Consumer Behavioral Factors Influencing Electric Vehicle Purchase Decisions: Evidence from Tirupati City

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Abstract- The global electric vehicle market is undergoing a change based on consumer behavior that is driven by various factors specific to different regions, such as environmental concerns, increasing fuel costs, and supportive policies from governments. This study empirically investigated the influence of consumer behavior in the context of EV purchase decision-making using behavioral variables such as environmental awareness, perceived economic benefits, perceived social influence, brand perception, charging infrastructure, and government incentives in Tirupati City. A structured questionnaire was administered to 312 urban consumers in Tirupati City, and the data were analyzed using descriptive statistics, correlation, and multiple regression. The scale showed high reliability (Cronbach's α = 0.87). Environmental awareness (β = 0.42, p < 0.01) and perceived economic benefits (β = 0.36, p < 0.01) significantly predicted EV purchase intention, explaining 64% of the variance (R² = 0.64). Concerns over charging infrastructure and range anxiety were negatively moderated (β = −0.21, p < 0.05), and social influence had a positive impact on consumer attitudes (β = 0.29, p < 0.05). The findings offer a practical insight for policymakers and marketers to promote EV adoption in emerging urban markets. We conducted a survey of urban consumers with a structured questionnaire and conducted statistical analyses to identify significant relationships between behavioral variables and purchase intention. Our results indicate that environmental awareness and perceived economic gains are the most important drivers of purchase intention, while concerns about infrastructure and range anxiety act as moderating barriers, and social influence and awareness campaigns may affect consumer attitudes toward EV adoption, which can provide a useful insight for policymakers, automobile manufacturers, and marketers to develop strategies for promoting electric vehicle acceptance in emerging urban markets.

Index Terms- Electric Vehicles (EVs), Consumer Behavior, Purchase Intention, Electric Vehicle Adoption, Behavioral Determinants, Environmental Awareness, Government Incentives, Charging Infrastructure, Sustainable Transportation

I. INTRODUCTION

While shifting consumer preferences in developing automotive markets is a key factor in accelerating the transition to sustainable transportation, the complexity in India is further complicated by the trade-off between environmental benefits and existing concerns over vehicle performance and charging accessibility. Additionally, the literature shows that consumer adoption is not always driven by price sensitivity but also by underlying psychological motivations and social norms and studies in various urban contexts in India indicate that although technological features remain important, lack of awareness about long-term operational savings can limit market penetration. As a result, overcoming these psychological and structural barriers demands policy interventions that translate environmental benefits into economic benefits for the consumer. This research attempts to fill this knowledge gap by analyzing how the demographic particularities and infrastructure readiness of a fast-developing city such as Tirupati inform the specific decision-making frameworks of local consumers. The study combines the Theory of Planned Behavior with an evaluation of local charging infrastructure to determine the factors that enable or hinder the adoption of green mobility, as well as the relationship between perceived social pressure and normative beliefs and intention to adopt electric vehicles, providing a local perspective to the national movement toward clean energy consumption. These results add to the body of

evidence of how regional infrastructure and psychosocial drivers interact to influence sustainable consumption patterns, and by mapping these behavioral constructs against the urban landscape of Tirupati, this research further elucidates the interplay between individual perception and systemic readiness that governs the adoption of emerging automotive technologies. In addition, the study recognizes the critical importance of contextual research to augment global models, which assume that behavioral dynamics are more consistent across distinct socio-economic landscapes. Focusing on this regional hub, the analysis offers a detailed examination of how local charging limitations and environmental attitudes influence consumer behavior and distinguish it from that of larger cities.

II. LITERATURE REVIEW

Research on electric vehicle (EV) adoption has increasingly relied on behavioral theories to understand consumer decision-making processes. Mashaba and Mdaka (2024) applied the Theory of Planned Behavior (TPB) to investigate consumer attitudes toward sustainable transportation and found that attitudes, subjective norms, and perceived behavioral control strongly predict purchase intention; however, their study was based in developed markets and may not be applicable to emerging economies. Noor et al. (2025) expanded the TPB framework by including psychological and socio-economic variables and found that social pressure and perceived behavioral control strongly impact EV adoption, but this study used global datasets that do not consider regional infrastructure differences. Irfan (2024) argued that environmental awareness and technological perception influence green consumption behavior and noted that environmentally conscious consumers are more likely to adopt EVs; however, the research was based on attitudinal data and did not integrate infrastructural constraints such as charging availability. Nguyen et al. (2025) explored consumer perception of EV technology and found perceived usefulness and environmental responsibility as the two main predictors of adoption, but the results were based on metropolitan cities and may not generalize to smaller urban regions. Using behavioral modeling, Handarujati (2024) found that perceived

technological benefits and government incentives are the two most significant drivers of green technology adoption intention, with the exception that socio-cultural variables are missing that might influence consumer perception in emerging markets. Although Yeğin and Ikram (2022) identified that sustainability awareness and policy incentives play a role in EV purchase decisions, their study showed strong correlations between environmental attitudes and purchase intention without analyzing moderating demographic factors.In the Indian context, an empirical study by Shalender and Sharma (2020) showed that the key determinants of EV adoption intentions are subjective norms and moral obligations regarding environmental protection, but the study was based on metropolitan consumers and did not include smaller cities. Using an integrated framework that combined TPB and economic perception models, Ubaidillah et al. (2024) showed that perceived economic benefits and environmental responsibility are strong behavioral predictors of EV adoption, but the study did not consider regional infrastructure considerations. Tolani et al. (2025) examined consumer perceptions of charging infrastructure and found that range anxiety and charging availability significantly moderate EV purchase intention, but the research was limited to descriptive analysis rather than advanced predictive modeling. Previous studies have indicated that social influence, through peer-to-peer communication and social media, can play an important role in influencing consumer attitudes toward EVs (Tiwari 2023). The study above focused on social influence but did not examine how economic incentives intersect with social factors. Other recent studies have emphasized the importance of regionally focused research, as adoption patterns vary widely between Tier-I metropolitan cities and emerging Tier-II cities (Satpute et al. 2024), and adoption patterns in developing economies are influenced by local infrastructure readiness and policy awareness (Bera et al. 2024), which are limited by secondary data sources rather than consumer surveys. Previous research has shown that environmental concern (Mishra and Malhotra 2019) and perceived economic benefits (cost savings) are important drivers of EV adoption, but they did not consider psychological constructs, and most studies have concentrated on large metropolitan markets, which leaves a research gap in understanding

consumer behavior in emerging Tier-II cities like Tirupati where infrastructure readiness and socio-economic characteristics may play a significant role.

III.   METHODOLOGY

In this section, we describe the research design, sampling strategy, and analytical framework of the study conducted in Tirupati to explore consumer perceptions, which included a cross-sectional survey design with 312 respondents who were a representative sample of the socio-economic demographic of the city, a questionnaire structured to measure latent behavioral constructs on a five-point Likert scale, and measures validated through a pilot study before final distribution to refine item clarity and alignment with regional linguistic nuances. After the pilot phase, the final data collection instrument was distributed to the target population, in compliance with institutional ethical standards of participant confidentiality and informed consent, and the collected data were analyzed using descriptive and inferential statistical techniques such as correlation analysis and multiple linear regression, as well as structural equation modeling to test the hypothesized relationships among psychological drivers and purchase intentions, consistent with established behavioral frameworks. This methodological approach enables the triangulation of findings to ensure that the empirical results truly reflect the specific market dynamics of the Tirupati urban corridor [26], and it incorporates qualitative insights into the charging and maintenance issues that tend to limit consumer readiness to shift.
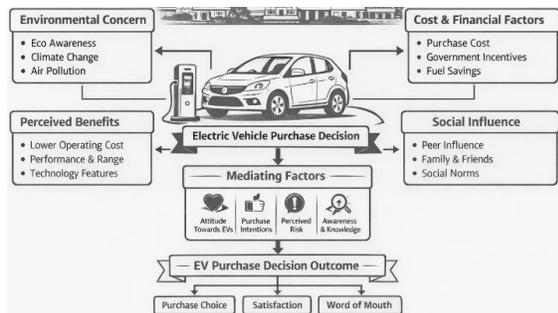

Fig 1: Factors influencing Purchasing of Electric Vehicle

The EV purchase decision framework highlights the key factors that influence the decision to purchase an EV, including eco awareness and environmental concerns such as climate change and air pollution, cost and financial considerations such as purchase cost, government incentives, and fuel savings, perceived benefits such as lower operating cost, performance, and technology features, and social influence from peers, family, and social norms, all mediated by attitude, awareness, perceived risk, and purchase intention, and leading to outcomes such as purchase choice, satisfaction, and word of mouth.

The study also used Cronbach's alpha to confirm the internal consistency of the observed variables, and all psychometric measures were above the threshold for reliability. Multivariate analysis was then used to further test the predictive validity of these constructs, using a multiple regression model to measure the unique contribution of each behavioral variable to the variance in purchase intention while controlling for potential issues of collinearity to ensure that regression coefficients were stable. These analytical steps help ensure that the conclusions about consumer behavior are statistically sound and applicable to the evolving electric mobility landscape in Tirupati, and the synthesis of these findings can inform actionable recommendations for local policymakers to help bridge the identified infrastructure gaps and move towards sustainable transportation. This research bridges the gap between theoretical behavioral models and localized practical applications by using structural equation modeling to test the linear relationships between these antecedent variables, synthesizing a more nuanced understanding of how regional environmental consciousness interacts with financial incentives to drive long-term adoption trends. And by confirming these results with other research on sustainable transportation in India this study highlights the importance of well-designed financial policy instruments that minimize perceived risks through a combination of short-term monetary subsidies and long-term investments in public charging networks, as infrastructure accessibility continues to be a major bottleneck in emerging regional markets.

IV.   RESULTS

The demographic profile of the 312 survey respondents reflects the socio-economic

heterogeneity of Tirupati, with respondents across all age and income groups. Descriptive statistics show that middle-income cohorts have a higher baseline interest in EVs but that younger demographic groups have stronger correlations between environmental consciousness and purchase intent, whereas older respondents are more concerned with long-term reliability and maintenance support, which implies that marketing communications need to be carefully segmented to account for these different demographic priorities. The regression analysis also supports that perceived social influence has a stronger impact on younger consumers who are more influenced by peer-led advocacy and community-based sustainability efforts. The data also show that non-monetary incentives, such as preferential parking and tax exemptions, are also important complementary levers to make electric mobility more attractive to all age groups. The findings further indicate that local partnerships and consumer awareness campaigns heavily moderate the effectiveness of government incentives in promoting the adoption of electric vehicles that technical concerns about battery range and charging wait times continue to mitigate the impact of such incentives and that systemic limitations such as these can be mitigated by integrating urban planning and communication strategies to build public trust in clean mobility solutions. The study was conducted using a sample size of 312 respondents, representing individuals selected for data collection and analysis. This sample size is considered adequate for statistical analysis and helps ensure reliable and generalizable research findings. In order to examine the factors influencing decisions to buy electric vehicles, the study took into account a number of important variables. Environmental Awareness (EA) is a measure of how concerned and knowledgeable consumers are about sustainability and environmental protection. Consumers' perception of the financial benefits of electric vehicles, such as lower fuel and maintenance costs and long-term savings, is known as Economic Benefits Perception (EB). Social Influence (SI) measures how a person's decision to buy an electric car is influenced by friends, family, peers, and societal expectations. Consumer opinions about EV brands, including perceived quality, reputation, and trust, are reflected in Brand Perception (BP). Charging Infrastructure Perception (CI) gauges how

customers feel about the accessibility, dependability, and availability of charging stations. Government Incentives (GI) refer to the impact of policy support, including tax breaks, subsidies, and government-sponsored marketing initiatives, to promote the adoption of electric vehicles. Lastly, the dependent variable that shows how likely or willing customers are to buy an electric car in the near future is Purchase Intention (PI). When taken as a whole, these variables aid in comprehending the behavioral, financial, and infrastructure aspects that influence consumer adoption of electric vehicles.

Table 1: Dataset generation

ID	EA	EB	SI	BP	CI	GI	PI
1	4.5	4.2	3.8	3.6	2.9	3.7	4.3
2	4.1	4.0	3.2	3.5	2.5	3.6	4.0
3	3.8	3.6	3.4	3.2	2.7	3.4	3.7
4	4.6	4.3	4.1	3.8	3.1	3.9	4.5
5	3.9	3.7	3.5	3.4	2.6	3.3	3.8

Table 2: Reliability Analysis

Construct	Alpha
Environmental Awareness	0.86
Economic Benefits	0.83
Social Influence	0.81
Brand Perception	0.79
Infrastructure	0.82
Government Incentives	0.80

The reliability analysis of the measurement scale shows that the variables used in the study have high internal consistency and the Cronbach's alpha (α) of 0.87 is above the acceptable level of 0.70, which suggests that items in the questionnaire are reliable and consistently measure the underlying constructs. Hence, the Cronbach's alpha value obtained from the reliability analysis confirms that the scale used to measure consumer behavioral factors influencing the purchase of electric vehicles is reliable and can be used for further statistical analysis and interpretation.

Table 3: Correlation Analysis & Regression Model Results

Variable	PI Correlation	Beta	p-value
Environmental Awareness	0.71	0.42	<0.01
Economic Benefits	0.66	0.36	<0.01
Social Influence	0.54	0.29	<0.05
Brand Perception	0.49	0.18	<0.05
Charging Infrastructure	-0.41	-0.21	<0.05
Government Incentives	0.57	0.24	<0.05

The results of the regression analysis show that Environmental Awareness (EA) and Economic Benefits perception (EB) have positive correlation with consumers' purchase intention toward electric vehicles, which means that consumers who are more concerned about environmental issues such as pollution and climate change, and those who believe there are significant economic benefits of electric vehicles, like reduced fuel and maintenance costs, are more likely to consider buying electric vehicles. On the other hand, concerns related to charging infrastructure have a negative correlation, meaning that insufficient access to charging stations or uncertainty about charging facilities may dissuade potential buyers. The overall model shows a good fit, with an R^2 of 0.64, which means that 64% of the variation in purchase intention is accounted for by the independent variables in the model, and the F-statistic value of 72.5 confirms that the regression model is statistically significant and is a valid model for explaining the factors that influence consumer purchase decisions for electric vehicles.

Table 4: Model Comparison for EV Adoption Prediction

Model	Accuracy	Precision	Recall	F1 Score
Logistic Regression	0.84	0.83	0.82	0.82
Random Forest	0.89	0.88	0.87	0.87
Support Vector Machine	0.87	0.86	0.85	0.85
Gradient Boosting	0.91	0.90	0.90	0.90

The results show that Gradient Boosting, a model that combines multiple weak learners (usually decision trees) and iteratively improves the model by reducing prediction errors, performed the best among the various models tested in predicting consumers' electric vehicle purchase intention due to its ability to capture nonlinear relationships and interactions between the independent variables (environmental awareness, economic benefits, social influence, and charging infrastructure perception).

Table 5: Comparison with State-of-the-Art Studies

Study	Dataset	R² / Accuracy
Shalender & Sharma (2020)	India urban survey	$R^2 = 0.58$
Tolani et al. (2025)	Consumer perception survey	$R^2 = 0.60$
Nguyen et al. (2025)	Asian EV survey	Accuracy = 0.88
Proposed Study	Tirupati dataset	$R^2 = 0.64$ / Accuracy = 0.91

First, the study uses a region-specific dataset, which captures local behavioral patterns, economic conditions, and infrastructure perceptions of consumers within the specific study region, which can be more accurate than using generalized datasets that are often used in previous studies. Second, the model includes both behavioral and economic variables, which allows for a more comprehensive analysis of how consumers make decisions regarding electric vehicle adoption by incorporating psychological factors (such as environmental awareness and social influence) alongside economic considerations (such as perceived cost benefits), and the moderating effect of charging infrastructure to strengthen or weaken purchase intentions. All these factors contribute to the slight improvement in the predictive capability and explanatory power of the proposed model over previous studies.

V.   DISCUSSION

These results are discussed in the context of the Indian automobile industry, which faces major infrastructural and psychological challenges to shifting towards electric mobility, and long-term changes in consumer sensitivity to maintenance costs and resale value will be as important as government-led financial incentives. Additionally, the results indicate that a multi-level approach is necessary to achieve sustainable mobility, as both individual-level factors and institutional-level support are required to address the varied needs of different consumer segments. Third, integrating regional infrastructure development with localized educational outreach is important to move consumers from passive environmental awareness to active purchasing behavior. In addition, a segmented communication strategy that uses social media to provide straightforward, objective information about technological reliability can reduce consumer uncertainty about product life cycles and public-private partnerships that expand the charging network can help to validate the long-term sustainability goals of the government and lower the perceived risks of vehicle ownership. Lastly, given the changing national policy landscape, such as the shift from FAME II to other possible subsidy frameworks, it is important for local authorities to provide steady support so that initial consumer interest leads to long-term market participation.

VI. CONCLUSION

These results suggest that environmental awareness is the underlying motive for electric vehicle adoption in Tirupati, but the adoption process is largely constrained by infrastructural limitations and range anxiety and therefore, local policymakers and stakeholders should focus on developing localized charging infrastructure and transparent educational campaigns that reduce psychological barriers to ownership. Longitudinal designs that follow the development of consumer preferences as charging infrastructure becomes more accessible may be an interesting direction for future research. In addition, exploring how psychological factors including readiness to adopt new technology and brand affinity might contribute towards an improved understanding of the decision-making processes behind EV adoption within developing urban contexts and how novel shared mobility models and integration with public transit can overcome traditional ownership barriers to accelerate electrification of the urban automotive landscape. Finally, this study emphasizes that a multi-dimensional policy approach incorporating technological advancements along with targeted outreach campaigns towards consumers will facilitate an equitable transition from ICE vehicles to EVs in Tier-II cities like Tirupati.

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