragmented or short-term policies often struggle to achieve significant progress. The availability and quality of charging infrastructure also differ dramatically between urban and rural areas, creating disparities in access. Urban centers, where governments and private sector players have invested in dense charging networks, have become hotspots for EV adoption, while rural areas lag due to infrastructural and economic challenges. This uneven landscape suggests that while policy interventions are essential, their design, implementation, and regional adaptability play a significant role in determining their success.

Socio-Economic and Cultural Dimensions of Electric Vehicle Adoption

Socio-economic status and cultural factors profoundly influence the adoption of electric vehicles globally. Higher income levels, greater educational attainment, and access to information are often associated with greater willingness to adopt new technologies like EVs. Younger consumers, in particular, tend to be more open to the idea of electric mobility, driven by environmental concerns and an interest in innovative technologies. Conversely, older populations may exhibit greater resistance, often due to limited exposure to EVs or skepticism about their long-term reliability.

Cultural preferences, such as brand loyalty to traditional vehicle manufacturers, a strong attachment to internal combustion engine vehicles, or a perception that EVs lack performance capabilities, can further shape adoption trends. Additionally, differences in lifestyle, commuting patterns, and vehicle usage needs across countries and regions influence how consumers perceive the benefits and drawbacks of EVs. These factors underscore the importance of considering local contexts and consumer diversity when designing policies and marketing strategies to promote electric mobility.

Unaddressed Areas in Existing Research

Although the body of research on electric vehicle adoption has grown significantly, certain areas remain underexplored. Many studies have focused predominantly on four-wheeler passenger vehicles, while limited attention has been given to other segments such as two-wheelers, three-wheelers, and commercial fleets, which play a critical role in many markets. There is also a need for more detailed analyses of the impact of socio-economic and cultural factors across different regions, as well as a deeper understanding of how policy measures interact with consumer behavior over time. Furthermore, existing research often lacks a comprehensive stakeholder perspective that includes not only consumers but also industry professionals, engineers, and policymakers, whose insights can offer a more holistic view of the challenges and opportunities in the EV ecosystem.

Contribution of the Present Study

This study aims to bridge these gaps by offering a global perspective on EV adoption, informed by diverse stakeholder insights. It synthesizes theoretical models with real- world dynamics to explore the interplay of drivers, barriers, socio-economic factors, and policy interventions. The goal is to provide a holistic understanding of the global transition toward electric mobility and to identify pathways for fostering sustainable and inclusive EV adoption worldwide.

RESEARCH METHODOLOGY

This study seeks to examine the adoption of electric vehicle (EV) technology within the automobile sector, with a particular focus on the Indian market. The research methodology incorporates a mixed-methods approach, blending qualitative and quantitative techniques to provide a thorough and well-rounded understanding of the subject matter.
Research Design: This study follows a descriptive and exploratory research design. It aims to outline the current trends in electric vehicle adoption within the automobile sector. Additionally, it investigates the key factors that encourage or inhibit this adoption.

Objectives of the Study:

1. analyze the current trends and patterns of electric vehicle adoption.
2. To examine the factors driving the adoption of EV technology.
3. To identify the barriers and challenges hindering EV adoption.
4. To assess the impact of government policies and incentives.
5. To understand consumer preferences and challenges.

- Sample Design: A purposive sampling technique selected 75 respondents, including EV users, engineers, sales managers, and industry experts, to ensure a relevant and diverse sample.

- Data Collection Tools: A structured questionnaire was meticulously developed and administered electronically via email and social media channels. Furthermore, in- depth interviews were conducted to acquire comprehensive insights into the subject matter.

- Data Analysis Techniques: Quantitative data was analyzed using basic statistical methods to identify patterns and trends. Qualitative responses were reviewed to extract key themes and insights.

- Time Horizon: This research utilizes a cross-sectional study design, analyzing data from 2023 to 2025 and incorporating forecasted projections through 2030.

- Ethical Considerations: Ethical protocols were strictly adhered to throughout this study. Prior to participation, all respondents provided informed consent. To ensure anonymity and confidentiality, all collected responses were treated as such.

RESULT

The study reveals the following key outcomes based on the responses from 75 participants across various roles in the automobile sector:
Young Adults Are Leading the Shift: Among the 75 respondents, 35 (47%) were aged between 25 and 35 years, highlighting the strong engagement of younger individuals in the electric vehicle sector. The sample included 47 males (63%) and 28 females (37%). The group comprised 20 EV engineers (27%), 30 users (40%), 15 sales professionals
(20%), and 10 industry specialists (13%).

Electric Vehicle Adoption Is Gaining Momentum: Of the 75 respondents, 23 currently use electric vehicles, while 38 plan to adopt one within the next three years. The remaining 14 prefer to continue using conventional fuel vehicles, primarily due to concerns over cost and infrastructure.

Key Drivers of Adoption: Of the 75 respondents, 65% cited environmental benefits and 55% lower operational costs as main reasons for adopting EVs. Government incentives (35%) and advanced features (30%) also played important roles.

Consumer Preferences and Priorities: Among the 75 respondents, 45 (60%) preferred an EV driving range of 300–500 km per charge, suitable for intercity travel. Twenty- three (30%) favored a range of 200–300 km, while seven (10%) were comfortable with less than 200 km. This highlights the critical importance of driving range in purchase decisions.

Barriers to EV Adoption: Among respondents, 25 identified high upfront costs as the primary barrier (33%), followed by limited charging infrastructure (19 respondents, 25%), range anxiety (16 respondents, 21%), and battery performance concerns (14 respondents, 18%). These challenges underscore the need for improved infrastructure and cost reductions.

Future Outlook of EV: The outlook for electric vehicles in India is optimistic. Of the 75 respondents, 34 (45%) believe EVs will capture 50% of the market by 2030, while 23 (30%) expect this milestone by 2035. Key growth drivers include declining battery costs, projected to fall below USD 100/kWh by 2030, and emerging technologies such as solid-state batteries. Battery swapping for two- and three-wheelers is also anticipated to be a significant trend. Despite ongoing concerns over cost and infrastructure, the majority agree that EV adoption will accelerate with appropriate support and innovation.

DISCUSSION

This section offers a comprehensive interpretation of the research findings, aligns them with the study's objectives, and situates them within the context of existing scholarly literature to extract substantive insights.

Interpretation of Results: The findings demonstrate an increasing interest in electric vehicles (EVs) among Indian consumers, notably within the 25–35 age group. Key motivators for adoption include environmental awareness and reduced operating expenses, which align with theories such as the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT) that highlight perceived benefits and advantages. The widespread acceptance of battery electric vehicles (BEVs), particularly among two- and three-wheeler users, signals a preference for cost-effective and practical solutions for urban transportation.

Implications of the Findings: This study indicates that India's electric vehicle market is at a crucial turning point, supported by rising consumer interest, technological progress, and favorable policies. These factors create strong potential for faster EV adoption nationwide. However, challenges such as inadequate charging infrastructure and high vehicle costs remain significant barriers. To achieve mass adoption, it is essential for both government and industry to invest in expanding public charging networks and reducing battery expenses. Additionally, increasing the availability of affordable, entry-level EV models will be critical. Addressing these challenges will enable India to fully capitalize on the growing momentum towards sustainable transportation.

Comparison with Previous Studies: The findings of this study are consistent with earlier research at both global and national levels, which also emphasize cost, infrastructure, and environmental awareness as key factors influencing electric vehicle adoption. Similar to past studies, this research confirms that although EV adoption is on the rise, significant barriers remain, particularly the high initial costs and limited availability of charging facilities. This consistency highlights that these challenges continue to be major obstacles to wider EV acceptance and require focused efforts to overcome.

Limitations of the Study: This study was constrained by a relatively small sample size of 75 respondents, predominantly from urban areas, which limits the generalizability of the findings to rural populations and the broader consumer base. Additionally, given the rapid evolution of the electric vehicle market, certain insights may become outdated as the sector progresses. Furthermore, the reliance on self-reported data introduces the possibility of response bias, which may affect the accuracy of the results.

CONCLUSION

This study provides a comprehensive examination of the current dynamics and future prospects of electric vehicle adoption in India, underscoring the sector's critical juncture amid evolving technological, economic, and policy landscapes. The analysis demonstrates that increasing consumer awareness, technological advancements, and an encouraging policy framework collectively establish a favorable environment for accelerated adoption of electric vehicles. Nonetheless, despite this positive trajectory, significant impediments remain, particularly with respect to the limited charging infrastructure and the elevated costs associated with electric vehicle ownership. These challenges are further exacerbated by the disparity between urban and rural populations, highlighting the imperative for inclusive policies that address affordability and accessibility concerns across diverse demographic segments.

To facilitate the widespread adoption of electric vehicles, it is incumbent upon both governmental authorities and private sector stakeholders to direct concerted efforts toward expanding the charging infrastructure network and fostering the availability of economically accessible, entry-level electric vehicle models. Policy instruments aimed at cost reduction— particularly in battery technology—and consumer incentives are essential to mitigate financial barriers that inhibit adoption. Concurrently, sustained educational initiatives to enhance public understanding of the environmental and economic benefits of electric vehicles will be critical in nurturing a receptive market environment.

While the limitations pertaining to sample size and urban concentration constrain the generalizability of the findings, the results are consistent with extant national and international scholarship, which similarly identifies cost and infrastructure as pivotal factors influencing electric vehicle adoption. Given the rapidly evolving nature of the electric vehicle sector, continuous empirical inquiry will be essential to monitor developments and inform adaptive policy and industry responses.

In summation, the electric vehicle market holds substantial promise as a cornerstone of sustainable development objectives. Through strategic interventions that address prevailing constraints and capitalize on emerging opportunities, significant progress can be made toward the transition to cleaner transportation modalities, thereby contributing meaningfully to global climate mitigation efforts. This study thus serves as a foundational resource for policymakers, industry practitioners, and academic researchers committed to fostering the growth and sustainability of the electric vehicle ecosystem within the unique socio-economic fabric of the region.

REFERENCES :

1. Gupta, R., & Banerjee, D. (2024). State-level analysis of EV registration trends in India. Journal of Transport Geography, 96, 103193.
2. International Energy Agency. (2023). Global EV Outlook 2023. Retrieved from https://www.iea.org/reports/global-ev-outlook-2023
3. Chaudhary, A., Iyer, P., & Mehta, S. (2024). Growth dynamics of electric two- wheelers in India: A regional analysis. International Journal of Sustainable Transportation, 18(4), 305–319.
4. Ministry of Road Transport & Highways. (2022). EV Adoption Statistics. Retrieved from https://morth.nic.in
5. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478.
6. Ministry of Heavy Industries, Government of India. (2021). Faster Adoption and Manufacturing of Electric Vehicles (FAME II) Policy. Retrieved from https://heavyindustries.gov.in
7. Ministry of Heavy Industries. (2024). PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme.
8. ICCT. (2025). India synchronizes EV sales and charging infrastructure growth in 2024. International Council on Clean Transportation.
9. S&P Global. (2025). India's EV Market: Trends and Future Prospects.
10. NITI Aayog. (2024). National targets for EV adoption by 2030. Government of India.
11. Zhang, Y., Kumar, A., & Martinez, J. (2024). Global electric vehicle market review: Sales, policies, and projections. Nature Energy, 9(11), 957–966.
12. Smith, T., & Lee, H. (2023). Comparative analysis of global EV policy frameworks and their outcomes. Energy Research & Social Science, 94, 102880.
13. KPMG in India & Confederation of Indian Industry. (2024, October). India electric vehicle market: Physical, power, economic, and social infrastructure, key drivers for accelerating EV adoption. KPMG in India & Confederation of Indian Industry.
14. World Resources Institute India. (2025). India Significantly Scales Up Electric Vehicle Adoption.
15. Economic Times EnergyWorld. (2025, January 12). India's EV penetration at 7.4% in 2024, may reach 30% by FY30: Report. Economic Times.