Consumer Adoption and Purchase Towards Electric Two-Wheelers: An Empirical Study in India

Mrs. M. SUGITHA
Ph.D. Research Scholar (Full Time), Research Department of Commerce,
Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women, Chennai 600 044.

Under Guidance of Dr. G. TAMILSELVI
Assistant Professor, Department of Commerce,
Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women, Chennai 600 044.

Abstract

The imperative for sustainable transport has increasingly shifted focus toward Electric Vehicles (EVs), particularly two-wheelers, driven by escalating environmental concerns and the volatility of fossil fuel prices. This study investigates consumer perception and adoption trends regarding EVs, explicitly examining the behavioral factors that govern purchasing decisions in the context of emerging economies. The research posits that while consumers acknowledge EVs as economical alternatives with lower operating costs and significant government incentives, substantial barriers remain. These challenges, including high upfront capital costs, insufficient charging infrastructure, and the psychological phenomenon of range anxiety, critically limit widespread acceptance. Employing an exploratory research design, this study utilizes statistical tools such as Analysis of Variance (ANOVA) and Chi-square tests to analyze primary data collected from 300 respondents. The findings highlight significant relationships between consumer awareness channels and future buying intentions, suggesting that while the operational benefits are understood, the infrastructural ecosystem remains a primary hesitation point. Consequently, the study concludes that a synergistic approach involving improved charging infrastructure, targeted consumer awareness campaigns, and supportive policy frameworks is essential to accelerating the trajectory of sustainable transportation.

1. Introduction

The global automobile industry is currently navigating a pivotal transformation driven by the dual pressures of environmental degradation and the economic instability of fossil fuel markets. As climate change mitigation becomes a central tenet of international development goals, the transition from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) has emerged as a critical strategy for decarbonizing the transportation sector. In densely populated urban environments, two-wheeler EVs are gaining particular traction due to their maneuverability and potential for reducing urban air pollution. However, the rate of EV adoption varies significantly across different demographics and geographies, influenced heavily by individual perceptions, social behaviors, and prevailing market conditions. While the theoretical benefits of EVs—ranging from zero tailpipe emissions to reduced noise pollution—are well documented, the consumer decision-making process is complex and multifaceted.

Despite the clear operational advantages, such as lower maintenance costs and energy efficiency, the market faces resistance stemming from structural and psychological barriers. Primary among these is "range anxiety," the fear of depleting the battery before reaching a charging destination, which is exacerbated by a perceived or actual lack of charging infrastructure. Furthermore, the high initial acquisition cost of EVs compared to their petrol counterparts remains a significant deterrent for price-sensitive consumers. Existing literature has extensively modeled infrastructure planning to mitigate these issues; for instance, optimization models have been proposed to balance fleet size and charging infrastructure under CO2 constraints (Nakao et al., 2025). However, technical availability does not always translate to consumer confidence. The disparity between the availability of technology and its adoption suggests that behavioral factors—such as trust in technological reliability and awareness of government subsidies—play a decisive role. Recent studies have also highlighted that the distribution of charging infrastructure is often inequitable, heavily skewed against disinvested neighborhoods, which further complicates the adoption landscape for diverse socio-economic groups (Khan et al., 2021).

This paper addresses these gaps by focusing on the consumer perspective within the specific domain of two-wheeler EVs. While technical studies often optimize for grid stability or fleet management, there is a pressing need to understand how these technical realities filter down to individual purchasing intent. Therefore, this study makes the following contributions:

- It empirically analyzes the impact of demographic variables (age, occupation, education) on consumer perception, specifically distinguishing between economic motivators and environmental consciousness.
- It evaluates the specific barriers to adoption, quantifying the weight consumers place on high initial costs versus long-term operational savings.
- It provides policy-relevant recommendations based on statistical evidence linking consumer awareness levels to the likelihood of adoption, aiming to bridge the gap between hesitation and action.

2. Related Work

The academic discourse surrounding Electric Vehicle adoption is vast, generally categorizing research into technological infrastructure planning, grid integration economics, and socio-behavioral adoption drivers. This section reviews these key areas to contextualize the current study's focus on consumer perception.

2.1 Technological and Infrastructural Planning

A significant portion of existing literature focuses on the logistical challenges of establishing a robust charging network. The placement of charging stations is not merely a geographic problem but a complex optimization challenge involving stochastic demand and energy constraints. For example, Nakao et al. proposed a bi-level optimization model for demand-responsive feeder services, highlighting the trade-offs between charging efficiency and infrastructure costs to meet specific CO_2 emission targets (Nakao et al., 2025). Similarly, scalable computational frameworks have been developed to address the coupling between EV travel behaviors and charging events over large geospatial areas, emphasizing that the network size of the transportation system and the electric grid must be planned in unison (Hong et al., 2020). These studies underscore the "supply-side" of the equation. If infrastructure is poorly planned or insufficient, fleet operations become inefficient, requiring larger fleet sizes to maintain service levels, as demonstrated by Varma et al., who quantified the relationship between charging speeds and fleet requirements (Varma et al., 2023). However, while these models optimize for efficiency, they often assume rational actor behavior, which this current study seeks to test against actual consumer sentiment.

2.2 Smart Charging and Grid Integration

Beyond physical placement, the interaction between EVs and the energy grid is a critical determinant of economic viability. The concept of Vehicle-to-Grid (V2G) and smart charging (V1G) introduces flexibility that can alter the cost-benefit analysis for both utilities and consumers. Sanvito et al. argued that coordinated planning of European charging infrastructure could yield billions in system cost savings, primarily through smart charging protocols that reduce peak load pressures (Sanvito et al., 2026). This economic efficiency is crucial because it theoretically lowers the total cost of ownership for EVs, a key factor in consumer adoption. Furthermore, the responsiveness of the infrastructure itself is vital; Chung et al. discussed the design of fast-response smart charging systems that utilize local data collection to manage peak demands effectively (Chung et al., 2013). While these technological advancements promise lower operational costs and better grid stability, their complexity may not be fully understood by the average consumer, creating a knowledge gap that this study aims to explore.

2.3 Socio-Economic and Behavioral Drivers

The third stream of research, which aligns most closely with this paper, examines the human and social elements of adoption. The utilization of charging infrastructure is deeply embedded in socio-economic contexts. Straka et al. (2020) utilized geospatial datasets to analyze how the environment surrounding slow charging infrastructure impacts energy consumption distributions, finding that charging behavior is not uniform but contingent on local activities and functions (Straka et al., 2020). Furthermore, the predictability of charging station popularity has been linked to urban context and GIS data, suggesting that location attractiveness plays a psychological role in reducing range anxiety (Straka et al., 2019). Crucially, equity remains a major concern. Babur and Macfarlane highlighted the importance of regional modeling to ensure equitable access, noting that adoption is often hindered in low-income communities due to a lack of infrastructure access, which exacerbates health disparities related to traffic pollution (Babur & Macfarlane, 2026). This aligns with Khan et al., who found that charging station distribution often fails to correlate with population density in dense urban environments, disenfranchising specific demographics (Khan et al., 2021). These social disparities form the backdrop for understanding why consumer perception varies so widely across different population segments.

3. Method and Approach

To accurately assess consumer perception and the behavioral factors influencing EV adoption, this study employs a descriptive and exploratory research design. The methodology is structured to capture both the quantitative intent of consumers and the qualitative reasoning behind their preferences.

3.1 Data Collection Framework

The study utilizes a mixed-data approach, integrating primary and secondary data sources.

- **Primary Data:** The core dataset was generated through a structured questionnaire administered to a sample population in the target region. The sampling method employed was convenience sampling, yielding a total of 300 valid responses. The questionnaire was designed to elicit information regarding demographic profiles (age, gender, income level, occupation), current vehicle ownership, awareness of EV technology, and specific attitudes toward adoption barriers and motivators.
- **Secondary Data:** Contextual data regarding EV sales trends (2021-2025), government policy details, and technological specifications were collated from industry reports and academic literature to support the analysis.

3.2 Participant Demographics

The respondent pool reflects a diverse cross-section of the potential market. Among the 300 respondents, the majority identified as male, falling within the economically active age range of 21 to 60 years. The occupational demographic was dominated by salaried individuals and those with undergraduate education levels. A subset analysis of 70 specific respondents indicated high awareness levels, with 64 individuals aware of electric two-wheelers and 60 having prior experience riding them. This high level of familiarity within the sample allows for more reliable insights into the "experienced" consumer mindset rather than purely speculative opinions.

3.3 Analytical Strategy

The collected data undergoes rigorous statistical processing to test the reliability of observed trends.

1. **Descriptive Statistics:** Used to outline the strengths (nature-friendly, low operational cost) and weaknesses (high initial cost, charging time) perceived by the respondents.

2. **Hypothesis Testing:**
    - **ANOVA (Analysis of Variance):** This technique is applied to determine if there are statistically significant differences in the means of purchasing intention across different demographic groups (e.g., does the intention to buy differ significantly between age groups or income levels?).
    - **Chi-Square Test:** Used to examine the association between categorical variables, specifically testing the relationship between "Consumer Awareness Channels" (how they learned about EVs) and "Future Buying Intentions."

3.4 Evaluation Plan

The validity of the study rests on establishing a correlation between awareness and adoption. The evaluation framework posits that higher awareness of government incentives and long-term cost savings will correlate positively with the willingness to adopt, despite the barriers of high upfront costs. The study validates this by cross-referencing the perceived "Opportunities" (growing demand, tech advancements) against the "Threats" (regulation changes, competitor vehicles like CNG). This approach ensures that the findings move beyond simple opinion polling to reveal the structural drivers of consumer behavior.

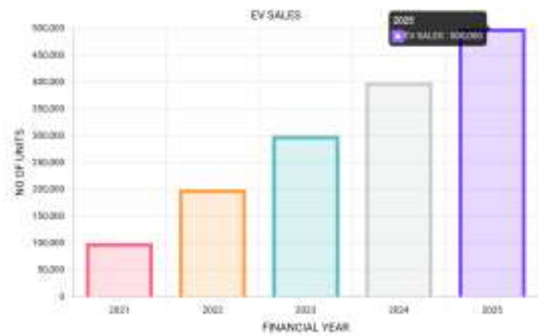
4. Discussion

The results of the study illuminate a complex landscape where economic pragmatism clashes with infrastructural reality. The analysis confirms that the primary drivers for EV adoption are "Pull" factors: the promise of lower operational costs and environmental benevolence. However, "Push" factors—specifically infrastructure deficits and cost—remain potent inhibitors.

4.1 Economic versus Environmental Motivators

Respondents identified the eco-friendly nature of EVs (zero emissions) and low operational expenditures (no fuel costs) as the dominant strengths. This aligns with the broader life cycle assessment literature, which suggests emission reductions of up to 97% compared to petrol vehicles. However, the study identifies a critical friction point: the high upfront cost. While the *Total Cost of Ownership (TCO)* of an EV is often lower over 5-10 years, the initial capital requirement acts as a high barrier to entry for the average salaried consumer. This finding suggests that current government subsidies, while helpful, may not be visible enough or substantial enough to offset the "sticker shock" for all demographic segments.

Sales Graph (2021-2025) FIN YR



4.2 The Infrastructure Bottleneck and Range Anxiety

The data underscores "insufficient charging infrastructure" and "long charging times" as the most significant weaknesses. This reflects the "chicken-and-egg" problem described in infrastructure planning literature (Nakao et al., 2025). Consumers are hesitant to buy vehicles without visible charging stations, while investors are hesitant to build stations without vehicle density. This anxiety is not merely about the *number* of stations but their *distribution* and *reliability*. As noted in related works, predicting the popularity and utility of charging locations requires complex analysis of urban activities (Straka et al., 2019). If charging points are not located near amenities (shops, workplaces) or in residential areas, their utility decreases. Furthermore, the threat of limited charging capacity impacting customer priorities is real; without fast-response smart charging infrastructure (Chung et al., 2013), the user experience (waiting times) deteriorates, reinforcing negative perceptions.

4.3 Policy Implications and Equity

The study highlights that salaried professionals show greater interest in adoption, which raises questions about equity. If adoption is skewed toward higher-income groups, the benefits of cleaner air and lower transport costs are not equally shared. This echoes findings on the inequitable access to charging infrastructure in other major urban centers (Khan et al., 2021). Policy interventions must therefore go beyond purchasing subsidies. There is a need for policies that democratize charging infrastructure. Concepts such as "WEcharge," which proposes business models for sharing privately owned charging infrastructure with the public, could address the space and cost constraints in dense urban areas like Chennai (Hashmi et al., 2022). Additionally, regulations need to remain stable; the "Threat" identified in the study regarding fluctuating government rules indicates that policy uncertainty scares off potential buyers.

4.4 Limitations and Future Directions

While this study provides valuable behavioral insights, it is limited by its convenience sampling method and geographic focus on a specific urban demographic. The reliance on 300 respondents, mostly male and educated, may not fully capture the sentiment of rural or less educated populations who are also critical to mass adoption. Future work should expand the scope to include:

- **Rural Adoption Models:** Investigating how infrastructure planning (Nakao et al., 2025) applies to non-urban settings where range anxiety is more acute.
- **Longitudinal Studies:** Tracking consumer sentiment over time as battery technology improves and costs decline.

- **Grid Impact Analysis:** Further exploring how consumer charging behavior impacts local grid stability (Hong et al., 2020), bridging the gap between behavioral science and electrical engineering.

5. Conclusion

The transition to electric two-wheelers represents a significant opportunity for sustainable development, offering a pathway to reduce environmental damage and mitigate the impact of rising fuel prices. This study has demonstrated that consumer perception is currently in a state of flux, balanced between the attractive pull of operational economy and the repelling force of high initial costs and infrastructural anxiety. The statistical analysis reveals a strong, positive correlation between consumer awareness and the willingness to adopt EVs, validating the hypothesis that education and familiarity are key adoption drivers.

However, awareness alone is insufficient. The "Weaknesses" identified—specifically the lack of charging facilities and long charging times—are structural barriers that individual enthusiasm cannot overcome. To realize the full potential of sustainable transport, a multi-stakeholder approach is required. Policymakers must focus on stabilizing regulations and ensuring equitable infrastructure distribution, potentially incentivizing shared private charging networks to rapidly expand coverage. Manufacturers must prioritize reducing battery costs to lower the entry price point. Ultimately, the future of sustainable transportation relies on synchronizing technological advancement with a deep understanding of consumer behavior, ensuring that the shift to EVs is not just a technological possibility but a practical reality for the mass market.