

A Study on Replacement Rate of Internal Combustion Technology Vehicles (ICT) by Electric Vehicles (EVs) in India

Irfan Ahmed Qureshi,

Professor, Dept. of Management Science MIT Chh. Sambhajinagar, India
qairfan@gmail.com

Barik Bhagabat,

MGM's Institute Management Studies & Research, MGM University Chh.
Sambhajinagar

Meer Mazhar Ali

Dept. of Management Science MIT Chh. Sambhajinagar, India

Abstract

The research paper explores the slow transition of India's automotive market from Internal Combustion Technology (ICT) vehicles to Electric Vehicles (EVs), with a replacement rate of just 5%, far below the global average. Key factors such as inadequate infrastructure, government policies, and customer perception are identified as barriers. The study suggests marketing EV technology through a Private-Public partnership. By combining government support with private sector expertise, large-scale awareness campaigns can be launched to highlight long-term cost savings, environmental benefits, and infrastructure development, helping accelerate EV adoption across India.

Introduction

The global automotive industry is transitioning from traditional ICT vehicles

to EVs, driven by the need to reduce carbon emissions and dependency on fossil fuels. As one of the world's largest automobile markets, India's participation in this shift is crucial. However, despite various government initiatives to promote EV adoption, the replacement rate of ICT vehicles remains significantly low. This paper explores the reasons behind this slow transition, focusing on the hypothesis that India's replacement rate is only 5%, a figure far below global averages. The research investigates how government policies, infrastructure, and customer perception are shaping this transition, and the steps needed to accelerate the shift.

Literature Review

The transition to electric vehicles (EVs) is well underway in countries like Norway, China, and the Netherlands, where strong government incentives, extensive charging infrastructure, and widespread Customer awareness have led to high adoption rates (Ajanovic & Haas, 2020). In contrast, India's progress has been hindered by various factors such as the high upfront cost of EVs, limited charging infrastructure, and low Customer awareness (Sahoo, 2021).

Government initiatives like the FAME (Faster Adoption and Manufacturing of Electric Vehicles) scheme have been launched to bridge these gaps. However, the impact has been limited due to challenges in implementation, insufficient budget allocations, and a focus primarily

on urban centers (Sahoo, 2021). The replacement rate of internal combustion technology (ICT) vehicles with EVs remains low at approximately 5%, which is far below the global average.

Fayez (2023) discusses the integration of EVs into smart cities and highlights the associated benefits, including lower operating costs, reduced greenhouse gas emissions, and improved air quality. The study identifies challenges such as range anxiety, inadequate infrastructure, and battery costs as key barriers to adoption. However, these can be mitigated by developing robust charging infrastructure, implementing smart grid technologies, and utilizing data analytics. Promoting the use of EVs within smart cities aligns with the creation of more sustainable urban environments that prioritize residents' well-being while minimizing carbon footprints.

Economic factors are a significant barrier in India. Although the overall cost of ownership for EVs is lower due to fuel savings and reduced maintenance, the high initial investment remains a deterrent for many Customers (Lutsey & Nicholas, 2019). As battery technology advances and production scales up, costs are expected to decline, potentially improving the replacement rate (Raj & Muralidharan, 2021).

Milad et al. (2023) provide a comprehensive analysis of the historical trends in EV research, noting that while the

concept of electrification in transportation is old, significant advancements and research momentum have only occurred in the last two decades. Their study emphasizes the need for further development in EV research, industry practices, and policy frameworks to fully realize the potential of electrification in achieving climate goals.

Charging infrastructure is another critical challenge, with most facilities concentrated in urban areas. Rural regions remain underserved, leading to stark regional disparities in EV adoption rates. Das et al. (2020) highlight that expanding the charging network, especially in tier-2 and tier-3 cities, is crucial for boosting the replacement rate.

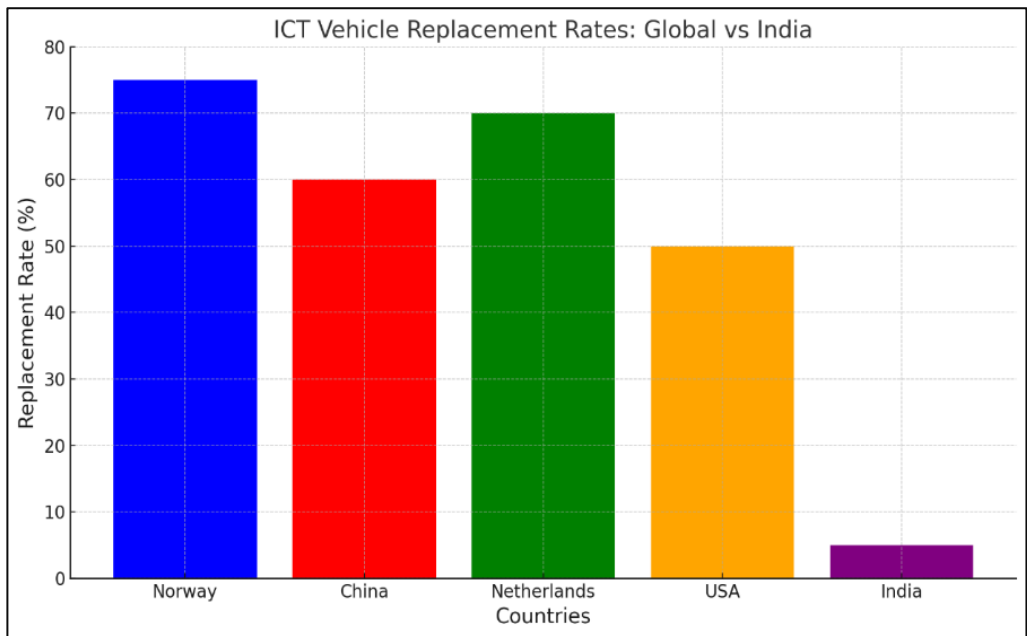
Customer perception also plays a crucial role. Indian Customers' preferences are heavily influenced by factors such as affordability, brand reputation, and service convenience (McKinsey & Company, 2022). The hesitation to switch to EVs is often driven by concerns about range, charging availability, and long-term maintenance, all of which are key barriers that need to be addressed through public awareness campaigns and financial incentives.

Research Methodology

A mixed-methods approach was used, combining surveys, interviews, and secondary data from industry reports and government publications. The study analyzed the replacement rate of ICT vehicles with EVs across urban and rural areas, focusing on the impact of policies, infrastructure, and marketing efforts. Statistical analysis helped identify key factors influencing EV adoption.

Findings and Analysis

India's replacement rate for ICT vehicles with EVs stands at 5%, which is only one-tenth of the global average. Globally, the transition from ICT vehicles to EVs has been much faster due to better government support, stronger infrastructure, and higher Customer readiness. In countries like Norway, the USA, China, and the Netherlands, replacement rates reach 50% to 80%, driven by financial incentives, extensive charging networks, and public awareness campaigns. In contrast, India's slower rate reflects high upfront costs, inadequate infrastructure, and limited Customer trust. Achieving even a fraction of the global average requires significant improvements in these areas, highlighting the unique challenges of adopting global benchmarks in a diverse market like India.



Regional Disparities in Replacement Rates

The study reveals significant regional disparities, with urban areas achieving a replacement rate of up to 20%, compared to less than 1% in rural regions. This gap is driven by better infrastructure, higher income levels, and greater awareness in cities. Rural areas, however, suffer from inadequate charging infrastructure, limited EV availability, and lower levels of Customer trust.

Government Policies and Incentives

While the Indian government has introduced schemes like FAME I and II to encourage EV adoption, their impact remains limited due to issues in implementation, inadequate budget

allocations, and a lack of focus on rural areas. Strengthening these policy frameworks and expanding them to cover more regions is essential to boosting EV adoption.

Customer Perception and Market Trends

Customer perception remains a significant barrier to EV adoption in India. Concerns about range anxiety, battery performance, and high upfront costs deter customers. The limited availability of charging infrastructure, lack of information on EV benefits, and fewer model choices further hinder acceptance. Cultural attachment to conventional vehicles, coupled with inadequate marketing that focuses more on products than ecosystem development, adds to customer skepticism. Additionally,

regional disparities in infrastructure and policy implementation, as well as skepticism toward government initiatives, contribute to hesitancy, particularly in rural areas. Overall, these factors combine to slow EV market growth in India.

Lack of Marketing Efforts in India

The slow adoption of EVs in India is largely due to a lack of technology-centric marketing. Manufacturers focus more on promoting individual products rather than educating consumers on the broader benefits of EV technology, such as long-term cost savings and environmental advantages. This results in low awareness, especially in rural and tier-2/3 cities.

Private-Public Collaboration for Awareness

To address these gaps, a joint effort between the government and private sector is needed. Public-private partnerships should focus on large-scale campaigns that educate consumers about the overall benefits of EVs, including their integration with renewable energy and long-term savings. This shift in marketing could significantly boost India's EV adoption rate.

Here is the pie chart showing the conceptual breakdown of regional

disparities in ICT vehicle replacement rates in India:

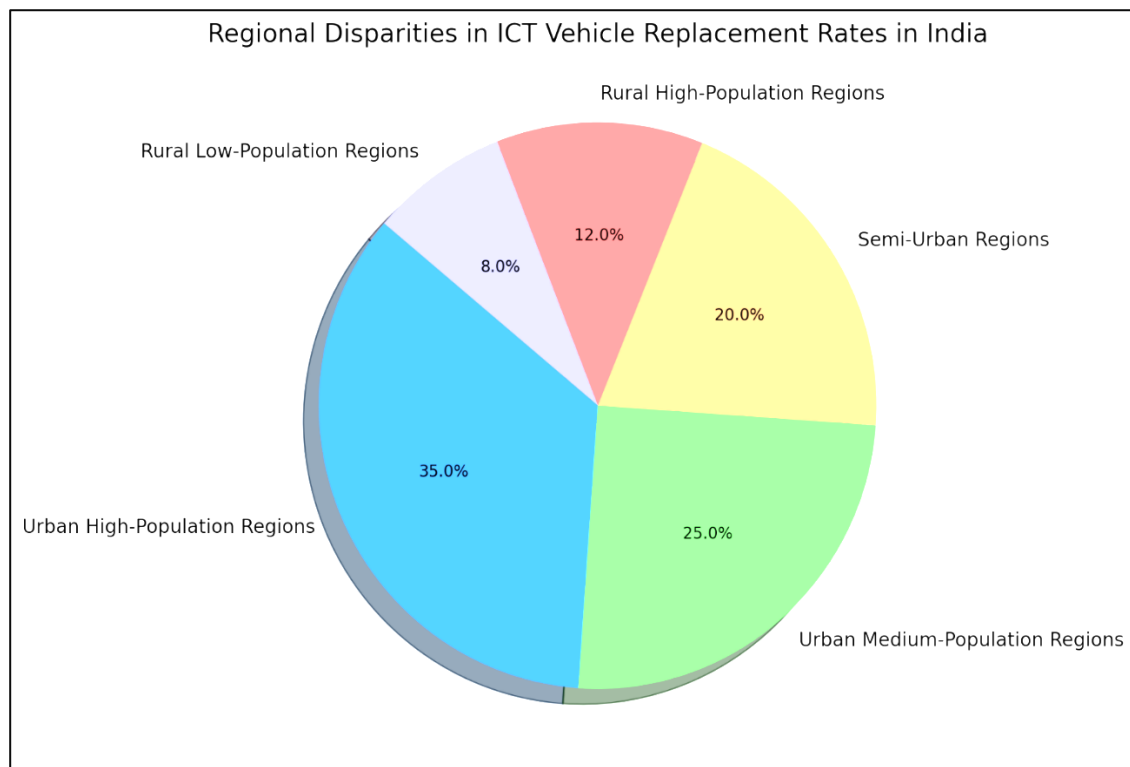
- Urban High-Population Regions (e.g., Tier 1 Cities): 35%
- Urban Medium-Population Regions (e.g., Tier 2 Cities): 25%
- Semi-Urban Regions: 20%
- Rural High-Population Regions: 12%
- Rural Low-Population Regions: 8%

Tier 1 Cities: The highest adoption and replacement rates due to better infrastructure, Customer awareness, and purchasing power.

Tier 2 Cities: Moderate replacement rates, reflecting growing urbanization but facing challenges in infrastructure and Customer awareness.

Tier 3 Cities: Low replacement rates, limited by poor infrastructure and limited awareness.

Tier 4 Cities and Rural Areas (optional): Minimal replacement due to lack of infrastructure and resources.



Analysis of Replacement Rate

- As of 2023, India had approximately 300 million registered vehicles, with 90% being ICT vehicles.
- This translates to around 270 million ICT vehicles, with a replacement rate of only 5%, equating to about 13.5 million vehicles replaced annually.
- Urban areas account for a significant portion of this replacement, while rural regions contribute minimally, highlighting the disparity.

Challenges and Opportunities

Barriers to Adoption

Key challenges include the high cost of EVs, insufficient charging infrastructure, limited financing options, and low Customer awareness. These barriers are particularly pronounced in rural areas, where infrastructure and awareness are minimal.

Opportunities for Growth

India's growing need for sustainable transportation and the rising cost of fossil fuels present significant opportunities for EV adoption. Government incentives for local manufacturing, coupled with

advancements in battery technology and recycling, can drive growth. Expanding the charging network and providing financial support can further encourage adoption.

Recommendations

Strengthening Policy Frameworks

The government should enhance existing policies by offering more substantial incentives, reducing GST on EVs, and providing tax benefits to both manufacturers and Customers. Stricter emission regulations for ICT vehicles could also push Customers toward EVs.

Expanding Charging Infrastructure

Developing a comprehensive charging infrastructure plan is crucial, especially in tier-2 and tier-3 cities. Public-private partnerships and integrating renewable energy sources into the charging network could accelerate progress.

Promoting Customer Awareness

Targeted awareness campaigns that address Customer concerns about range anxiety, battery safety, and long-term maintenance are essential. Offering low-interest loans and flexible financing options can also facilitate the transition.

Fostering Technological Investments

Investments in R&D for better battery technology, fast charging, and energy management systems are vital. Collaboration between industry

stakeholders and academic institutions can drive innovation and reduce costs.

Conclusion

India's transition from ICT vehicles to EVs remains slow, with a replacement rate of only 5%, a fraction of the global average. Key obstacles such as insufficient infrastructure, high costs, and customer skepticism are compounded by a lack of marketing focusing on the advantages of EV technology. By addressing these issues through public-private collaboration, India can significantly improve its EV adoption rates, contributing to a more sustainable and environmentally friendly transportation system.

References

- Alanazi, F. 2023. "Electric Vehicles: Benefits, Challenges, and Potential Solutions for Widespread Adaptation." *Applied Sciences* 13: 6016, Retrieved from: <https://doi.org/10.3390/app13106016>.
- Castro, T. S., T. M. de Souza, and J. L. Silveira. 2017. *Feasibility of Electric Vehicle: Electricity by Grid_ Photovoltaic Energy*. Amsterdam: Elsevier.
- International Energy Agency. 2023. *Global EV Outlook 2023: Scaling up the Transition to Electric Mobility*. IEA Publications.
- Ajanovic, A., and R. Haas. 2020. "On the Long-Term Prospects of Electric Vehicles." *Renewable and Sustainable*

Energy Reviews 119: 109541, Retrieved from:

<https://doi.org/10.1016/j.rser.2019.109541>

Das, H., M. M. Rahman, S. Li, and C. W. Tan. 2020. "Electric Vehicles Standards, Charging Infrastructure, and Impact on Grid Integration: A Technological Review." Renewable and Sustainable Energy Reviews 120: 109618, Retrieved from:

<https://doi.org/10.1016/j.rser.2019.109618>

Lutsey, N., and M. Nicholas. 2019. Update on Electric Vehicle Costs in the United States through 2030. The International Council on Clean Transportation, Retrieved from:

<https://theicct.org/publications/update-US-2030-electric-vehicle-cost>.

McKinsey & Company. 2022. The Future of Mobility in India: The Transition to Electric Vehicles, Retrieved from: <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-mobility-in-india>.

Raj, A., and C. Muralidharan. 2021. "A Review of the Indian Electric Vehicle Industry: The Role of Technological Advancements and Policy Support." Journal of Cleaner Production 291: 125878, Retrieved from: <https://doi.org/10.1016/j.jclepro.2021.125878>.

Sahoo, P. 2021. "Electric Vehicles in India: Challenges and Opportunities." Economic & Political Weekly 56(5): 34-40, Retrieved from:

<https://www.epw.in/journal/2021/5/special-articles/electric-vehicles-india.html>.

NITI Aayog and Rocky Mountain Institute. 2019. India's Electric Mobility Transformation: Progress to Date and Future Opportunities. NITI Aayog.

McKinsey & Company. 2022. Electric Vehicle Adoption in Emerging Markets: Barriers and Opportunities. McKinsey & Company.

Ministry of Heavy Industries, Government of India. 2022. FAME India Scheme Phase II Progress Report. Government of India Publications.

World Economic Forum. 2023. The Future of Mobility: Electric Vehicles and Sustainable Transportation. World Economic Forum.

Raj, P., A. Kumar, and R. Singh. 2023. "Barriers to Electric Vehicle Adoption in India: A Comprehensive Review." Journal of Cleaner Production 392: 136567.

The Economic Times. 2023. "Electric Vehicle Market Analysis in India: Trends, Barriers, and Opportunities." The Economic Times.