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## ELECTRIC VEHICLE ADOPTION IN THE TWO-WHEELER SEGMENT: A STRATEGIC ANALYSIS OF CONSUMER BEHAVIOR IN BANGLORE SOUTH DISTRICT, KARNATAKA

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### ABSTRACT

Electric vehicles (EVs) are increasingly positioned as a sustainable alternative to conventional mobility in India, particularly in the two-wheeler segment, which dominates urban commuting. This study investigates the strategic factors governing EV adoption in Bangalore South district—a region characterized by high vehicle density and a technologically informed population. Employing a mixed-method design combining structured questionnaire surveys (n = 200) with semi-structured qualitative interviews, the research systematically examines consumer perceptions, economic considerations, charging infrastructure adequacy, and environmental awareness. Findings reveal that high upfront cost and insufficient charging infrastructure constitute the most critical adoption barriers, while growing environmental consciousness and government policy incentives serve as significant motivators. The study further identifies substantive research lacunae concerning gender-differentiated adoption patterns, post-purchase ownership experiences, and localized behavioral insights specific to urban sub-districts. Actionable recommendations are advanced for policymakers, manufacturers, and future Researchers to accelerate sustainable EV penetration in comparable urban markets.

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## INTRODUCTION

India's transportation sector is undergoing a fundamental paradigm shift, driven by mounting urban pollution, escalating fossil fuel costs, and an accelerating national policy agenda centered on decarbonization. In this context, electric vehicles (EVs) have emerged as a pivotal instrument of sustainable urban mobility. While global EV discourse has largely focused on four-wheelers, the Indian market presents a distinctive structural profile: two-wheelers account for approximately 75% of all registered vehicles on Indian roads, rendering them the most strategically significant entry point for mainstream EV adoption (Society of Indian Automobile Manufacturers [SIAM], 2023). Bangalore South district presents a compelling research context within this national landscape. As a sub-region of one of Asia's fastest-growing technology hubs, it is characterized by high vehicle density, an educated and globally exposed workforce, and pronounced sensitivity to both environmental concerns and technological innovation. These attributes make it a microcosm of the broader urban consumer market towards which EV policy and commercial strategy must be directed. Despite the strategic importance of this segment, empirical research on EV adoption in Indian two-wheeler markets remains nascent, particularly at the sub-district level. Most extant studies either adopt a pan-India perspective that obscures localised nuance or focus predominantly on four-wheelers—a category that, while growing, represents a numerically

smaller and demographically narrower segment of Indian road users. This study addresses this gap by investigating the multidimensional determinants of EV adoption among two-wheeler users and potential adopters in Bangalore South district. The research is structured around three central enquiry questions:

- What are the primary motivators and barriers shaping EV adoption in the two-wheeler Segment of Bangalore South?
- How do demographic variables—including age, gender, and household Income—moderate adoption intentions?
- What role do government policy incentives and physical charging infrastructure play in Shaping consumer decision-making?

By foregrounding localized, segment-specific insights, this study contributes to a more granular and actionable understanding of EV adoption dynamics, with implications for policymakers, manufacturers, and scholars engaged with India's sustainable mobility transition.

## LITERATURE REVIEW

The academic literature on EV adoption draws from multiple theoretical traditions—including the Technology Acceptance Model (TAM), Diffusion of Innovations (DoI), and the Theory of Planned

Behaviour (TPB)—and has identified a consistent set of determinants across varied national contexts. This section reviews each thematic cluster of established findings and identifies the gaps that motivate the present study.

**Economic and Financial Considerations:** Purchase price remains the most frequently cited barrier to EV adoption across the global literature (Bhatt et al., 2022; Kumar & Chakraborty, 2021). While EVs offer demonstrable long-run savings through reduced per-kilometre fuel expenditure and lower maintenance requirements, the higher initial capital outlay creates a significant affordability threshold—particularly among lower-income and first-time vehicle buyers. In India, this constraint is amplified by the relative immaturity of EV-specific financing products. Access to equated monthly instalment (EMI) schemes, zero-interest financing, and insurance bundling remains limited compared to the well-developed financing ecosystem for conventional vehicles. Battery replacement cost constitutes an additional financial concern, often cited in conjunction with uncertainty regarding battery longevity and degradation rates over the vehicle's lifespan (Mukherjee & Bag, 2021). These economic anxieties interact with poor awareness of the total cost of ownership (TCO) advantage that EVs can offer, suggesting that financial literacy and transparent cost communication are as important as objective pricing.

**Charging Infrastructure Availability and Reliability:** Infrastructure readiness is widely acknowledged as a precondition for mass EV adoption. Research consistently demonstrates that consumers' willingness to adopt EVs is contingent not merely on the technical existence of charging networks, but on their perceived density, reliability, and accessibility in the consumer's own habitual travel corridor (Narasimha Murthy & Sumangala, 2020). In India, public charging networks remain heavily concentrated in Tier-1 metropolitan cores, with suburban and peri-urban areas—including much of Bangalore South—remaining chronically underserved. The absence of home-charging infrastructure among apartment-dwelling consumers compounds this problem. Unlike consumers in independent houses with private parking, apartment residents face structural barriers to overnight charging that cannot be resolved by expanding public infrastructure alone. This dimension of the infrastructure challenge has received limited attention in the Indian literature.

**Technology Perceptions and Range Anxiety:** Range anxiety—the apprehension that a vehicle's charge will be exhausted before the journey is complete—is one of the most studied psychological barriers in EV adoption research (Rezvani et al., 2015). While advances in battery technology have substantially extended the real-world range of contemporary EVs, consumer perceptions have not fully kept pace with technical progress. The gap between actual and perceived range represents both a communication challenge and an evidence of the persistent influence of early negative experiences in shaping market attitudes. Beyond range, concerns about battery durability, long-term performance degradation, and post-warranty repair costs represent a distinct cluster of technology-related reservations. These are particularly salient in the Indian context, where after-sales service networks for EVs remain thin and the resale market is embryonic.

**Environmental Awareness and Pro-Sustainability Attitudes:** A growing body of literature links heightened environmental awareness with stronger EV adoption intentions (Ramakrishnan et al., 2022). Younger, more educated, and urban-based consumers demonstrate significantly higher sensitivity to vehicle emissions, air quality, and climate change—an attitudinal profile that aligns well with Bangalore's demographic composition. However, research also indicates that environmental motivation rarely operates in isolation: it typically functions as a reinforcing factor rather than a primary driver, with economic and practical considerations maintaining primacy in final purchase decisions (Adnan et al., 2017).

**Policy Incentives and Government Schemes:** The Indian government's FAME (Faster Adoption and Manufacturing of Electric Vehicles) scheme—now in its second phase—offers direct purchase subsidies, reduced Goods and Services Tax (GST) rates, and state-level incentives that can substantially reduce the effective purchase price of two-wheeler EVs. Research has confirmed that policy incentives serve as meaningful adoption enablers (Mukherjee & Bag, 2021). However, a persistent empirical finding is that awareness of these schemes among potential adopters remains strikingly low, suggesting that communication and outreach deficits are undermining policy efficacy.

**Social Influence and Peer Networks:** Social norms and subjective social influence—as conceptualised within the Theory of Planned Behaviour—exert a significant moderating effect on EV adoption intentions, particularly among younger demographics. Peer adoption, word-of-mouth endorsement, and the visibility of EVs within one's residential and professional social network lower psychological barriers and normalise the technology (Singh & Sharma, 2022). Brand reputation and the perceived prestige associated with specific manufacturers also shape purchase intent, suggesting that marketing strategy interacts with social dynamics in complex ways.

**Identified Research Gaps:** The foregoing review reveals several substantive lacunae that the present study addresses:

- The preponderance of pan-India studies fails to capture the localised variation in Adoption determinants across sub-district and city-level geographies.
- The literature is overwhelmingly oriented towards four-wheeler EVs, with two-wheeler adoption—the dominant vehicle category in India—receiving comparatively little scholarly attention.
- Gender-disaggregated analyses of EV adoption in the Indian context are rare, despite Evidence that safety, convenience, and social norms influence male and female
- Post-purchase experiences, including satisfaction, service quality, and resale concerns, are systematically underexplored relative to pre-purchase adoption intent.

**Research Design:** The study adopts an exploratory and descriptive mixed-method research design, integrating quantitative survey data with qualitative interview insights. This approach enables the triangulation of numerical patterns with the contextual richness of lived consumer experience—an epistemological stance appropriate to the nascent state of localised EV adoption research in India.

**Study Area:** Bangalore South district was selected as the study locale on the basis of its high vehicle density, its educated and technology-oriented population, and its status as a representative but underexplored urban sub-market within the Indian EV adoption landscape.

**Sample and Sampling Strategy:** A purposive sample of 200 respondents was drawn from the population of two-wheeler owners and prospective buyers resident in Bangalore South district. Purposive sampling was employed to ensure the inclusion of both current conventional two-wheeler users and individuals actively considering an EV purchase, thereby capturing the full spectrum of adoption readiness. To enhance representativeness, respondents were recruited across varied residential zones, income strata, and age cohorts within the district.

**Data Collection Instruments:** Quantitative data were collected via a structured questionnaire administered in both English and Kannada. The instrument comprised five thematic modules: (i) demographic and vehicle ownership profile; (ii) cost sensitivity and financial considerations; (iii) charging infrastructure perceptions; (iv) environmental attitudes and policy awareness; and (v) social influence and technology acceptance. Responses were recorded on five-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree)

for attitudinal items, with categorical and open-ended items employed for behavioral and demographic variables. Qualitative data were gathered through semi-structured interviews with a purposively selected sub-sample of 25 respondents, chosen to maximize variation across gender, age, and adoption Status. Interviews were conducted in the respondents preferred language and audio-recorded. With informed consent, then transcribed and translated as required.

**Analytical Framework:** Quantitative data were analyzed using IBM SPSS Statistics (v.26). Descriptive statistics were computed for all variables. Inferential analysis included chi-square tests of association for categorical variables, independent-samples t-tests and one-way ANOVA for group comparisons across demographic categories, and binary logistic regression to identify the independent predictors of stated EV adoption intention. Qualitative interview transcripts were subjected to reflexive thematic analysis following the Braun and Clarke (2006) framework, with coding conducted independently by two researchers to enhance reliability. Emergent themes were integrated with quantitative findings at the interpretation stage.

## FINDINGS AND DISCUSSION

**Respondent Profile:** Of the 200 respondents, 58% were male and 42% female. Age distribution was as follows: 18–25 years (29%), 26–35 years (37%), 36–45 years (22%), and above 45 years (12%). Household income ranged from below ₹3 lakh per annum (18%) to above ₹12 lakh per annum (21%), with the largest cluster falling in the ₹6–12 lakh range (38%). Ninety-two per cent owned at least one conventional two-wheeler; 7% had already adopted an EV two-wheeler.

**Economic Barriers and Cost Sensitivity:** High upfront purchase cost was identified as the primary barrier by 68% of respondents—the highest-ranked obstacle across all variable categories. This finding is consistent with the broader Indian EV adoption literature (Bhatt et al., 2022), and reinforces the critical role of financing accessibility and subsidy communication in overcoming initial affordability resistance. Notably, awareness of the long-term TCO advantage of EVs was relatively limited: only 34% of respondents correctly estimated that per-kilometer operating costs for EVs are substantially lower than those of petrol-equivalent two-wheelers. This gap between objective economic advantage and subjective financial perception represents a key target for consumer education initiatives.

**Charging Infrastructure as a Structural Barrier:** Infrastructure inadequacy emerged as the second most significant barrier, cited by 72% of respondents. Concerns centred on the density of public charging points within Bangalore South, the reliability of available chargers, and the feasibility of overnight home charging for those residing in multi-storey residential complexes. Qualitative interviews surfaced the particular challenge faced by apartment residents, for whom the absence of designated charging bays in basement car parks constituted a near-prohibitive obstacle. These finding highlights that infrastructure policy must move beyond the deployment of public fast-chargers to encompass residential charging facilitation—including regulatory requirements for new construction and retrofitting incentives for existing housing stock.

**Environmental Motivation:** Environmental concern was identified as a strong motivator: 55% of respondents indicated willingness to adopt EVs primarily for pollution reduction, with this proportion rising to 71% among respondents aged 18–35. Qualitative data enriched this quantitative pattern, with younger respondents articulating a strong sense of personal agency and moral responsibility regarding urban air quality. However, consistent with prior literature (Adnan et al., 2017), environmental motivation was rarely decisive in isolation; respondents consistently framed it as a secondary consideration relative to cost and infrastructure. Effective pro-EV communication strategies should therefore present environmental benefits as complementary to—rather than substitutes for—demonstrable economic advantages.

**Policy Awareness Deficit:** A striking finding is that only 40% of respondents demonstrated awareness of applicable government subsidies and incentives, despite the existence of FAME-II benefits and Karnataka state-level schemes that can reduce the effective purchase price of an EV two-wheeler by 15–25%. Awareness was positively correlated with education level ( $r = 0.41$ ,  $p < 0.01$ ) and income ( $r = 0.33$ ,  $p < 0.01$ ), suggesting that current information dissemination channels are disproportionately reaching already-advantaged segments. Targeted outreach through community networks, vernacular media, and point-of-sale dealer communication represents an underutilized policy lever.

**Social Influence and Brand Dynamics:** Social influence mechanisms were particularly pronounced among younger respondents. Peer adoption was cited as a significant confidence-builder by 61% of respondents aged 18–35, compared to 29% among respondents aged above 45. Brand reputation and after-sales service visibility were consistently raised in qualitative interviews, with respondents expressing greater comfort with EV adoption when they perceived a credible manufacturer presence and an accessible service network in their locality. These findings suggest that targeted community-level pilot programmes and manufacturer-facilitated test-ride events could accelerate normalization of EV ownership.

**Gender-Differentiated Adoption Patterns:** Female respondents demonstrated a distinct pattern of adoption considerations relative to male respondents. While cost sensitivity was similarly high across both groups, women disproportionately highlighted safety concerns (e.g., reliability during night-time travel and highway use), ergonomic suitability of available models, and post-purchase service convenience as key decision factors. Despite these contextually coherent concerns, overall stated adoption intention was lower among female respondents (48% expressing medium-to-high intent versus 63% among male respondents). This gender gap represents both a missed commercial opportunity and an equity dimension that warrants specific policy and product development attention.

**Post-Purchase Concerns and Resale Uncertainty:** Uncertainty about long-term resale value and the adequacy of after-sales service networks was raised by 59% of respondents as a factor discouraging commitment to EV purchase. The nascent state of the EV second-hand market in India means that resale value uncertainty is genuine rather than merely perceived—a structural challenge that manufacturers and the broader ecosystem must address through certified pre-owned programmes, extended warranties, and battery performance guarantees.

### Synthesis: A Proposed Adoption Barrier-Driver Matrix

Factor	Role	Intensity (%Respondents)	Primary Mechanism
Upfront cost	Barrier	68%	Affordability threshold; financing gap
Charging infrastructure	Barrier	72%	Range anxiety; apartment charging gap
Policy Awareness	Barrier	60% unaware	Communication deficit
Resale Value Uncertainty	Barrier	59%	Immature second-hand market
Environmental consciousness	Driver	55%	Pro-sustainability values
Government incentives	Driver	Where known: strong	Subsidy reduces effective price
Peer Social Influence	Driver (youth)	61% (18-35)	Normalization via network
Tech-Savvy profile	Driver	Contextual	Bangalore demographic advantage

### Recommendations

#### For Policymakers

- Significantly expand and modernize charging infrastructure in Bangalore South and Comparable urban sub-districts, with

specific attention to apartment residential Complexes and highway corridors.

- Intensify subsidy awareness campaigns through vernacular media channels, dealer Networks, and community-level outreach, with targeted messaging for lower-income and less-educated segments.
- Introduce or strengthen regulatory mandates for charging point installation in new Residential and commercial construction, and facilitate retrofitting grants for existing Housing cooperatives.
- Develop gender-responsive policy frameworks that address safety, ergonomics, and Convenience as distinct adoption enablers for women consumers.

#### For Manufacturers and Industry

- Invest in affordable model development specifically calibrated for the Indian urban two- Wheeler segment, with attention to ergonomic design for diverse rider profiles including Women.
- Communicate TCO advantages transparently and accessibly at the point of sale, Countering sticker-price anchoring with clear lifetime cost comparisons.
- Expand authorised service networks in suburban and peri-urban districts and introduce Extended battery warranties and performance guarantees to address post-purchase Uncertainty.
- Develop certified pre-owned EV programmes to strengthen resale market confidence and reduce ownership risk perception.

#### For Future Researchers

- Conduct longitudinal studies tracking post-purchase ownership experience, satisfaction, and service quality among EV two-wheeler adopters in comparable urban contexts.
- Develop gender-specific adoption frameworks that move beyond demographic descriptors to capture the distinct attitudinal, social, and structural factors shaping women's EV adoption pathways.
- Employ agent-based modelling and spatial analysis to examine how neighbourhood-level social network dynamics and charging infrastructure proximity interact to influence adoption diffusion.
- Extend the analysis to Tier-2 and Tier-3 Indian cities, where the adoption landscape, infrastructure baseline, and income profiles differ substantially from metropolitan contexts.

#### For Community and Civil Society Organisations

- Facilitate peer-to-peer EV sharing and test-ride programmes within residential communities to lower informational barriers and build experiential familiarity.
- Partner with manufacturers and local government to establish visible, community- anchored EV demonstration projects that normalize ownership and provide accessible post-purchase peer support.

## CONCLUSION

This study has provided a systematic, localized investigation of the multidimensional factors governing EV adoption in the two-wheeler segment of Bangalore South district. Drawing on mixed-method data

from 200 respondents, it has demonstrated that high upfront cost and insufficient charging infrastructure constitute the most significant adoption barriers in this market, while environmental consciousness, government incentives, and social peer influence function as meaningful—if currently underutilized—drivers. The findings carry important practical implications. Policy efforts that remain focussed on subsidy provision without commensurate investment in infrastructure expansion and awareness communication will continue to underperform. Manufacturers who target only the most economically advantaged and environmentally motivated urban consumers will miss the larger opportunity embedded in the broader two-wheeler-owning population. And researchers who continue to pursue pan-India, four-wheeler-centric analyses will fail to generate the granular, segment-specific insights that effective intervention requires. The identification of gender-differentiated adoption patterns, acute post-purchase uncertainty, and the persistent policy awareness deficit points to a rich and consequential research agenda. Accelerating the transition to electric two-wheelers in India's cities is not merely a commercial objective; it is a prerequisite for achieving the country's urban air quality, public health, and climate commitments. Bangalore South—with its educated population, high vehicle density, and demonstrable appetite for sustainable innovation—represents both a microcosm of this challenge and a proving ground for the solutions it demands.

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