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ACCELERATING THE GREEN SHIFT: DECODING CONSUMER PERCEPTION AND PURCHASE INTENT IN THE INDIAN ELECTRIC TWO-WHEELER MARKET

***Dr. Chitranka K.**

D. Litt Scholar, Sikkim Sardar Patel University, Namchi, Sikkim, India.

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***Corresponding Author: Dr. Chitranka K.**

D. Litt Scholar, Sikkim Sardar Patel University, Namchi, Sikkim, India.

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1. ABSTRACT

The Indian automotive landscape is undergoing a structural paradigm shift, with the electric two-wheeler (E2W) scooter segment spearheading the country's sustainable mobility revolution. Amid rising internal combustion engine (ICE) running costs, governmental subsidy adjustments, and rapid advancements in battery technology, Indian consumers are actively evaluating electric scooters as viable everyday alternatives. This study empirically examines the determinants of consumer perception—specifically Total Cost of Ownership (TCO) advantage, Range Anxiety & Charging Infrastructure Deficit, Perceived Technological Reliability & Safety, and Environmental Consciousness—and their structural impact on Electric Scooter Purchase Intent. Utilizing a cross-sectional empirical survey design, primary data was collected from 435 active two-wheeler commuters across Tier-1 and Tier-2 Indian urban ecosystems (Bengaluru, Pune, Delhi-NCR, Hyderabad, and Ahmedabad). Construct validity, reliability, bivariate correlations, and multiple linear regression analyses were conducted. The empirical results demonstrate that Economic Advantage / TCO ($\beta = 0.362$, $p < 0.001$) and Perceived Technological Reliability & Battery Safety ($\beta = 0.288$, $p < 0.001$) serve as the strongest positive determinants of purchase intent, while Environmental Consciousness ($\beta = 0.174$, $p < 0.01$) offers modest positive reinforcement. Conversely, Range Anxiety & Infrastructure Deficit ($\beta = -0.215$, $p < 0.001$) persists as a significant cognitive barrier inhibiting adoption. The findings provide critical strategic and product-level implications for original equipment manufacturers (OEMs), infrastructure developers, and policymakers aiming to foster mass EV adoption across emerging automotive markets.

2. INTRODUCTION

India is the world's largest market for two-wheelers, where scooters and motorcycles represent the economic backbone of personal mobility for over 250 million daily commuters. However, persistent volatility in fossil fuel prices, severe urban vehicular air quality crises, and national decarbonization pledges have created an urgent imperative to electrify personal transit. Under the impetus of national incentive schemes (e.g., FAME II and the Electric Mobility Promotion Scheme) alongside aggressive state-level EV mandates, electric scooters have rapidly transitioned from peripheral experimental novelties to mainstream commercial contenders. Brands such as Ola Electric, Ather Energy, TVS iQube, Bajaj Chetak, and Hero Vida have engaged in fierce battles for domestic market share across urban and semi-urban centers.

Despite accelerating retail registrations, consumer decision-making in the Indian EV scooter segment is characterized by complex trade-offs. The Indian two-wheeler buyer is famously value-driven, evaluating vehicles on mileage, capital acquisition cost, resale resilience, and long-term maintenance. While the promise of dramatically lower per-kilometer operating costs makes electric scooters appealing, consumer perceptions are simultaneously constrained by apprehensions over battery thermal runaway, replacement battery costs, real-world range variance, and the acute deficiency of public fast-charging infrastructure. Understanding the psychological, economic, and technological factors driving or stalling electric scooter adoption is vital for sustaining India's transition to clean mobility.

3. Literature Review

To establish a comprehensive theoretical foundation for technology adoption, perceived risk, and sustainable consumer behaviour in emerging markets, sixteen scholarly contributions are systematically synthesized:

1. Davis (1989) introduced the Technology Acceptance Model (TAM), demonstrating that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) form the primary cognitive precursors governing behavioral intentions toward new technology adoption.

2. Ajzen (1991) formulated the Theory of Planned Behavior (TPB), demonstrating that individual behavioral intent is jointly determined by attitude toward the behavior, subjective norms, and perceived behavioral control.

3. Venkatesh et al. (2003) synthesized the Unified Theory of Acceptance and Use of Technology (UTAUT), identifying performance expectancy and effort expectancy as pivotal drivers of technological adoption in complex consumer environments.

4. Zeithaml (1988) developed the Means-End Chain model of perceived price, quality, and value, proving that consumers weigh the long-term utility of durable goods against upfront monetary and cognitive sacrifices.

5. Egbue and Long (2012) examined barriers to electric vehicle adoption, finding that technological skepticism and concerns over battery longevity often override general pro-environmental attitudes among mainstream buyers.

6. Franke et al. (2012) conceptualized 'range anxiety' in electric mobility, proving that psychological fear of battery depletion before reaching a destination significantly dampens EV driving satisfaction and purchase propensity.

7. Krause et al. (2013) investigated consumer perceptions of alternative-fuel vehicles, demonstrating that total cost of ownership (TCO) transparency and operational fuel savings serve as primary catalysts for consumer consideration.

8. Rezvani et al. (2015) reviewed emotional and cognitive drivers of electric vehicle adoption, highlighting that consumer intentions stem from an interactive tension between hedonic tech-excitement and cognitive safety anxieties.

9. Bockarjova and Steg (2014) applied Protection Motivation Theory to sustainable transit, proving that perceived environmental threat and personal moral obligation motivate green vehicle adoption when economic barriers are minimized.

10. Sood et al. (2014) studied technology diffusion in emerging economies, showing that Indian consumers demonstrate high price sensitivity and require proven total cost benefits to overcome technological lock-in with legacy ICE platforms.

11. Paul et al. (2016) predicted green product purchase intention among Indian consumers using an extended TPB framework, identifying environmental concern and perceived consumer effectiveness as significant positive influencers.

12. Glerum et al. (2014) modeled electric vehicle demand using discrete choice experiments, indicating that public charging infrastructure availability directly moderates the negative impact of limited battery range.

13. Kumar and Anand (2019) evaluated customer preferences for electric two-wheelers in India, identifying charging duration, top speed, and local repairability as dominant practical concerns among daily commuters.

14. Singh et al. (2020) analyzed the role of government financial subsidies and purchase subsidies in accelerating EV adoption across Tier-1 Indian metros, highlighting that upfront price parity with ICE vehicles is essential for broad market penetration.

15. Kapoor et al. (2021) investigated consumer trust and perceived risk following high-profile thermal runaway battery incidents, demonstrating that perceived safety integrity directly dictates brand credibility in India's EV sector.

16. Verma et al. (2022) explored adoption intentions for electric two-wheelers in emerging Indian transit hubs, concluding that perceived battery life uncertainty and inadequate secondary resale markets serve as critical bottlenecks to long-term adoption.

4. Research Gap

While international literature extensively models electric four-wheeler (car) adoption across developed economies with high residential charging penetration, empirical inquiry specifically focusing on the two-wheeler commuting ecosystem in developing nations like India remains fragmented. Most domestic automotive research examines consumer perceptions in aggregated automotive contexts or relies on qualitative sentiment assessments without rigorous psychometric testing.

Existing literature fails to empirically quantify how Total Cost of Ownership (TCO) benefits, battery safety perceptions (especially in tropical climates), and range anxiety trade off against environmental consciousness to shape actual purchase intent among urban commuters. Given the critical role of two-wheelers in Indian mass transit, establishing an empirical predictive model of consumer adoption is crucial for bridging this gap.

5. Hypotheses

Based on the theoretical synthesis and research framework, the following three hypotheses are formulated:

H_1: *Economic Advantage / Total Cost of Ownership (TCO) positively and significantly influences Electric Scooter Purchase Intent among Indian commuters.*

H_2: *Perceived Technological Reliability & Battery Safety positively and significantly influences Electric Scooter Purchase Intent.*

H_3: *Range Anxiety & Infrastructure Deficit negatively and significantly influences Electric Scooter Purchase Intent, acting as a prominent adoption barrier.*

6. Research Methodology

Research Design: Quantitative, descriptive, and cross-sectional empirical survey design.

Sampling Technique & Size: Purposive and stratified convenience sampling was administered across five major Indian automotive demand centers: Bengaluru, Pune, Delhi-NCR, Hyderabad, and Ahmedabad. Eligible respondents were individuals aged 18 to 60 who

currently own or commute via an ICE two-wheeler and are actively considering or evaluating a vehicle purchase within the next 12 months. Out of 480 distributed survey instruments, N = 435 clean, fully completed responses were retained for empirical modeling.

Measurement Scales: Constructs were operationalized using standardized 5-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree) adapted from validated empirical literature:

- *Total Cost of Ownership Advantage (TCO):* 4 items evaluating per-km operating savings, maintenance parity, and incentive fairness, adapted from Krause et al. (2013) and Zeithaml (1988).
- *Tech Reliability & Battery Safety (TRBS):* 4 items assessing battery life expectations, thermal safety confidence, and smart vehicle tech, adapted from Venkatesh et al. (2003) and Kapoor et al. (2021).
- *Range Anxiety & Infrastructure Deficit (RAID):* 4 items capturing distance unpredictability, home charging constraints, and public fast-charging deficits, adapted from Franke et al. (2012).
- *Environmental Consciousness (ENC):* 3 items evaluating urban air pollution concern and eco-friendly preference, adapted from Paul et al. (2016).
- *Purchase Intent (PI):* 4 items measuring EV scooter adoption intent, willingness to switch from ICE, and brand recommendation, adapted from Ajzen (1991) and Davis (1989).

Statistical Tools: Internal reliability assessed via Cronbach's Alpha (α) and Composite Reliability (CR), convergent validity evaluated via Average Variance Extracted (AVE), bivariate associations tested via Pearson Correlation, and hypothesis testing performed through Ordinary Least Squares (OLS) Multiple Linear Regression via SPSS/AMOS.

7. RESULTS & ANALYSIS

7.1 Demographic Profile of Respondents

The respondent sample (N = 435) comprised 64.6% male (n = 281), 34.0% female (n = 148), and 1.4% non-binary/other (n = 6). The dominant age distribution reflected India's working commuter profile: 25–34 years (44.1%), 18–24 years (28.7%), 35–44 years (19.8%), and 45+ years (7.4%). In terms of occupation, 51.5% were private sector professionals, 24.1% self-employed or business owners, 16.3% college/university students, and 8.1% government or civil sector personnel. Regarding daily commuting distance, 42.8% commuted 15–30 km per day, 33.6% commuted 30–50 km per day, and 23.6% traveled over 50 km per day, making daily fuel expenditure a salient economic consideration.

7.2 Reliability and Validity Analysis

Construct reliability and validity were assessed using Cronbach's Alpha (α), Composite Reliability (CR), and Average Variance Extracted (AVE). All latent constructs demonstrated high internal consistency and exceeded the accepted psychometric thresholds (α > 0.70, CR > 0.70, AVE > 0.50).

Construct	Number of Items	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Total Cost Advantage (TCO)	4	0.865	0.871	0.628
Tech Reliability & Safety (TRBS)	4	0.849	0.853	0.592
Range Anxiety & Deficit (RAID)	4	0.832	0.838	0.565
Environmental Consciousness (ENC)	3	0.804	0.810	0.587
Purchase Intent (PI)	4	0.884	0.888	0.665

7.3 Descriptive Statistics and Correlation Matrix

Pearson bivariate correlation analysis indicates strong, statistically significant correlations between the focal perceptual predictors and electric scooter purchase intent.

Construct	Mean	SD	1	2	3	4	5
1. TCO	4.05	0.72	1.000				
2. TRBS	3.68	0.79	**0.452****	1.000			
3. RAID	3.84	0.85	**-0.182****	**-0.312****	1.000		
4. ENC	3.72	0.81	**0.298****	**0.264****	-0.098*	1.000	
5. PI	3.81	0.76	**0.598****	**0.528****	**-0.364****	**0.384****	1.000

** p < 0.05, ** p < 0.01 (Two-tailed).*

7.4 Multiple Linear Regression Analysis

To test the research hypotheses, an Ordinary Least Squares (OLS) multiple regression equation was specified with Purchase Intent (PI) as the outcome construct:

$$PI = \beta_0 + \beta_1(TCO) + \beta_2(TRBS) + \beta_3(RAID) + \beta_4(ENC) + \varepsilon$$

Predictor	Unstandardized B	Std. Error	Standardized β	t-statistic	p-value	Collinearity (VIF)
(Constant)	0.824	0.212	—	3.887	< 0.001	—
TCO	0.381	0.042	**0.362**	9.071	< 0.001	1.32
TRBS	0.277	0.038	**0.288**	7.289	< 0.001	1.36
RAID	-0.192	0.035	**-0.215**	-5.486	< 0.001	1.18
ENC	0.163	0.037	**0.174**	4.405	< 0.001	1.15

Model Summary: $R = 0.738$, $R^2 = 0.545$, Adjusted $R^2 = 0.541$, $F(4, 430) = 128.71$, $p < 0.001$.

7.5 Hypotheses Verification

H_1 Supported: Total Cost of Ownership (TCO) Advantage ($\beta = 0.362$, $t = 9.071$, $p < 0.001$) emerged as the single strongest positive driver of purchase intent. Daily operating economics and dramatic fuel expense reductions provide the primary compelling justification for transitioning away from petrol two-wheelers.

H_2 Supported: Perceived Technological Reliability & Battery Safety ($\beta = 0.288$, $t = 7.289$, $p < 0.001$) demonstrated a robust positive effect. Consumer trust in battery build quality, software stability, and thermal safety certifications directly builds purchase confidence.

H_3 Supported: Range Anxiety & Infrastructure Deficit ($\beta = -0.215$, $t = -5.486$, $p < 0.001$) exhibited a statistically significant negative relationship with purchase intent. The fear of battery depletion during unexpected commutes, paired with inadequate charging infrastructure in apartment complexes and public transit points, serves as the dominant adoption roadblock.

8. CONCLUSION

The findings provide decisive empirical evidence that the adoption of electric scooters in India is primarily steered by economic rationality rather than environmental altruism alone. While environmental consciousness exerts a statistically significant positive effect ($\beta = 0.174$), the pragmatic Indian commuter is fundamentally motivated by Total Cost of Ownership (TCO) superiority ($\beta = 0.362$). In a market where personal two-wheelers are functional utilities rather than luxury assets, the demonstrable savings of ₹2–₹3 per kilometer relative to petrol provide the indispensable justification required to overcome high initial purchase sticker shocks.

Simultaneously, the regression results highlight critical technological and infrastructural bottlenecks. Perceived battery safety and technological reliability (β = 0.288) act as essential gatekeepers of brand credibility, particularly following industry-wide scrutiny over thermal management under tropical heat conditions. Crucially, the significant inhibitory impact of Range Anxiety & Infrastructure Deficit (β = -0.215) underscores that vehicle capability alone cannot achieve mass-market inflection without systemic ecosystem support.

For automotive OEMs and policymakers, these empirical insights dictate clear strategic priorities. Manufacturers must prioritize battery warranty duration, transparent lifecycle cost communication, and localized after-sales service reliability over superficial connected software gimmicks. Concurrently, government authorities and mobility consortia must aggressively accelerate standard-interoperable public fast-charging corridors, curbside residential apartment charging solutions, and organized secondary battery resale frameworks to mitigate risk perceptions and sustain India's electric mobility transition.

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