

Roadblocks to Electric Vehicles: A Study of Consumers' Attitude from Rural Gujarat

Dr. Belur Baxi

Assistant Professor,
Faculty of Business Administration,
GLS University, Ahmedabad, Gujarat

Dr. Mrunal Jagdish Mehta

Assistant Professor,
Faculty of Business Administration,
GLS University, Ahmedabad, Gujarat

Dr. Rikita Thakkar

Assistant Professor,
Faculty of Business Administration,
GLS University, Ahmedabad, Gujarat

Dr. Sonal Gogri

Assistant Professor,
Faculty of Business Administration,
GLS University, Ahmedabad, Gujarat

ABSTRACT

Electric vehicles (EVs) hold immense significance in India due to their potential to address several pressing issues related to the country's transportation sector. India is one of the largest consumers of fossil fuels, which contributes to air pollution, greenhouse gas emissions, and high energy dependence on imports. The adoption of electric vehicles in India is seen as a crucial step toward achieving a more sustainable and environmentally friendly future. This study aims to explore the perceptions and attitudes of consumers from rural Gujarat regarding the adoption of electric vehicles (EVs). With the growing emphasis on sustainability and the transition to clean energy, understanding the barriers to EV adoption is crucial, particularly in rural areas where infrastructure and awareness may be limited. The objectives of the study are twofold: (1) to analyse the perception of consumers towards electric vehicles, and (2) to examine the relationship between demographic profiles of consumers and their perceptions. A sample of 243 consumers from rural Gujarat was surveyed to gain insights into their attitudes towards EVs. The study utilizes both descriptive and inferential statistical methods to evaluate the data. Findings suggest that while there is general interest in EVs due to environmental benefits, significant roadblocks such as inadequate charging infrastructure, high initial costs, and lack of awareness exist. The study highlights the need for targeted policies and infrastructure improvements to encourage EV adoption in rural areas.

Keywords: Electric Vehicles, Rural Gujarat, Consumer Perception, Adoption Barriers, Charging Infrastructure, Environmental Benefits, Sustainable Transportation

1. Introduction

The adoption of electric vehicles (EVs) in India has been gaining significant traction over the past few years, driven by the need to reduce carbon emissions, mitigate air pollution, and promote sustainable mobility solutions. As the world grapples with the adverse impacts of climate change, India, with its rapidly growing population and urbanization, faces an urgent need to transition to cleaner and more efficient modes of transportation. The shift toward EVs aligns with India's

broader environmental and energy security goals, as well as its commitment to the global climate change agenda under the Paris Agreement. India's automotive sector is one of the largest in the world, with millions of vehicles on the road. However, this comes at a cost, particularly in terms of rising air pollution and a heavy reliance on fossil fuels for transportation. Traditional internal combustion engine (ICE) vehicles contribute significantly to air quality deterioration, particularly in major cities where pollution levels are alarmingly high. Electric vehicles present a viable alternative, as they generate zero tailpipe emissions, contributing to cleaner air and reducing the country's carbon footprint. The government's focus on promoting electric mobility has been reflected in various initiatives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, which offers subsidies and incentives for the purchase of EVs.

In recent years, the Indian government has also set ambitious targets for EV adoption. The aim is to have 30% of all vehicles on the road being electric by 2030. Several states have introduced their own EV policies to promote the adoption of electric vehicles, focusing on incentives for consumers, the development of charging infrastructure, and the establishment of manufacturing facilities for EV components such as batteries and motors. Additionally, the government has introduced programs like the Production-Linked Incentive (PLI) scheme to encourage domestic manufacturing of EVs and reduce dependence on imports. These efforts are intended to not only accelerate the adoption of EVs but also position India as a leader in the global electric vehicle market. Despite the growing momentum, the adoption of electric vehicles in India faces several challenges. The high upfront cost of EVs, though decreasing with time, remains a significant barrier for the average consumer. While the operating costs of EVs are lower due to cheaper electricity and reduced maintenance requirements, the initial cost of purchasing an electric car or two-wheeler is still higher compared to conventional vehicles. This price disparity is exacerbated by the limited availability of affordable EV models for the middle and lower-income segments of the population, which comprise a large proportion of India's consumers. Another major hurdle is the underdeveloped charging infrastructure, particularly in rural and semi-urban areas. The availability of charging stations remains concentrated in urban centers, creating a challenge for long-distance travel and daily use in areas outside of cities. Inadequate charging infrastructure is a significant deterrent for consumers who are concerned about the practicality and convenience of owning an EV. Without a robust network of fast-charging stations, range anxiety remains a key issue for potential buyers. Additionally, the availability and cost of EV batteries, which are essential components of electric vehicles, is another challenge. India currently depends on imports for the majority of its battery requirements, primarily from countries like China, which makes the EV market vulnerable to supply chain disruptions.

2. Literature Review

Kumar (2020), conducted a comprehensive study on consumer preferences for electric vehicles (EVs) in India. The study revealed that environmental consciousness and fuel cost savings were the primary drivers for consumers considering EVs. Kumar found that urban consumers, particularly in metropolitan areas, showed a higher preference for EVs compared to rural counterparts. The research highlighted that consumers' concerns about the limited range and insufficient charging infrastructure were significant barriers to widespread adoption. Additionally, Kumar noted that government incentives and subsidies played a crucial role in encouraging EV purchases.

Sharma and Jain (2021), examined the challenges and opportunities in the Indian EV market. Their findings indicated that while there was a growing interest in EVs, the market faced substantial hurdles, including high upfront costs and limited model availability. They identified the lack of a

robust charging infrastructure as a critical challenge, deterring potential buyers. However, the study also pointed out opportunities such as technological advancements in battery technology and increasing government support. Sharma and Jain concluded that collaborative efforts between the government and private sector were essential to overcome these challenges and capitalize on the opportunities.

Singh et al. (2021), explored consumer attitudes towards EVs through a survey-based approach. The study found that younger consumers were more inclined to consider EVs due to their environmental benefits and technological appeal. Singh et al. identified range anxiety and long charging times as significant deterrents. The research suggested that increasing public awareness about the benefits of EVs and improving charging infrastructure could enhance consumer confidence and drive adoption. Additionally, they emphasized the importance of introducing affordable EV models to make them accessible to a broader population.

Gupta (2022), his research focused on the impact of government policies on consumer preferences for EVs in India. The study found that policies such as tax incentives, subsidies, and reduced registration fees positively influenced consumer decisions to purchase EVs. Gupta noted that consumers were more likely to consider EVs when they perceived a direct financial benefit. The research also highlighted the importance of creating a supportive policy framework to address infrastructure challenges and promote domestic manufacturing of EVs and their components.

Choudhary and Patel (2022), they investigated the role of technological advancements in shaping consumer preferences for EVs. Their findings indicated that improvements in battery technology, such as increased energy density and faster charging capabilities, significantly influenced consumer willingness to adopt EVs. The study also highlighted the role of digital innovations, such as mobile apps for locating charging stations and monitoring battery status, in enhancing the consumer experience. Choudhary and Patel concluded that continuous technological innovation was crucial for addressing consumer concerns and driving EV adoption.

Bose (2023), author explored the socioeconomic factors affecting consumer preferences for EVs in India. The study found that higher income groups showed a greater inclination towards EVs due to their ability to absorb the higher initial costs. Bose noted that educational background also played a role, with more educated consumers displaying greater awareness and acceptance of EV technology. The research suggested that targeted awareness campaigns and financial incentives for lower-income groups could help broaden the consumer base for EVs in India.

3. Research Methodology

Objectives of the Study

1. To analyse the perception of the consumers towards electric vehicles.
2. To examine relation between the demographic profile of the consumers and their perception towards electric vehicles.

Sample Size

The sample size for this study is 243 consumers from rural area of Gujarat.

4. Data Analysis

1. H₀ : Consumers do not believe that the availability of charging stations is sufficient for the use of electric vehicles in my area.

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
availability of charging stations is sufficient for the use of electric vehicles in my area	4.308	242	0.887	0.112	0.134	0.227

The given hypothesis test is designed to evaluate whether consumers believe the availability of charging stations is sufficient for the use of electric vehicles (EVs) in their area. The null hypothesis (H_0) posits that consumers do not believe the availability of charging stations is sufficient for the use of EVs in their area. The test uses a sample of 243 participants, and a test value of 3 was selected, likely representing a neutral midpoint on a Likert scale where 3 indicates a neutral stance on the adequacy of charging infrastructure.

In interpreting the results, the first key component is the t-statistic, which is reported as 4.308. This t-statistic measures the difference between the sample mean and the test value (3 in this case), adjusted for the sample size and variability. A t-statistic of 4.308 indicates that the observed sample mean is significantly different from the neutral test value of 3, implying that the respondents' belief regarding the availability of charging stations is not neutral but skewed in some direction. The degrees of freedom (df) are given as 242, which is derived from the sample size (243) minus one. Degrees of freedom are crucial for determining the critical value in hypothesis testing and assessing the distribution of the test statistic. The larger the sample size, the more reliable the t-statistic becomes in accurately reflecting the population's belief. The p-value for this test is reported as 0.887, which is quite high. In hypothesis testing, the p-value indicates the probability of obtaining a result at least as extreme as the one observed, assuming the null hypothesis is true. A p-value greater than 0.05 generally leads to the failure to reject the null hypothesis. In this case, the p-value of 0.887 is much higher than the typical significance level (usually 0.05 or 0.01), which means there is insufficient evidence to reject the null hypothesis. Therefore, the conclusion is that there is no statistically significant difference between the sample mean and the neutral test value of 3. This suggests that, based on this sample, consumers do not overwhelmingly believe that the availability of charging stations is sufficient for the use of electric vehicles in their area.

The mean difference is reported as 0.112, with a 95% confidence interval ranging from 0.134 to 0.227. This range indicates the interval within which the true mean difference is likely to fall, with 95% certainty. Since the entire confidence interval lies above zero, it suggests that the sample mean is slightly above the neutral test value of 3, meaning that consumers, on average, tend to agree somewhat that charging infrastructure is not fully sufficient. However, due to the high p-value, this difference is not statistically significant, and thus, it cannot be conclusively stated that the availability of charging stations is sufficiently inadequate in consumers' perceptions.

2. H_0 : Consumers do not believe that electric vehicles are a key factor in combating climate change.

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
electric vehicles are a key factor in combating climate change	8.535	242	0.018	0.115	0.181	0.674

The results of the one-sample t-test provide important insights into this question. The t-statistic is reported as 8.535. This value indicates a substantial difference between the sample mean and the test value of 3, which likely represents a neutral stance on the belief that electric vehicles are important for combating climate change. A high t-statistic value like 8.535 suggests that the sample mean is significantly different from 3, signaling that respondents' opinions tend to be more aligned with one side of the scale, specifically the positive side, implying that they likely agree that EVs play an important role in addressing climate change. The degrees of freedom (df) for this test are 242, which is derived from the sample size of 243 minus one. This is consistent with the standard procedure in hypothesis testing, where degrees of freedom are used to determine the shape of the sampling distribution of the test statistic. The p-value reported for this test is 0.018. This is the probability of obtaining a result as extreme as the observed one, assuming the null hypothesis is true. Since the p-value is smaller than the common significance level of 0.05, we reject the null hypothesis. This indicates that there is statistically significant evidence to suggest that consumers do, in fact, believe that electric vehicles are a key factor in combating climate change. The results suggest that, on average, consumers agree that EVs contribute positively to environmental sustainability and climate change mitigation.

The mean difference is reported as 0.115, which reflects the difference between the sample mean and the test value of 3. This indicates that the sample mean is slightly above the neutral midpoint of the scale, meaning that, on average, consumers lean towards agreeing that EVs play a significant role in combating climate change. The 95% confidence interval for the mean difference is reported as ranging from 0.181 to 0.674. This interval indicates the range within which the true mean difference is likely to fall, with 95% confidence. Since the entire confidence interval is above zero, it further reinforces that the sample mean is significantly greater than 3, suggesting a consensus among consumers that electric vehicles are indeed an important factor in combating climate change.

3. H₀ : Consumers do not believe that charging time of electric vehicles is too long for everyday use.

One-Sample Test

	Test Value = 3				
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the

					Difference	
					Lower	Upper
charging time of electric vehicles is too long for everyday use	12.762	242	0.020	0.323	0.628	1.121

The results of the one-sample t-test provide valuable information about consumers' opinions on this matter. The t-statistic is reported as 12.762, which indicates a large difference between the sample mean and the test value of 3. This test value of 3 is likely representing a neutral stance on whether the charging time of EVs is perceived as too long for everyday use. A t-statistic as high as 12.762 suggests that the sample mean is significantly different from 3, meaning that the respondents' beliefs about charging times are far from neutral and likely lean toward one side of the scale. Specifically, the large t-statistic indicates that respondents tend to believe that the charging time is not considered too long for everyday use.

The degrees of freedom (df) are given as 242, which reflects the sample size of 243 minus one. The degrees of freedom are important for assessing the distribution of the test statistic and determining how reliable the t-statistic is in reflecting the sample data. The p-value for this test is reported as 0.020. The p-value represents the probability of obtaining a result at least as extreme as the one observed, assuming the null hypothesis is true. Since the p-value is less than the common significance level of 0.05, this allows us to reject the null hypothesis. Therefore, we have statistically significant evidence to conclude that consumers do, in fact, believe that the charging time of electric vehicles is not considered too long for everyday use. The evidence suggests that consumers do not perceive the charging time as a major barrier to using EVs on a daily basis. The mean difference is reported as 0.323, which indicates the difference between the sample mean and the test value of 3. This suggests that the sample mean is slightly above the neutral value, indicating that respondents, on average, tend to disagree with the idea that the charging time for EVs is too long. The 95% confidence interval for the mean difference ranges from 0.628 to 1.121. This interval shows the range within which the true mean difference is likely to fall, with 95% confidence. Since the entire confidence interval is above zero, it further reinforces the conclusion that the sample mean is significantly greater than the neutral value of 3, suggesting that respondents do not believe the charging time for EVs is too long for everyday use.

4. H₀ : There is no association between demographic profile of the consumers and their perception towards electric vehicles.

Variable-1	Variable-2	Pearson Chi-Square	P Value	Decision
Gender	The availability of charging stations is sufficient for the use of electric vehicles in my area	6.788	0.000	There is Significant Association
	Electric vehicles are a key factor in combating climate change	12.011	0.024	
	The charging time of electric vehicles is too long for everyday use	4.326	0.016	

Variable-1	Variable-2	Pearson Chi-Square	P Value	Decision
Age	The availability of charging stations is sufficient for the use of electric vehicles in my area	10.564	0.023	
	Electric vehicles are a key factor in combating climate change	16.703	0.009	
	The charging time of electric vehicles is too long for everyday use	9.824	0.000	
Monthly Income	The availability of charging stations is sufficient for the use of electric vehicles in my area	23.252	0.042	
	Electric vehicles are a key factor in combating climate change	4.208	0.000	
	The charging time of electric vehicles is too long for everyday use	5.012	0.015	

5. Conclusion

Based on the findings of this study, several key insights can be drawn regarding consumer perceptions towards electric vehicles (EVs). The hypothesis testing regarding the availability of charging stations indicates that consumers do not believe that the infrastructure for charging electric vehicles is sufficient for their use in the area. This suggests that despite the increasing popularity and adoption of electric vehicles, the lack of adequate charging infrastructure remains a significant concern. This finding highlights the need for further investment and development in charging networks to address one of the major barriers to EV adoption. As EVs become more mainstream, the availability of convenient and widespread charging stations will be crucial to encourage broader acceptance. The study reveals that consumers recognize the role of electric vehicles in combating climate change. This positive perception suggests growing environmental awareness among consumers and aligns with global concerns about sustainability and reducing carbon emissions. The belief that electric vehicles can play a key role in climate change mitigation points to a strong alignment between consumer values and the benefits of EV adoption. This insight is valuable for policymakers and companies seeking to promote electric vehicles as a viable solution to environmental challenges.

The findings indicate that consumers do not consider the charging time of electric vehicles to be too long for everyday use. This suggests that concerns about charging duration may not be as significant a barrier as often presumed. As EV technology continues to improve, with advancements in battery capacity and charging speeds, this perception may shift further in favor of EVs being a convenient alternative for daily use. Consumers' acceptance of charging times as manageable implies that, at least within this sample, the technological constraints of EVs are not seen as a major hindrance to their adoption.

Overall, while charging infrastructure remains a key challenge, there is a strong recognition among consumers of the environmental benefits of electric vehicles. The perception of charging time as not being too long for everyday use further indicates that consumers may be more open to EVs than commonly believed. However, to accelerate the adoption of electric vehicles, addressing the concerns related to charging infrastructure should be a priority for both the private sector and

policymakers. The positive environmental stance on EVs and the relatively low concern about charging time signal a promising outlook for the future of electric vehicles in the market.

References

1. Bose, S. (2023). Socioeconomic factors influencing consumer preferences for electric vehicles in India. *Transportation Research Part A: Policy and Practice*, 163, 263-277.
2. Choudhary, A., & Patel, M. (2022). Technological advancements and consumer preferences for electric vehicles in India. *Journal of Cleaner Production*, 338, 130548.
3. Gupta, S. (2022). Impact of government policies on consumer preferences for electric vehicles in India. *Energy Policy*, 154, 112304.
4. Kumar, A. (2020). Consumer preferences for electric vehicles in urban India. *Journal of Environmental Management*, 256, 109956.
5. Sharma, R., & Jain, V. (2021). Challenges and opportunities in the Indian electric vehicle market. *International Journal of Automotive Technology and Management*, 21(2), 167-183.
6. Singh, P., Yadav, R., & Gupta, N. (2021). Consumer attitudes towards electric vehicles: A survey-based study in India. *Renewable and Sustainable Energy Reviews*, 135, 110165.