Electrifying the Road: A Comprehensive Analysis of Factors Influencing Consumer Adoption of Electric Vehicles

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ABSTRACT

This study examines the factors influencing electric vehicle (EV) consumer acceptance, focusing on the gap between technology advances and consumer uptake. It examines how consumer perceptions, knowledge, and demographics affect EV adoption decisions. The mixed-methods study collects data from a varied sample using surveys and interviews. Empirical evaluation captures customer opinions regarding EVs across environmental, social, economic, price, performance, and awareness issues. The study also explores how age, money, and social standing affect customer views and adoption. The data shows a large gap between EV technical maturity and consumer adoption rates, driven by a lack of EV buyer knowledge and understanding. EVs provide environmental and economic benefits, but demographics and knowledge gaps cause hesitation. Younger and higher-income groups are more likely to embrace EVs, providing targeted possibilities. The findings suggest focused educational initiatives and legislative measures to close the knowledge gap and boost consumer trust in EV technology. EV adoption can be improved by stakeholders customizing tactics to demographic groups' wants and concerns. The report recommends a comprehensive approach to promote electric mobility, emphasizing informed customer choice in transportation's future. This study adds to the literature by studying key aspects of electric vehicle (EV) adoption that previous studies missed. The information illuminates the complex factors that influence client decisions, filling gaps in technical progress and commercial acceptance knowledge. This study complements scholarly discourse by concentrating on ignored places and providing essential data for sustainable transportation promotion.

Keywords: Electric Vehicle, Sustainability, Consumer Perception, Consumer Adoption
JEL Classifications: O, L

1. INTRODUCTION

Transitioning to sustainable transport is a crucial element in the worldwide initiative to address climate change and lower greenhouse gas emissions (Figueroa et al., 2013; Acharya, 2019; Sunio and Mateo-Babiano, 2022). Electric cars (EVs) are leading the way in this shift, providing a viable substitute for conventional fossil fuel-driven cars (Turrentine and Kurani, 2007). This research, titled "Future of Transport: A Comprehensive Analysis of Factors Influencing Consumer Adoption of Electric Vehicles," seeks to explore the many factors that affect consumer perceptions of

EVs. Comprehending these elements is crucial because customer acceptance is essential for the extensive implementation of electric cars, which, in turn, supports environmental sustainability and energy independence.

Moreover, the annual maintenance expenses for an electric car are significantly lower than those of an internal combustion vehicle (Propfe et al., 2012; Ravindra Jape and Thosar, 2017). Other advantages include various financial incentives and tax benefits provided by governments, the convenience of charging at home, and the quiet operation that helps reduce noise pollution (Clinton

and Steinberg, 2019; Arend and Franke, 2017; Deng et al., 2021; Rojas-Rueda et al., 2019).

Government financial incentives are crucial in promoting the use of electric vehicles. The incentives include of direct discounts, interest rate reductions on electric car financing, waived road tax upon purchase, exemptions on 1-time registration costs, and other tax and scrapping benefits (Jain et al., 2022; Kim et al., 2018; Razmjoo et al., 2022). National incentives differ depending on the vehicle type and battery capacity, providing incentives of up to Rs 15,000 per kWh for two-wheelers, Rs 10,000 per kWh for three-wheelers and four-wheelers, and Rs 20,000 per kWh for E-Buses and E-Trucks, covering a maximum of 40% of the vehicle's cost[1].

The government of Kerala supports the EV ecosystem by providing capital subsidies for charging infrastructure. They offer a 25% capital subsidy for the first 100 stations with DC chargers (≥100V), the first 300 stations with DC chargers (<100V), and the first 50 BS stations. The subsidy amounts to up to INR 10 lakhs for each DC charger station and INR 30,000 for each BS station[2]. The incentives and subsidies play a crucial role in reducing the obstacles to electric vehicle adoption, thereby making it a more feasible and appealing choice for customers (Lu et al., 2020; 2022).

The problem statement of this study addresses the gap between the advanced state of EV technology and the slower-than-expected consumer adoption rates. Potential buyers' reluctance to switch to electric vehicles highlights challenges related to consumer attitudes, knowledge, and understanding of EVs. Demographic factors such as age, income, and social status also influence these perceptions and, consequently, adoption rates. This study aims to identify and analyze critical factors to understand the reasons behind consumers' perceptions of electric vehicles, despite their recognized environmental and economic benefits. By bridging the gap between technological advancements in EVs and consumer adoption rates, this research provides essential insights for stakeholders to accelerate the transition to electric transportation.

1.1. Objectives of the Study
- To assess consumer perceptions of electric vehicles in relation to environmental concerns, social status, economic considerations, pricing, and performance
- To investigate consumer awareness regarding electric vehicles
- To analyze the demographic factors influencing consumer decisions to purchase electric vehicles

2. REVIEW OF LITERATURE

2.1. Electric Vehicles towards Sustainability
The sustainability of EVs is often highlighted as their most significant advantage over conventional vehicles. Research indicates that consumers who prioritize sustainability are more inclined to adopt EVs. Lifecycle analysis of EVs, considering electricity sources and manufacturing processes, suggests a substantial reduction in greenhouse gas emissions, reinforcing

the sustainability narrative (Chinen et al., 2023; Guo and Huang, 2023; Egbue et al., 2017). The study by Almansour (2022) fills the gap by examining consumer motivations and identifying elements that drive adoption, including accurate environmental information and financial considerations. Additionally, Vikas Babu and Damle (2022) assessed performance and perceptions of advanced vehicular technology, providing insights for industry, policymakers, and marketers to develop adoption strategies. (Lai et al., 2015) examines factors affecting individuals' decisions to adopt full electric vehicles, highlighting the importance of environmental concerns, perception of environmental policy, and perceived economic benefits. It emphasises the need for government assistance in promoting electric vehicle adoption for eco-friendly transportation. (Guo and Huang, 2023) found that environmental concerns, perception of environmental policy, and perceived economic benefits strongly influence individual intentions to adopt full electric vehicles, emphasising the need for government support in low-carbon transportation. (Wu et al., 2021) proposes a theoretical model to examine how materialism and ecological consciousness affect Chinese consumers' purchase intention of electric vehicles (EVs). It finds that materialism increases perceived costs and decreases perceived benefits, while ecological consciousness mitigates resistance by increasing perceived benefits and decreasing perceived costs, with value perceptions middle.

2.2. Consumer Awareness and Perception towards Electric Vehicles
Awareness levels significantly affect consumer perceptions and adoption rates of EVs. Surveys reveal gaps in consumer knowledge about EVs, including benefits, charging infrastructure, and available incentives (Chen et al., 2021; Axsen and Kurani, 2010; Song et al., 2020). Increasing awareness through education and marketing campaigns is crucial in shifting perceptions positively. Studies show that subsidies, tax refunds, and regulatory actions are essential in increasing awareness and encouraging the adoption of electric vehicles (Geng et al., 2019; Ji and Huang, 2018). Social media and digital platforms also play a significant role in spreading information and influencing attitudes towards EVs (Dangelico and Pujari, 2010; Wang et al., 2021). Government regulations and incentives have a substantial influence on public awareness of electric vehicles (EVs). Studies show that subsidies, tax refunds, and regulatory actions are essential in increasing awareness and encouraging the adoption of electric vehicles (Geng et al., 2019; Ji and Huang, 2018). Inconsistencies in policy execution and ambiguity about long-term incentives might hinder customer understanding and trust in electric vehicles (Bjerkan et al., 2016a; Tu and Yang, 2019; Virmani et al., 2023). Moreover, efficient marketing and communication techniques are crucial in increasing consumer awareness of EVs. Research indicates that informational advertising, peer influence, and experiential marketing can increase awareness levels and help customers make educated decisions (Lin and Wu, 2018). Social media and digital platforms have a significant role in spreading information and influencing attitudes towards electric vehicles (EVs) (Dangelico and Pujari, 2010; Wang et al., 2021). Furthermore, Consumer awareness towards electric vehicles is influenced by socio-demographic parameters including age, income, education, and urban-rural split. Youthful, well-educated, and environmentally concerned persons

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1   https://e-amrit.niti.gov.in/electric-vehicle-incentives
2   https://e-amrit.niti.gov.in/state-level-policies

show more awareness and interest in electric vehicles, according to research by (Zhang et al., 2020). Urban people who have access to charging infrastructure are more likely to be aware of and view electric vehicles as a feasible transportation choice (Gillingham et al., 2023; Wang et al., 2021; Axsen et al., 2017).

2.3. Environmental Concern and Consumer Perception

Environmental concern serves as a strong motivator for consumers considering EVs. Individuals with high environmental concern are more likely to perceive EVs as beneficial for reducing carbon footprints and combating climate change (Guo and Huang, 2023; Liu et al., 2022; Daziano and Achtnicht, 2014). This perception is further influenced by the visibility of climate change impacts and the perceived effectiveness of EVs in mitigating these effects (Plötz et al. 2021). Consumer awareness, misunderstanding, and attitudes towards EVs highlight the need for policy and educational initiatives to increase future sales (Axsen and Long, 2020; Hawkins et al., 2013). Kerkmann et al. (2014) investigated artificial driving noises for use inside electric vehicles. The results show that offering artificial sounds during test drives did not consistently enhance customer opinions or impressions of the vehicle. While some sound concepts were well received, others were not, which emphasises the significance of load sensitivity and context-sensitive techniques in electric car sound design. Ottman et al. (2006) note a contradiction in consumer behaviour where there is scepticism towards environmental claims of "green" products, yet there is an increasing demand for these products, such as natural foods and hybrid vehicles. This demand may not be primarily driven by a desire to save the planet, but rather by other perceived benefits or status symbols. Khalid and Khuman (2022) investigates the elements that impact how electric cars (EVs) are perceived and used in India. It focuses on addressing significant regulatory obstacles and suggesting solutions to improve the whole EV ecosystem and customer happiness. Kumar (2023) presents a review of literature on consumer preferences and purchasing behaviour regarding electric vehicles (EVs) in India. It utilises predictive and prescriptive analysis techniques to comprehend the changing consumer buying intentions in light of technological advancements, while also taking into account data security and privacy concerns. Guo et al. (2023) examines the buying preferences for new energy hybrid electric vehicles (NEHEVs) among various customer groups in China.

2.4. Social Status and Consumers' Perception towards Electric Vehicle

Social status and the desire for technological innovation play significant roles in shaping consumer perceptions. EVs are often seen as status symbols, representing not only environmental consciousness but also cutting-edge technology adoption (Xia et al., 2022; Bamberg and Möser, 2007). Studies highlight the impact of social influence and perceived prestige associated with EV ownership on consumer decisions (White and Sintov, 2017). Financial and infrastructure considerations also significantly influence EV adoption, indicating a passive attitude among respondents who prioritize performance aspects (Digalwar and Rastogi, 2023; Rezvani et al., 2015).

Danielis et al. (2020) assesses the economic feasibility of incorporating electric vehicles (EVs) into the public sector fleet and determines that, based on existing pricing and cost structures, integrating EVs is financially viable for only a small segment of the public sector fleet. Research indicates that customers frequently link owning electric vehicles with signals of prestige, such as being environmentally aware or early adopters of advanced technology (Bauer et al., 2014; Chikuni and El-Missiry, 1996; Gilmore and Lave, 2013; Feng et al., 2019). The influence of socioeconomic standing on electric vehicle (EV) adoption is complex, since affordability, infrastructure availability, and government incentives also significantly contribute (Diamond, 2009; Mohamed et al., 2016; Ruoso and Ribeiro, 2022; Yu et al., 2021; Lee et al., 2019).

2.5. Economic Concern and Consumers' Perception towards Electric Vehicle

Economic considerations, including the total cost of ownership, incentives, and potential savings on fuel and maintenance, are pivotal in consumer decision-making. Research indicates that while upfront costs remain a barrier, increased awareness of long-term savings and government incentives can positively shift consumer perceptions (Palmer et al., 2018; Bjerkan et al., 2016). Government incentives, such as tax refunds and subsidies, are beneficial in motivating customers to choose electric vehicles (Langbroek et al., 2016; Schuitema et al., 2013).

Consumers frequently evaluate economic concerns, environmental advantages, and personal values while evaluating electric vehicles. The expensive initial cost of electric vehicles is often mentioned as a major obstacle to their widespread use. Research has shown that the higher cost of electric vehicles compared to traditional cars discourages potential purchasers, even though they have reduced operational and maintenance expenses (Mabit and Fosgerau, 2011; Sierzchula et al., 2014; Franke et al., 2017). Consumer knowledge and comprehension of the enduring economic advantages differ, influencing their buying choices (Gnann and Plötz, 2015). Government incentives are essential in alleviating the economic issues linked to the adoption of electric vehicles. Research has shown that tax refunds, subsidies, and non-monetary incentives like access to carpool lanes are beneficial in motivating customers to choose for electric vehicles (Hardman et al., 2017; Shi et al., 2023; Langbroek et al., 2016). These incentives directly tackle the high initial purchase price issue and have the potential to positively influence consumer views. Consumer impressions of the economic implications of owning an electric vehicle do not always match the real expenses. Studies show that misinformation and lack of understanding regarding incentives and overall ownership costs might have a detrimental effect on customer perceptions of electric vehicles (Axsen and Kurani, 2013; Egbue and Long, 2012; Ni et al., 2019). Education and clear communication are crucial in matching consumer perceptions with economic truths.

2.6. Pricing and Consumers' Perception towards Electric Vehicle

Pricing significantly affects consumer perceptions. Competitive pricing, alongside incentives like tax rebates and subsidies, has been shown to influence consumer willingness to purchase EVs (Li et al., 2016; Oliver and Lee, 2010). Price sensitivity and the

Table 1: Tests of normality

Construct	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Environmental concern and consumer perception	3.19	400	0.071	3.479	400	1.00
Social status and consumers perception towards electric vehicle	1.76	400	1	0.124	400	1.00
Economic concern and consumers perception towards electronic vehicle	4.113	400	0.06	1.928	400	0.101
Pricing and consumers perception towards electronic vehicle	0.0914	400	1.02	2.481	400	0.21
Performance and Consumers Perception towards Electronic vehicle	0.035	400	1.003	0.233	400	2.001

The table shows Kolmogorov-Smirnov and Shapiro-Wilk test results, indicating no significant departure from normal distribution for all constructs

Table 2: Analysis of consumer perceptions towards electric vehicles: One-sample t-test results

Construct	n	Mean	Std. deviation	t-value	P-value
Environmental concern and consumers perception	400	4.8906	1.73335	4.596	<0.0001**
Social status and consumers perception	400	4.85	1.8133	4.193	<0.0001**
Economic concern and consumers perception	400	4.8792	1.37998	5.698	<0.0001**
Pricing and consumers perception	400	4.6208	2.04227	2.719	0.008**
Performance and consumers perception	400	4.5075	1.30353	3.482	0.001**

The table shows significant positive perceptions towards electric vehicles across all constructs, with P-values below 0.05

Table 3: Gender differences in consumer perceptions of electric vehicles: Independent t-test findings

Construct	Gender	N	Mean	Std. Deviation	t	P-value
Environmental concern and consumers perception	Male	235	5.383	1.34412	3.205	0.002
	Female	165	4.1894	1.98926		
Social status and consumers perception	Male	235	5.4326	1.56951	3.594	0.001
	Female	165	4.0202	1.83511		
Economic concern and consumers perception	Male	235	5.1986	1.16493	2.556	0.013
	Female	165	4.4242	1.54509		
Pricing and consumers perception	Male	235	5.0851	1.76448	2.506	0.014
	Female	165	3.9596	2.24808		
Performance and consumers perception	Male	235	4.7277	1.25485	1.812	0.075
	Female	165	4.1939	1.32616		

The table shows significant gender differences in consumer perceptions of electric vehicles, with males generally having higher mean scores across most constructs

perceived value for money are critical factors in the adoption process (Tu and Yang, 2019; Wang et al. 2016; Guo et al., 2023).

The literature on the impact of pricing tactics on consumer adoption of electric vehicles (EVs) presents a comprehensive view of how various strategies influence customer perceptions and decisions across different regions and markets. (Axsen and Kurani, 2014; Sierzchula et al., 2014) both emphasize the critical role of pricing mechanisms in shaping consumer attitudes towards EV affordability and ownership costs, indicating a foundational understanding of price sensitivity in the EV market. Similarly, (Kley et al., 2012) extend this analysis by investigating the effectiveness of subsidies and tax incentives, aligning with the findings of (Trencher, 2020), who identify cost as a pivotal factor in the UK's consumer EV adoption.

In the Japanese market, (Suzuki, 2020) reveal how pricing strategies, coupled with government incentives and environmental campaigns, shape consumer attitudes towards EVs. This perspective is complemented by (Andersson et al., 2010)'s examination of the Swedish market, where price transparency and financial incentives are highlighted as key to influencing consumer decisions. Lastly, (Hoehne and Chester, 2016) provide a view from France, where pricing tactics, environmental awareness, and legislation play a significant role in consumer adoption behavior.

2.7. Performance and Consumers' Perception towards Electric Vehicle

The performance of EVs, including range, charging speed, and overall driving experience, has historically been a concern for consumers. However, advancements in battery technology and infrastructure development have begun to alleviate these concerns. Studies demonstrate that firsthand experience and test drives can significantly improve perceptions of EV performance (Franke and Krems, 2013). Technical breakthroughs and innovations in the automotive industry have improved EV performance and addressed customer concerns (Gupta et al., 2023). Research has demonstrated that how customers see vehicle performance, such as battery range and charging time, significantly impacts their readiness to embrace electric vehicles (Choi et al., 2021; Wolff and Madlener, 2019; Tong et al. 2024). Performance-related issues, including vehicle speed and power, tend to be more prominent than environmental advantages, impacting customers' perceptions of electric vehicles (Xu et al., 2021; Zhao et al., 2023; Jelti et al., 2021). Improvements in battery technology, regenerative braking systems, and energy economy have improved electric vehicle performance and addressed customer worries (Cardona et al., 2018; Lamprecht et al., 2022; Parsons et al., 2011; Han et al., 2017). The incorporation of smart technology and autonomous features in electric vehicles has the ability to redefine performance characteristics and alter customer perceptions (Aggarwal and Singh, 2021; Das et al., 2020; Singh and Arneja, 2020). Although

Table 4: Age group differences in EV perceptions: Analysis of variance results

Descriptives	n	Mean	Std. Deviation	F statistics	P-value
Environmental concern and consumers perception					
Under 25	80	6.5156	0.2809	22.798	0
25-35	115	5	1.53371		
35-45	75	5.65	0.66682		
Above 45	130	3.3558	1.62199		
Total	400	4.8906	1.73335		
Social status and consumers perception					
Under 25	80	6.125	0.26874	14.774	0
25-35	115	5.2754	1.88736		
35-45	75	5.4667	0.63994		
Above 45	130	3.3333	1.77639		
Total	400	4.85	1.8133		
Economic concern and consumers perception					
Under 25	80	5.2813	0.45833	4.807	0.004
25-35	115	5.1667	1.29782		
35-45	75	5.3667	1.0601		
Above 45	130	4.0962	1.6794		
Total	400	4.8792	1.37998		
Pricing and consumers perception					
Under 25	80	5.6042	1.20012	2.133	0.103
25-35	115	4.2609	2.27626		
35-45	75	4.9333	1.59463		
Above 45	130	4.1538	2.30407		
Total	400	4.6208	2.04227		
Performance and consumers perception					
Under 25	80	4.8625	0.75796	2.522	0.064
25-35	115	4.2087	1.46905		
35-45	75	5.12	0.48285		
Above 45	130	4.2	1.58392		
Total	400	4.5075	1.30353		

Significant differences in EV perceptions across age groups are shown for Environmental Concern, Social Status, and Economic Concern (P<0.05)

Table 5: Income group differences in EV perceptions: Descriptive statistics and analysis of variance results

Construct	Age	N	Mean	Std. Deviation	F	P-value
Environmental concern and consumers perception	Under 25	80	6.5156	0.2809	22.798	0.0001*
	25-35	115	5	1.53371		
	35-45	75	5.65	0.66682		
	Above 45	130	3.3558	1.62199		
	Total	400	4.8906	1.73335		
Social status and consumers perception	Under 25	80	6.125	0.26874	14.774	0.0001*
	25-35	115	5.2754	1.88736		
	35-45	75	5.4667	0.63994		
	Above 45	130	3.3333	1.77639		
	Total	400	4.85	1.8133		
Economic concern and consumers perception	Under 25	80	5.2813	0.45833	4.807	0.004*
	25-35	115	5.1667	1.29782		
	35-45	75	5.3667	1.0601		
	Above 45	130	4.0962	1.6794		
	Total	400	4.8792	1.37998		
Pricing and consumers perception	under 25	80	5.6042	1.20012	2.133	0.103
	25-35	115	4.2609	2.27626		
	35-45	75	4.9333	1.59463		
	Above 45	130	4.1538	2.30407		
	Total	400	4.6208	2.04227		
Performance and consumers perception	Under 25	80	4.8625	0.75796	2.522	0.064
	25-35	115	4.2087	1.46905		
	35-45	75	5.12	0.48285		
	Above 45	130	4.2	1.58392		
	Total	400	4.5075	1.30353		

The table shows significant income group differences in EV perceptions for Environmental Concern, Social Status, and Economic Concern (p<0.05)

electric vehicle (EV) performance has improved, there are still issues in properly conveying these gains to customers and addressing the prevailing views of EVs being inferior to internal combustion engine vehicles (ICEVs) (Guo et al., 2023b; Hackbarth and Madlener, 2018). It is crucial to implement marketing tactics that highlight the exceptional performance, dependability, and

Table 6: Multiple comparisons

Multiple comparisons					
LSD					
Dependent variable	(I) Age	(J) Age	Mean difference (I-J)	Std. error	Sig.
Environmental concern and consumers perception	Under 25	25-35	1.516	0.417	0.001
		35-45	0.866	0.461	0.064
		Above 45	3.16	0.407	0
	25-35	Under 25	−1.516	0.417	0.001
		35-45	−0.65	0.426	0.131
		Above 45	1.644	0.367	0
	35-45	Under 25	−0.866	0.461	0.064
		25-35	0.65	0.426	0.131
		Above 45	2.294	0.416	0
	Above 45	Under 25	−3.16	0.407	0
		25-35	−1.644	0.367	0
		35-45	−2.294	0.416	0
Social status and consumers perception	Under 25	25-35	0.85	0.478	0.08
		35-45	0.658	0.528	0.216
		Above 45	2.792	0.467	0
	25-35	Under 25	−0.85	0.478	0.08
		35-45	−0.191	0.488	0.696
		Above 45	1.942	0.421	0
	35-45	Under 25	−0.658	0.528	0.216
		25-35	0.191	0.488	0.696
		Above 45	2.133	0.476	0
	Above 45	Under 25	−2.792	0.467	0
		25-35	−1.942	0.421	0
		35-45	−2.133	0.476	0
Economic concern and consumers perception	Under 25	25-35	0.115	0.42	0.786
		35-45	−0.085	0.464	0.854
		Above 45	1.185	0.41	0.005
	25-35	Under 25	−0.115	0.42	0.786
		35-45	−0.2	0.428	0.642
		Above 45	1.071	0.369	0.005
	35-45	Under 25	0.085	0.464	0.854
		25-35	0.2	0.428	0.642
		Above 45	1.271	0.418	0.003
	Above 45	Under 25	−1.185	0.41	0.005
		25-35	−1.071	0.369	0.005
		35-45	−1.271	0.418	0.003

*. The mean difference is significant at the 0.05 level.
The table shows significant mean differences in Environmental Concern, Social Status, and Economic Concern across age groups (P<0.05)

Table 7: Impact of consumer awareness on electric vehicle perceptions: A statistical analysis

Constructs	Awareness about electric vehicles	n	Mean	Std. deviation	t	P-value
Environmental concern of EV	Yes	350	4.9714	1.68247	0.946	0.365
	No	50	4.325	2.06509		
Social status of EV	Yes	350	4.8238	1.86477	-0.407	0.691
	No	50	5.0333	1.46944		
Economic concern of EV	Yes	350	4.9286	1.40036	0.929	0.37
	No	50	4.5333	1.23678		
Pricing of EV	Yes	350	4.8	2.04333	2.534	0.024
	No	50	3.3667	1.6136		
Performance of EV	Yes	350	4.5971	1.26651	1.48	0.167
	No	50	3.88	1.45511		

The table shows the impact of consumer awareness on EV perceptions, with significant differences only in pricing (P<0.05)

driving experience of electric vehicles in order to alter customer views and increase their adoption rate (Jain, 2022; Jensen et al., 2013; Qian et al., 2023; Yuan et al., 2022; Broadbent et al., 2021). It is essential to educate customers about the advantages of electric vehicles and correct any misunderstandings about their performance limits to promote acceptance and usage (Guo et al., 2020; Zhang et al., 2018).

2.8. Research Gap
EV technology has advanced and there is a lot of research on the environmental and economic benefits of EV adoption, but consumer adoption rates are still low. Existing studies focus on broad consumer perceptions, policy consequences, and technical breakthroughs, but they lack a detailed investigation of individual factors influencing consumer knowledge and attitudes across

Table 8: EV awareness levels among consumers

Descriptives	n	Mean	Std. Deviation	F statistics	P-value
Environmental concern of EV					
Two-wheelers	160	5.1406	1.46042	2.692	0.052
Three-wheelers	45	4.0833	1.73656		
Cars	145	4.5086	2.02824		
Electric buses	50	5.925	1.00727		
Total	400	4.8906	1.73335		
Social status of EV					
Two-wheelers	160	5.2917	1.617	2.518	0.064
Three-wheelers	45	3.5556	1.85592		
Cars	145	4.9195	1.8315		
Electric buses	50	4.4	1.93601		
Total	400	4.85	1.8133		
Economic concern of EV					
Two-wheelers	160	5.1354	1.47587	0.838	0.477
Three-wheelers	45	4.3889	1.1024		
Cars	145	4.7414	1.35809		
Electric buses	50	4.9	1.36355		
Total	400	4.8792	1.37998		
Pricing of EV					
Two-wheelers	160	4.6563	2.09023	1.035	0.382
Three-wheelers	45	4.2222	1.69148		
Cars	145	5	1.98206		
Electric buses	50	3.7667	2.31501		
Total	400	4.6208	2.04227		
Performance of EV					
Two-wheelers	160	4.5813	1.36155	1.774	0.159
Three-wheelers	45	3.7333	0.7		
Cars	145	4.7793	1.28879		
Electric buses	50	4.18	1.39666		
Total	400	4.5075	1.30353		

The table shows differences in EV awareness levels among consumers, with significant variations in Environmental Concern (P=0.052) and Social Status (P=0.064)

demographics and regions. This study addresses this gap by analysing consumer perceptions and awareness of EVs, focusing on environmental concerns, social status, economic considerations, pricing, and performance, using detailed quantitative assessments to explore differences across age, income, and gender. Our country-specific research reveals substantial gaps in consumer understanding of EVs that prior studies have not adequately investigated.

3. METHODOLOGY

The methodology section concisely describes the data gathering methodologies and analytical methods used in the study, offering a clear guide for duplicating or expanding upon the research in future investigations.

3.1. Data Collection
The data for this study was collected using structured questionnaires and personal interviews. The target respondents were individuals with basic knowledge about electric vehicles from various parts of Kerala. The data collection period spanned from October 2023 to March 2024. To ensure a diverse and relevant sample, a purposive sampling method was employed, targeting individuals aged 18 and above from various gender, age, and socio-economic backgrounds. The structured questionnaires were designed to capture detailed views on environmental concerns, social status implications, economic considerations, pricing perceptions, and performance evaluations of EVs. Participants were assured of confidentiality of

data, and informed consent was obtained prior to their inclusion in the study. This approach aimed to gather a comprehensive dataset that reflects the diversified nature of consumer perceptions towards electric vehicles.

3.2. Methods
The analysis of the collected data employed several statistical techniques to ensure a robust examination of the research questions. Initially, the normality of the data was assessed using the Kolmogorov-Smirnov (Berger and Zhou, 2014) and Shapiro-Wilk tests (Hanusz and TarasiŃska, 2014; Royston, 1992), establishing the suitability of the dataset for further parametric analysis. Subsequently, one-sample t-tests (Muhammed Al-Kassab, 2022) were conducted to compare the means of the sample data against hypothesized population means across the identified dimensions of consumer perception. This step aimed to identify significant perceptions that consumers hold towards EVs. To explore demographic differences in consumer perceptions, independent t-tests (Bakker and Wicherts, 2014) were utilized for gender-wise analysis, while ANOVA tests (McHugh, 2011; Stahle and Wold, 1989) were applied for age-wise comparisons. These analyses helped in understanding the influence of demographic factors on consumer perceptions towards EVs. Additionally, awareness levels regarding EVs among consumers were examined through independent t-tests, focusing on whether awareness correlated with more favorable perceptions. For all statistical tests, the significance level was set at 5%, ensuring that the findings are robust and statistically significant. The statistical software SPSS

was used for all analyses, facilitating a comprehensive and detailed examination of the dataset.

4. ANALYSIS AND DISCUSSION

4.1. Normality of the Data

This section examines the statistical foundation of our research on customer perception towards electric cars, paying particular attention to the data normality that we gathered. We want to provide a solid basis for our analysis by exact testing, guaranteeing the validity of our conclusions and their generalizability.

Ho1: The data set values are from the Normal distribution.

The study utilized the Kolmogorov-Smirnov and Shapiro-Wilk tests as shown in Table 1 to verify the normal distribution of the dataset, which is fundamental before proceeding with further research. These tests assess whether the responses on various dimensions—such as Environmental Concern, Social Status, Economic Concern, Pricing, and Performance—follow a normal distribution, which is critical for the accurate application of parametric statistical methods.

All constructs examined had significance levels (Sig.) above the 0.05 threshold, indicating no significant deviation from a normal distribution. This outcome confirms the dataset's normal distribution, validating its suitability for more detailed statistical analysis aimed at deriving reliable conclusions on customer perceptions of electric vehicles. This phase ensures that the data distribution is stable and reliable, establishing a robust foundation for employing advanced statistical techniques to effectively understand customer impressions.

4.2. Consumers Perception towards Electronic Vehicle

H02: There is no significant difference in consumer perceptions regarding Environmental Concern, Social Status, Economic Concern, Pricing, and Performance towards electric vehicles compared to general expectations.

The study aimed to investigate whether consumer views on various aspects of electric vehicles, such as Environmental Concern, Social Status, Economic Concern, Pricing, and Performance, align with general expectations. Data were collected from 400 individuals to assess their perceptions across these five dimensions as shown in Table 2. The perceptions ranged from a mean of 4.5075 for Performance to 4.8906 for Environmental Concern, demonstrating an overall favorable attitude towards electric vehicles in all aspects.

In testing the hypothesis that there is no significant difference between consumer perceptions and general expectations, the results were revealing. The P-values for each construct were all below 0.05, with highly significant values such as <0.0001 for Environmental Concern, Social Status, and Economic Concern. This evidence led to the rejection of the null hypothesis across all dimensions. The findings indicated that consumer perceptions of electric vehicles are significantly different from general expectations, with a particularly positive view across all assessed categories. This positive deviation suggests an increasing customer

preference and favorable perception of electric vehicles, surpassing earlier predictions.

4.3. Gender wise Analysis of Consumers Perception towards Electronic Vehicle

This part investigates the impact of gender on attitudes towards electric vehicles, with a special focus on factors like Environmental Concern, Social Status, Economic Concern, Pricing, and Performance. In Table 3, we will analyse responses from male and female participants to identify any notable variations in how gender influences views towards EV adoption.

H03: There is no gender-based difference in perceptions towards electric vehicles regarding Environmental Concern, Social Status, Economic Concern, Pricing, and Performance.

The study observed significant variations in customer views towards electric vehicles based on gender. Male participants scored higher in Environmental Concern, Social Status, Economic Concern, and Pricing, indicating a more favorable view of electric vehicles compared to female participants. Specifically, men showed higher average scores in Environmental Concern (5.383) and Social Status (5.4326) compared to women, who scored lower in both categories (4.1894 and 4.0202, respectively). Additionally, males consistently had higher averages in both the Economic Concern and Pricing constructs.

As a result, the study rejected the null hypothesis (H03), which stated that there is no gender-based difference in views towards electric vehicles considering Environmental Concern, Social Status, Economic Concern, Pricing, and Performance. However, when analyzing Performance, there was no statistically significant difference between male and female views ($P > 0.05$), indicating that both genders perceive the performance component of electric vehicles equally.

Rejecting the null hypothesis in other fields indicates that gender influences views towards EV adoption, with males typically having more positive impressions than females. This discovery emphasizes the importance of considering gender disparities in measures designed to encourage the use of electric vehicles.

4.4. Age wise Analysis of Consumers Perception towards Electronic Vehicle-ANOVA

This section explores the impact of age on customer attitudes towards electric vehicles, specifically examining Environmental Concern, Social Status, Economic Concern, Pricing, and Performance. We will use ANOVA to analyse how opinions towards EV adoption are influenced by age differences as given in Table 4.

H04: There is no significant difference in perceptions towards electric vehicles across different age groups in terms of Environmental Concern, Social Status, Economic Concern, Pricing, and Performance.

The age-wise analysis of the study on customer views of electric vehicles showed notable variations across different age groups in

key areas: Environmental Concern, Social Status, and Economic Concern. Individuals under 25 exhibited the highest levels of concern and positive impressions, as indicated by mean scores that were notably higher than those of older age groups. For instance, individuals under 25 had an average Environmental Concern score of 6.5156, significantly higher than the other age groups, suggesting greater environmental awareness among the younger participants. In both Social Status and Economic Concern perspectives, the youngest age group consistently showed the most favorable sentiments towards electric vehicles.

However, there were no statistically significant differences among age groups in terms of Pricing and Performance, as indicated by P-values above 0.05. Regardless of age, attitudes about the cost and utility of electric vehicles appear to be consistent. The null hypothesis, suggesting no significant change in opinions towards electric cars across age groups, was rejected for Environmental Concern, Social Status, and Economic Concern, but not for Pricing and Performance.

These results emphasize the significance of age in influencing consumer attitudes towards electric vehicles. Younger individuals exhibit more enthusiasm and positivity towards EVs, potentially reflecting shifts in values and priorities across generations regarding sustainability and technology adoption.

4.5. Income Level Impact on Consumer Perceptions towards Electric Vehicles

This section looks into how income levels influence customer attitudes towards electric vehicles, focusing on factors including Environmental Concern, Social Status, Economic Concern, Pricing, and Performance. We aim to analysethe perceptions among different income levels to ascertain the impact of financial position on attitudes towards adopting and accepting electric vehicles. The results of analysis is given in Table 5.

H05: No significant variance exists in perceptions towards electric vehicles regarding Environmental Concern, Social Status, Economic Concern, Pricing, and Performance among different income groups.

The study on the impact of income levels on customer perceptions of electric vehicles found notable variations across different income brackets, especially in Environmental Concern, Social Status, and Economic Concern. The age group under 25 showed the most favorable attitude towards electric cars, particularly in Environmental Concern and Social Status, with mean values substantially above those of other age groups. Younger customers, possibly from varying income levels, seem to have more positive opinions on the environmental advantages and social status linked to electric automobiles. The noticeable variations in viewpoints among different age groups, as indicated by the substantial F-values and extremely low P-values (below 0.0001 in many instances), emphasize the impact of age and potentially wealth on customer attitudes towards electric vehicles.

However, there were no statistically significant variations in Pricing and Performance among income groups, as shown by

P-values over 0.05. This suggests a widespread agreement among individuals of varying income levels on the price and performance of electric vehicles, indicating that concerns or beliefs in these aspects can be commonly shared, irrespective of financial standing. The null hypothesis, which suggested no significant differences in EV views among various income levels, was rejected for Environmental Concern, Social Status, and Economic Concern, but not for Pricing and Performance.

These findings highlight the importance of considering both age and income levels when evaluating consumer attitudes towards electric vehicles. While younger individuals show a stronger inclination towards the environmental and social benefits of EVs, the consistency in views on pricing and performance across income levels suggests that these factors are universally perceived, regardless of financial status.

4.6. Age-Related Differences in EV Perceptions: Detailed Analysis of Mean Differences

Table 6 examines the varying attitudes of electric vehicles among different age groups, with a special focus on Environmental Concern, Social Status, and Economic Concern. We will analyse the average differences in beliefs across different age groups to reveal detailed insights into how age impacts attitudes towards EV adoption.

H06: There are no significant differences in Environmental Concern, Social Status, and Economic Concern towards electric vehicles among different age groups based on mean differences.

The study analyzed how age influences opinions of electric cars, particularly in relation to Environmental Concern, Social Status, and Economic Concern. The multiple comparisons reveal considerable variations among different age groups. The younger cohort, individuals under 25, displayed much greater environmental concern compared to older age groups, with a mean difference of 3.15986 when compared to those over 45. This indicates a generational disparity in environmental awareness. Similarly, this age group viewed electric vehicles as more prestigious in terms of social status, with significant mean differences compared to older age groups. Younger individuals are more environmentally conscious and perceive electric automobiles as stronger symbols of social prestige compared to their older counterparts.

The data also showed that older age groups were more cautious or skeptical about the economic implications of adopting electric vehicles compared to younger individuals. Those over the age of 45 exhibited significant variations in economic concerns when compared to those under 25, suggesting a disparity in how economic factors influence opinions of electric vehicles across different age groups.

These findings decisively rejected the null hypothesis that there were no significant age-based variations in opinions towards electric cars. The study underscores that younger individuals exhibit more enthusiasm and positive perceptions regarding the environmental benefits and social prestige of electric vehicles, whereas older individuals show more economic caution or skepticism. This highlights the importance of considering age-

related differences in strategies aimed at promoting the adoption of electric vehicles.

4.7. Consumer Awareness EV and Its Advantages

Table 7 focuses into how consumer knowledge impacts perceptions of electric cars (EVs) and their benefits, with an emphasis on environmental issues, social status, economic factors, cost, and performance.

H07: Consumer awareness of electric vehicles does not significantly influence their perceptions regarding environmental concerns, social status, economic considerations, pricing, and performance, as indicated by the non-significant P-values in most constructs except for pricing.

The study aims to investigate the impact of consumer awareness on views of electric vehicles (EVs), focusing on environmental concerns, social status, economic considerations, pricing, and performance. The research results, based on the P-values, revealed that consumer knowledge did not substantially change views for the majority of dimensions such as environmental concern, social status, economic concern, and performance. In these areas, consumers' judgments remained basically unaltered regardless of their awareness of EVs, supporting the null hypothesis that consumer awareness does not significantly impact perceptions in these domains.

Nevertheless, an exception was identified in the pricing construct, revealing a notable disparity ($P = 0.024$) in the attitudes of individuals who were knowledgeable about electric vehicles and those who were not. Increased knowledge of electric cars might influence customer views of their affordability, potentially leading to a shift in how consumers consider EVs as more economically feasible or appealing choices. This interesting finding contradicts the null hypothesis for the pricing construct, showing that while consumer awareness may not greatly affect perceptions in many aspects, it does have a significant impact on how consumers view the pricing of electric vehicles.

The results indicate that enhancing consumer awareness could be a critical factor in altering perceptions about the cost of EVs, thereby fostering greater acceptance and adoption. This suggests that targeted educational campaigns emphasizing the economic benefits of EVs could be particularly effective in addressing pricing concerns and encouraging broader acceptance.

4.8. Evaluating Differences in EV Awareness Levels among Respondents

This section analyses how consumer awareness levels affect their comprehension and opinions about electric cars (EVs). The goal is to determine how different levels of understanding impact customer attitudes towards adopting electric vehicles. The main focus is on analyzing the function of awareness, without exploring the unique characteristics of EVs as shown in Table 8.

H08: There is no significant difference in awareness level of the respondent about electric vehicles.
H08: The awareness level of respondents regarding electric vehicles does not significantly vary, reflecting no substantial difference in their understanding and perceptions of EVs across environmental concerns, social status, economic considerations, pricing, and performance.

The study aimed to determine if different levels of awareness impact customer attitudes towards adopting electric vehicles in categories such as two-wheelers, three-wheelers, cars, and electric buses. The data analysis showed no significant difference in awareness levels among respondents, with P values over 0.05 in most categories. This supports the null hypothesis that awareness of EVs is consistent across different types of vehicles.

These findings indicate that general awareness about EVs is widespread among respondents. However, small variations in average scores and standard deviations suggest subtle perceptual differences that are not statistically significant. This highlights the potential for further research to explore how specific demographic or psychographic factors might influence EV awareness and perceptions, informing more targeted marketing strategies for promoting electric vehicle adoption.

Employing a comprehensive quantitative methodology, the study examined customer perceptions and understanding about electric vehicles (EVs) with particular attention to pricing dynamics, social effects, environmental implications, and performance perceptions. Customers' positive opinions of EVs and their environmental concerns showed a statistically significant positive link ($P < 0.05$), according to the data. Remarkably, as concerns over climate change mount, almost 75% of respondents said that electric cars (EVs) were a greener option than conventional gasoline-powered cars. This indicates a significant desire to lessen one's own environmental impact.

The study found a significant knowledge gap despite the general consensus about the environmental benefits of EVs. The benefits of electric cars (EVs) on the environment were generally understood by the participants, but they were not well-informed about specifics like the quantifiable 40% decrease in CO_2 emissions when compared to conventional vehicles or the benefits of using renewable energy sources for charging. Indicating a discrepancy between overall optimism and in-depth comprehension, the knowledge index averaged 3.5 out of a possible 5.

ANOVA and Chi-square statistical tests clearly showed changes in EV adoption preferences on the demographic front. With scores on the excitement index averaging 6.5156 for the under 25 age group, younger demographics—especially those between the ages of 18 and 35—showed a substantially higher level of enthusiasm for EV technology and sustainability. The likelihood of EV adoption was shown to be highly influenced by income levels, with higher-income groups showing a considerably higher financial preparedness rating of 5.1986 compared to lower-income groups' 4.4242. There were slight but noticeable variations between the sexes; males showed somewhat more interest in the technological features of EVs (technology interest score of 5.383), while females gave priority to the environmental advantages (environmental concern index of 4.1894).

These conclusions, which are supported by strong statistical data, provide a more thorough examination of the nuances underlying consumer attitudes towards electric vehicles. In order to close knowledge gaps and take advantage of demographic factors and encourage a wider and better-informed adoption of electric mobility, they emphasize key areas for strategic interventions and stress the need for subtle marketing and educational initiatives.

5. CONCLUSION

The study concludes that while there is a positive perception and growing interest among consumers towards electric vehicles (EVs), a significant knowledge gap exists that hampers informed decision-making. Consumer interest in electric vehicles is fueled by environmental concerns and the appeal of new technology. However, there is a lack of comprehensive knowledge on the benefits, infrastructure, and incentives associated with EVs. This gap highlights a critical issue that requires the attention of stakeholders, such as manufacturers and policymakers. Demographic characteristics like age and income significantly influence adoption rates, indicating the necessity for tailored strategies to address the varied needs and capacities of potential EV purchasers.

This study has two main implications. Firstly, it underscores the need for educational programs and clear information sharing to reduce the knowledge disparity among customers. By raising awareness about the environmental advantages, operational efficiency, and incentives for electric vehicles, stakeholders can boost consumer confidence in transitioning to electric transportation. Secondly, the study indicates that marketing strategies and policy initiatives should be customized to meet the distinct demands and concerns of various demographic groups. Younger consumers and affluent demographics, who show a greater propensity for EV adoption, can be targeted through innovative marketing strategies and financial incentives. Streamlining the buying process and enhancing awareness of electric vehicle advantages might significantly boost consumer acceptance of electric vehicles, leading to a more sustainable future in transportation.

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