



Customer Adaptation towards Electric Vehicle in Gujarat

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ABSTRACT

Transitioning to electric vehicles (EVs) is vital for achieving sustainable mobility goals, driven by a focus on the environment, governmental policies, and increased technological capabilities. This study explores consumer perceptions and adoption factors that affect EV adoption in the Indian state of Gujarat. A mixed-methods approach was used relying on primary data collected through a structured questionnaire, including statistical analyses utilizing Chi-square, T-test, and ANOVA in SPSS. The study finds that awareness is an important influence on consumer intentions, with little evidence of gender being a factor in consumers' intentions to purchase an EV.

The present situation sees a mix of information sources, trust in battery technology, purchase price, the cost associated with the purchase, charging infrastructure, and financial incentives play a part in whether consumers will adopt an EV. While the state of Gujarat has adopted progressive EV policies, challenges remain regarding adoption for challenges such as high initial costs, inadequate charging infrastructure, and consumer skepticism. It is recommended that states target awareness through campaigns and a significant improvement of EV charging infrastructure, coupled with financial incentives for adoption, and support for mainstream collaboration between the government and the private sector in make policies in the EV sector, rather should also work towards co-designing policy in the EV sector and mapping out need for charging infrastructure provision. Future research would allow for the exploration of other demographic and behavioral factors and efficacy outcomes across differing policy, as be undertaken consumer behavior in respect to EV adoption. Providing an understanding of operating under these constraints will support the state of Gujarat to position itself in India's transition to electric mobility. Collectively, EV position an opportunity for a more sustainable future.

1.Introduction

Background

The automotive industry is undergoing a major transition toward sustainability through the introduction of electric vehicles (EVs). There are overwhelming concerns regarding climate change and recurrent air pollution; therefore, almost all countries' governments are encouraging the use of the cleaner alternative of EVs over traditional vehicles. In India, Gujarat is leading the way for transitioning towards electric mobility with pro-EV policies, financial incentives for EV procurement, and the development of charging infrastructure. However, the adoption or penetration of the market for EVs heavily relies on perceptions or attitudes held by consumers. In Gujarat, environmental concerns and sustainable processing; pricing; trust/reliability of the developing technologies; and accessibility i.e. charging stations all influence consumer perceptions and attitudes toward EVs.

Knowing how people in this context perceive and adopt EVs is relevant information for manufacturers, policy makers, and marketers looking to facilitate EV transitions. This research is aimed at examining and exploring factors that are leading consumers to adapt towards EVs in Gujarat, with a focus on drivers and barriers impacting consumer decisions. The study aims to investigate these perceived consumer perceptions and provide relevant information to promote and expand the uptake of EVs in the region and potentially support India's broader efforts to reduce carbon emissions and encourage sustainable transportation.

Problem Statement

While the automotive industry works towards sustainability, the transition to more electric vehicles (EVs) is essential to combat environmental challenges and the reduction of sustained greenhouse gases. Even with certain environmental and economic benefits, the rate of EV adoption has still stalled while the automotive industry expected to see an increase in EVs throughout the world, including Gujarat. Aspects like Customer perceptions, trust in technologies, economic environments/effects, and infrastructure are primary components in affecting perceptions of adoption/cost of ownership.

This research will address the major drivers and barriers that influence consumer perceptions and adoption of EVs in the Gujarat market. The objective is to understand the factors leading to change in preference to an electric vehicle, determine what aspects relate to purchase behavior, as well as, the influence of government policy and incentives on purchase choice. Understanding significant drivers and barriers can help all manufacturers, policy makers, stakeholders in Gujarat, better support EV adoption, and contribute to sustainable transportation in the state.

Objectives

- To identify the factors that promote customer adoption of electric vehicles.
- To study the impact of demographic variables, particularly age, on the adoption of electric vehicles.

Hypothesis

(Objective-1)

To identify the factors that promote customer adoption of electric vehicles.

- **H₀** : There is no significant association between awareness of electric vehicles and the intention to buy an electric vehicle.
- **H_a** : There is a significant association between awareness of electric vehicles and the intention to buy an electric vehicle.

(Objective-2)

To study the impact of demographic variables, particularly age, on the adoption of electric vehicles.

- **H₀** : There is no significant impact on the adoption of electric vehicle with respect to gender.
- **H_b** : There is significant impact on the adoption of electric vehicle with respect to gender.

2. Literature Review:

Researchers Pretty Bhalla, Inass Salamah, and Afroze Nazneen (2018) highlighted how environmental concerns, cost, trust in technology, and infrastructure impact electric vehicle (EV) acceptance. They noted the lack of understanding of Indian consumers' perceptions, suggesting that more localized focus on EV acceptance is warranted.

Vigna K Ramachandaramurthy, Muhammad Ajmal, Padmanathan Kasinath (2023) highlighted the significant influence of social impact, battery technology, and charging infrastructure on the use of EVs. They also noted the role that government incentives and aesthetics play in acceptance or user satisfaction.

Zulfiqar Ali Lashari, Joonho Ko, and Junseok Jang (2021) found that perceived usefulness, environmental concern, and economic advantage positively influenced consumer attitude toward purchasing EVs. They also emphasized that attitudes, knowledge, and government incentives facilitated acceptance of EVs, while technological concern impeded acceptance.

Dhanjay Yadav, Arvind Jayant Tandon, Preeti Kaushik, and Indira Gandhi (2024) reported that environmental concern and moral norm positively influenced EV adoption intentions within India, whereas perceived usefulness and compatibility did come out to be significant.

Aditya Kumar (2023) reported that consumers acknowledged the issue of climate and expressed a willingness to attempt to utilize eco-friendly vehicles, but the cost of eco-friendly vehicles was available. Battery technology and charging infrastructure, will be a large part of the consideration for long-term acceptance or adoption of eco-friendly vehicles.

Sharmila Devi, Ramachandaran, Henry Ng, Rajermani, and Arasu Raman (2023) mentioned that environmental awareness, vehicle price, and availability of charging stations tremendously affect consumers' adoption of EVs (electric vehicles) in Malaysia. Upgraded charging infrastructure is indispensable for increasing consumer uptake.

Sumas, Wongsunopparat, and Peter Cherian (2023) emphasized the importance of environmental concerns, government policies, cost saving, and technological changes in informing consumer decisions. They highlighted that battery condition, competitive pricing, and government policies are key factors for improving environmental awareness and behavioural intention for adoption

Fanchao Liao, Eric Molin, and Bert Van Wee (2021) also discussed financial, technical, and infrastructural considerations affecting preferences for EVs using advanced modelling, to engage policymakers, while stressing research gaps in the EV literature.

Priyanka Kushwah and Neha Tomer (2021) showed that financial incentives, an adequate supply of charging stations, environmental awareness, and cost disparities are significant factors impacting adoption in India. They noted that social norms are important for shaping behavioural intentions, drawing on the theories of behavioural change and diffusion.

According to P. Neupane and B. K. Sharma (2023), government support, industrial advancements, and consumer demand are the main facilitators for the adoption of electric vehicles (EVs). They concluded that incentives for financial support and upgrades in battery technology influence consumer demand for EVs and incentivized tax laws stimulate the sale of EVs.

Kotigari Reddi Swaroop, K. V. V. Murali Someswararao, N. Gurunatha Naidu, and K. V. Nagaraj (2022) suggested that the most important factors involved in consumer behavior and the adoption of EVs in South India were utility, constraints, beliefs, charging infrastructure, cost of purchase, government generates incentives, environmental awareness, and social influence.

Joy Karmarkar and Aparajita Mukherjee (2021) explains that government initiatives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), are important for reducing reliance on internal combustion engine (ICE) vehicles and promoting the adoption of EVs. The challenges in implementing policies related to infrastructure and various state policies were also discussed in the context of EV adoption.

3. Research Methodology

Study design

The study involves mixed method approach, as study uses survey for collecting quantitative data and research aims to describe the factors influencing customer perceptions and adoption as descriptive nature.

Data collection

Primary data : Collected through structured questionnaire

Secondary data : Secondary data have been collected through literature review

Sampling technique

Population : People of Gujarat

Sample size : 190 respondents

Sampling technique : Non probability convenience sampling

Data analysis

SPSS software is used for statistical analysis using CHI-SQUARE and T-Test, ANNOVA test to examine the factors and their influence on adoption.

4. Result and discussion

Hypothesis 1:(Chi-square)

		Would you consider buying an electric vehicle in the next 2 to 5 years?					
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total
Are you aware of electric vehicle?	Yes	17	99	54	39	4	162
	No	7	5	5	3	6	26
Total		24	14	59	42	49	188

Test	Value	df	Asymptotic Significance (2sided)
Pearson Chi-Square	13.462	4	0.009

Since all of the significance values are **below 0.05**, you can **reject the null hypothesis (H_0)**. This means that there is a **significant relationship** between **awareness of electric vehicles** and **the intention to buy an electric vehicle** in the next 2 to 5 years.

Hypothesis 2:(T-Test and ANOVA)

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Would you consider buying an electric vehicle in the next 2 to 5 years?	Male	135	3.437	1.4015	.1206
	Female	54	3.333	1.0094	.1374

Independent Samples Test									
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Would you consider buying an assumed electric vehicle in the next 2 to 5 years? not assumed	13.549	.000	.495	187	.622	.1037	.2097 .1828	-.3100	.5174 .4652

ANOVA

Would you consider buying an electric vehicle in the next 2 to 5 years?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.415	1	.415	.245	.622
Within Groups	317.215	187	1.696		
Total	317.630	188			

While ANOVA is typically used for comparing three or more groups, it can technically be used for two independent samples as well. However a two sample t-test is usually preferred in such cases because ANOVA and the t test produce the same result when comparing just two groups.

Since $p > 0.05$, we fail to reject H_0 (null hypothesis). This means gender does not have a significant impact on the willingness to buy an electric vehicle in the next 2-5 years.

5. Findings

Awareness and Induction of EVs: The research found a significant relationship between awareness of EVs and the intention to buy. The Chi-square test allowed us to measure statistical significance ($p = 0.009$) confirmed that there is a higher likelihood of someone purchasing an EV the more aware they are of EVs. This suggests that the promotion of EVs and consumer education on the EV is needed to promote adoption in the area of Gujarat.

The T-test and ANOVA results indicate **no significant impact of gender on EV adoption intention**. The **p-value (0.622 for T-test, 0.622 for ANOVA)** is greater than 0.05, meaning the difference between males (**Mean = 3.437**) and females (**Mean = 3.333**) is **not statistically significant**. Hence, gender does not influence EV purchase decisions.

Important Factors to Adoption of EVs: The research reiterated cost, trust in battery technology, charging infrastructure, and financial incentives are the consumer's primary concerns in regard to EVs or thinking about an EV. Environmentally friendly appeared in our notes, however the economic factor and practicality weighed heavy on the purchase decision.

Infrastructure and Policy: Our research confirms governmental policies, charging infrastructure, and financial incentives are important for inducing EV adoption. Even though Gujarat has progressive EV policies in the region, it is evident more targeted efforts are needed.

6. Suggestions

Raising Awareness with Campaigns : Since awareness is a big factor in the adoption of EVs, the government, auto-makers, and policymakers in general, should invest in educational programs, campaigns, and workshops that educate consumers about the benefits, savings, and incentives available to them with EVs.

Expanding the Charging Infrastructure: Establishment of an electric vehicle (EV) charging station network is necessary to help alleviate range anxiety that consumers may experience. Rather than develop strategies for establishing charging station networks for public EV charging, the government should contemplate developing public charging stations, incentives for installing home EV charging stations, and possible partnerships with private organizations to develop a thriving EV ecosystem. **Financial Incentives and Cost Savings ,** People may be hesitant to purchase an EV because of high initial purchase prices and battery replacement costs. There are many viable strategies that can be considered such as subsidies, tax credits, low- and no-interest financing to help create a financially attractive EV to consumers.

Targeting Consumer Trust and Perception: Concerns regarding battery life, durability, and performance remain for a consumer. Any company involved with EVs should strive to convey a transparent message about the warranty, maintenance costs, and advancements in battery technologies.

Government and Industry Coordination/Collaboration : Increased coordination between policymakers and EV manufacturers can help streamline policies, minimize costs of production, and overall EV adoption rate. Public-private partnerships can be utilized to assist with speedily deploying EV infrastructure, as well as stimulate mobility that is sustainable.

7. Future scope

Future Directions Investigating Further Demographic and Behavioural Factors: For future research, variables like individual income level, sensitivity to fuel price, environmental consideration, or lifestyle preference, could be used to explore how they might also impact customer adoption of electric vehicles (EVs). A combination of variables could lead to improved understandings of consumer behavior.

Longitudinal Study About Electric Vehicle Adoption Trends: It may be beneficial to have a long-term study to evaluate customers' perspectives, public policy on EV adoption, and technology change (e.g., battery capacity, range of travel, charging efficiency and costs, etc.) over the next 5-10 years, which offers many insights and perspectives on the evolution of attitudes towards EVs.]

Comparative Study Between States in India: As Gujarat is a state with progressive EV policy, a comparative study among Indian states would be beneficial to learn how policy, incentives, or market based implications drive customer EV adoption readiness and willingness.

Examine Impact of Advancements in Battery Technology: As battery technology improve, research should begin to focus on how falling costs, improved battery usage, and faster charging capacity might sway purchase decisions on EV adverse to future purchasing behaviors. **The Role of Electric Vehicle in Moving Towards Renewable Energy Sources:** Exploring how solar powered charging stations, smart grid resources, and efficiency measures influences EV adoption willingness could advance deeper communications surrounding a more sustainable mobility network.

8. Conclusion

Effective awareness and education campaigns can help resolve the knowledge gap and facilitate purchases of EVs. However, it should be noted that age has no statistically significant impact on purchasing an EV, which indicates other variables like affordability, charging infrastructure and trust in the technology of batteries have more of an impact on consumers' preferences.

While Gujarat is providing leadership on the transition to electric mobility with incentives and developing infrastructure, there are still barriers to the universal uptake of EVs. Barriers which include high cost of purchase, charging infrastructure, and battery life and maintenance of technology need to be addressed if more are to adapt electric mobility.

The research indicates that solutions such as providing a high public charging network, providing tax incentives, and showing transparency in the technology of EVs will greatly improve confidence. The research argues that collaboration between government and industry is key to hasten the transition through trust, incentives, and simply because the speed in which the people address this technology can consume Gov't and industries efforts.

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