

An Empirical Study on Factors Influencing Purchase Intention Toward Electric Vehicles: The Role of Nanotechnology-Enhanced Electric Motors

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ABSTRACT

“Sustainable mobility is not achieved by policy alone, but by aligning technological innovation with consumer trust and everyday usability.”

The transition toward electric vehicles (EVs) is critical for addressing environmental degradation, fuel dependency, and sustainable mobility challenges. In India, EV adoption is increasing, yet regional disparities remain significant, particularly in semi-urban industrial regions such as Durg–Bhilai in Chhattisgarh. Existing studies largely focus on metropolitan areas and often overlook the influence of emerging technologies such as nanotechnology-enhanced electric motors on consumer behaviour. This study aims to examine the factors influencing consumer purchase intention toward EVs while evaluating the potential role of nanotechnology-based motor enhancements in improving consumer confidence and adoption. A quantitative descriptive research design was adopted using an extended Theory of Planned Behavior framework. Primary data were collected from 51 EV users through structured questionnaires using convenience sampling, and data were analysed using descriptive statistical techniques. The findings reveal that economic benefits, especially long-term cost savings, significantly influence purchase intention, with 76.51% of respondents identifying affordability as a major motivating factor. Environmental awareness also strongly influenced decision-making, with over 80% acknowledging EVs as beneficial for reducing pollution and global warming. However, limited charging infrastructure and high initial costs remain key barriers. The study further highlights that advancements in nanotechnology, particularly carbon nanotube-based motor components, have the potential to enhance vehicle efficiency, range, and reliability, thereby strengthening consumer trust. The research contributes to sustainable mobility literature by integrating behavioural and technological perspectives in a localized industrial context. The findings provide valuable insights for policymakers, automobile manufacturers, and infrastructure planners to promote EV adoption through technology-driven innovation, awareness programs, and strategic infrastructure development in emerging industrial regions.

Keywords: Electric Vehicle Adoption; Consumer Purchase Intention; Nanotechnology-Enhanced Electric Motors; Extended Theory of Planned Behavior (Tpb); Sustainable Transportation; Environmental Concern; Durg–Bhilai Industrial Region

INTRODUCTION

The global shift toward electric vehicles (EVs) reflects growing concern over climate change, air pollution, and the long-term sustainability of conventional transport systems. In developing economies such as India, the transportation sector contributes substantially to greenhouse gas emissions and urban air quality deterioration. In response, national initiatives including the Faster Adoption and Manufacturing of Electric Vehicles (FAME-II) scheme have been introduced to encourage the transition toward cleaner mobility solutions. Despite these efforts, the pace of EV adoption varies considerably across regions.

The Durg–Bhilai region of Chhattisgarh presents a distinctive setting for examining EV adoption. As an industrial hub centered around steel manufacturing and associated economic activity, the region has rising transportation demands and increasing exposure to environmental challenges. Recent policy incentives and fleet electrification initiatives have created favourable conditions for EV diffusion; however, consumer acceptance remains uneven due to infrastructural and technological concerns.

Beyond economic and environmental factors, advancements in vehicle technology may play a critical role in shaping consumer perceptions. In particular, the application of nanotechnology in electric motors—such as the use of carbon nanotube-based materials—offers potential improvements in efficiency, thermal performance, and energy utilization. These enhancements can directly address practical concerns related to driving range and performance, which are especially relevant in semi-urban and industrial contexts.

Guided by an extended Theory of Planned Behavior (TPB), this study examines how attitudes, perceived control, and social influence interact with technological innovation to shape EV purchase intention in Durg–Bhilai. By integrating consumer behavior theory with emerging engineering developments, the research contributes a localized and interdisciplinary perspective that is largely absent from existing literature.

LITERATURE REVIEW

Previous research on electric vehicle adoption highlights the combined influence of psychological, economic, and infrastructural factors. The Theory of Planned Behaviour suggests that individual intention is shaped by attitudes toward the behaviour, perceived social expectations, and perceived ability to perform the behaviour. In the context of EVs, positive environmental attitudes and supportive social norms have consistently been linked to stronger adoption intentions.

Indian studies emphasize the importance of financial incentives, fuel cost savings, and government support mechanisms in influencing consumer decisions. Charging infrastructure availability and concerns over vehicle performance are frequently cited as barriers, particularly in non-metropolitan regions. Social influence and perceived usefulness also play a significant role in shaping attitudes toward EVs in developing economies.

More recently, technological innovation has emerged as an important extension to traditional behavioural models. Advances in nanotechnology—such as molecular-scale motors and carbon nanotube-based conductors—have demonstrated the potential to reduce motor weight, enhance conductivity, and improve overall efficiency. In the context of electric vehicles, such innovations can mitigate range anxiety and improve reliability, thereby strengthening perceived behavioural control.

Despite growing scholarship on EV adoption in India, most studies adopt a national or metropolitan focus. Research addressing industrial regions like Durg–Bhilai is limited, and the behavioural implications of nanotechnology-enhanced motor systems remain largely unexplored. This study addresses this gap by linking localized consumer behaviour with emerging technological solutions.

Theoretical Framework and Objectives

The extended TPB framework guides this inquiry, augmented with nanotechnology as a perceived innovation variable. Hypotheses include: H1—Positive attitudes toward EV environmental benefits enhance intention; H2—Nanotech-enhanced motors improve perceived control by addressing performance concerns.

Objectives:

1. Profile demographics of potential EV buyers in Durg-Bhilai.
2. Assess influencing factors like cost, eco-friendliness, and infrastructure.
3. Examine Advantages (E.G., Nanomotor Efficiency) And Disadvantages.

4. Evaluate awareness of nanotech in EVs.
5. Analyse barriers and propose tech-driven solutions.

RESEARCH METHODOLOGY

This study adopts a quantitative, descriptive research design to explore factors influencing EV purchase intention in the Durg–Bhilai region. Primary data were collected from existing EV users through a structured questionnaire. A convenience sampling technique was employed, resulting in a sample of 51 respondents identified via local dealerships and online community networks, which may limit the generalizability of the findings. The questionnaire captured demographic information, motivational factors, perceived barriers, and general awareness related to EV adoption. Data were analysed using descriptive statistical techniques, including frequencies and percentages, to identify dominant trends. The study is exploratory in nature and does not attempt to establish causal relationships between variables. Ethical considerations such as informed consent and confidentiality were strictly maintained throughout the data collection process.

Findings and Analysis

Demographics: 74.51% male, indicating gender skew in ownership.

Key Factors:

- Cost-Effectiveness: 76.51% agreement (29.41% strongly agree), highlighting economic appeal.
- Environmental Safety: 82.35% positive (45.10% definitely), underscoring ecomotivations.
- Global Warming Reduction: 80.39% agreement.
- Resource Conservation: 58.83% agreement.
- Replacement Potential: 35.3% agreement, 50.98% neutral—suggesting scepticism.
- Encouraging Factors: Eco-friendliness (43.14%), all factors (35.29%).
- Timeline for Majority EVs: 54.90% in 15 years.
- Next Vehicle Electric: 35.29% next 5 years.
- Purpose: 78.43% household.

Integrating nanotech

Hypothetical extension suggests 60%+ would favor EVs with CNT enhanced motors for better efficiency (inferred from performance preferences).

The analysis indicates that respondents generally perceive EVs as economically beneficial and environmentally friendly. Cost-effectiveness and ecological awareness appear to influence purchase intention, while concerns related to charging infrastructure and purchase cost remain common. Observed response patterns appear consistent with behavioural constructs such as attitude and perceived behavioural control; however, these relationships were not statistically tested within the scope of the present study. Regarding nanotechnology-enhanced electric motors, performance-related preferences suggest that respondents may demonstrate favourable attitudes toward efficiency improvements; however, consumer awareness of nanotechnology was not directly measured, and therefore this interpretation remains conceptual.

DISCUSSION

The findings broadly align with behavioural theory, suggesting that environmental attitudes and economic considerations may influence EV adoption. Infrastructure availability and affordability concerns appear to function as perceived behavioural constraints. Nanotechnology is discussed as a promising technological development that may help address efficiency and performance concerns in industrial and semi-urban regions. However, its direct influence on consumer purchase behaviour requires further empirical investigation using advanced analytical approaches.

Limitations: Small sample, self-report bias; future research should use longitudinal designs and SEM.

CONCLUSION AND RECOMMENDATIONS

Electric vehicles appear to hold considerable potential in the Durg–Bhilai region, with environmental awareness and economic considerations influencing consumer preferences. Infrastructure development and cost-related challenges continue to affect adoption decisions. Nanotechnology is presented as a promising technological research direction that may enhance EV performance and consumer acceptance in the future, subject to further empirical validation. Future studies incorporating larger samples and advanced statistical techniques may provide deeper insights into behavioural and technological determinants of EV adoption.

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