

An Analytical Examination of Determinants and Information Channels Influencing Consumer Behaviour toward Electric Vehicles in Ludhiana

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Abstract. The increasing emphasis on sustainable transportation has elevated electric vehicles (EVs) as a viable and eco-friendly alternative to conventional vehicles. This research investigates the key determinants influencing consumer behavior toward EV adoption and explores the impact of various information sources on consumer awareness and decision-making. Both primary and secondary data were employed for the analysis. Primary data were gathered through a structured questionnaire administered to 450 respondents in Ludhiana, encompassing diverse demographic backgrounds. Secondary data were derived from academic journals, government publications, and industry reports to contextualize EV adoption patterns in India. The collected data were analyzed using SPSS software, employing Exploratory Factor Analysis and Weighted Average Score methods to uncover the underlying behavioral dimensions affecting consumer choices. The study identified three major factors—environmental, technological, and social—that significantly influence consumer behavior. Among them, environmental concern was found to be the most dominant factor, with an Eigenvalue of 5.429. Additionally, social media emerged as the most influential information source, playing a pivotal role in enhancing awareness and shaping purchase intentions. Overall, the findings reveal that while environmental consciousness strongly drives consumer preference for EVs, inadequate information and concerns about performance consistency continue to hinder widespread adoption.

Keywords: Consumer Behaviour, Electric Vehicles (EVs), Information Sources, Factor Analysis and Sustainable Mobility

1. Introduction

The transport industry is undergoing a transformational upheaval, fuelled by the urgent need for sustainable mobility solutions. With escalating environmental concerns, fossil fuel depletion, and rising urban pollution levels, the shift from internal combustion engine vehicles to electric vehicles (EVs) has emerged as a global priority. Electric vehicles are commonly regarded as a cleaner and more energy-efficient alternative to regular autos, with the potential to significantly cut greenhouse gas emissions and reliance on nonrenewable energy resources.

In recent years, India's use of electric mobility has grown significantly, thanks to government incentives, technological breakthroughs, and an increasing emphasis on green energy. Despite this increase, total market penetration of EVs remains low. As of early 2025, Punjab has more than 25,000 registered EVs, accounting for just around 0.26% of the state's total vehicle population, with the majority being electric two- and three-wheelers. This gradual yet consistent rise represents a welcome trend towards greener mobility, but it also underlines the ongoing obstacles of consumer uptake and infrastructure development.

Ludhiana, Punjab's industrial and commercial capital, has emerged as a driving force in the state's electric mobility revolution. According to recent data, there are over 60,000 electric vehicles registered in Ludhiana, with approximately 80% of these registrations coming in the last three years. This spike reflects the city's rising preference for sustainable travel. The Ludhiana Municipal Corporation has also announced intentions to build 100 EV charging stations to help with the green transition and encourage more consumers to use electric mobility options.

Understanding the elements driving customer behaviour in such a dynamic environment is critical for increasing EV adoption. Consumer preferences for electric vehicles are influenced by a complex interaction of economic, environmental, technological, and social issues. While some customers are motivated by environmental awareness and a desire to lessen their carbon footprint, others are swayed by perceived performance, cost efficiency, charging infrastructure, and societal expectations. Furthermore, information channels such as social media, word of mouth, and brand advertising have become increasingly important in moldings understanding and attitudes towards electric vehicles.

Table 1: Context Metrics

Metric	Value	Date / Source Notes
Punjab: EV share of total vehicles	0.26%	As of mid-2023, EVs accounted for about 34,162 out of 1.31 crore total registered vehicles in Punjab. (The Times of India)
Total EVs in Punjab (all types)	25,597 EVs	As per data in early March 2025. (Inc42 Media)
Recent EV registrations in	9,908 units	Registered up to early

Punjab	March 2025. (EVINDIA)	
Year-wise growth in EV sales in Punjab	2021= 4,643 units 2022= 14,054 2023= 25,741	Shows steep growth, especially between 2021-23. (ijmra.us)
EV breakdown by type in Punjab	5,182 two-wheelers 9,310 three-wheelers 359 four-wheelers 52 buses	Data from EV dashboard; gives a sense that most EVs are two- and three-wheel vehicles. (The Times of India)
Ludhiana: Total EVs / Usage	Over 60,000 EVs reported in Ludhiana	According to a local news report about Ludhiana Municipal Corporation planning new charging stations. (The Times of India)
Ludhiana: EV registrations trend	80% of Ludhiana's total EV registrations came in the last 3 years (as of early 2023)	Implies accelerating adoption recently. (The Times of India)

2. Literature review

Axsen and Kurani (2008) investigated consumer awareness and preferences regarding PHEVs (plug-in hybrid electric vehicles) in the US. The main purpose of the study is to assess U.S. consumers' awareness, recharge capabilities, design preferences, and the potential energy impacts related to plug-in hybrid electric vehicles (PHEVs). Quantitative data was gathered from 2373 new vehicle-buying households in U.S through a web-based survey and it was conducted in three parts over multiple days, requiring participants to answer questions, review their own driving and parking patterns, and complete a series of PHEV design exercises. The findings showed that most new car buyers awareness level was low with PHEVs, but about one-third showed interest and had home recharging capabilities. Widespread PHEV adoption could significantly reduce gasoline use, though it might increase peak electricity demand without smart charging strategies. The study concludes that there is need for consumer education, supportive infrastructure, and to

promote off-peak recharging in order to properly manage power consumption, promote PHEV adoption, and optimise environmental advantages.

Lee et al. (2021) examined the influence of demographic characteristics on user satisfaction with EV charging infrastructure. This study's primary goal was to determine the demographic characteristics (e.g., age, gender, income, education level) significantly impact users' satisfaction levels and to understand how these factors interact with various aspects of the charging experience. Quantitative information was gathered using structured questionnaires from 500 EV users through stratified random sampling. Collected data was analysed through regression models, to determine the relationship between demographic variables and user satisfaction levels. Findings showed that satisfaction was 78% for users aged 20–35, 81% for high-income users with home charging, and 76% for users with a university degree, while users over 50 showed only 52% satisfaction. The study concludes that user satisfaction with EV charging infrastructure is greatly influenced by demographic characteristics. In order to customise services that satisfy the various needs of EV customers, regulators and infrastructure developers must have a thorough understanding of these variations. Recommendations include improving accessibility and information sharing to serve consumers from all demographic groups, as well as strengthening safety elements at charging stations, particularly to address issues brought up by female users.

Singh et al. (2020) conducted a meta-analysis of factors influencing adoption of electric vehicles Globally. It sought to synthesize existing research to understand the key determinants of EV adoption. Plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) were taken into consideration for this study. The main source of data collection was secondary source through 211 Peer-reviewed journals and articles within the time period of 2009 to 2019. Data was analysed through categorization and trend analysis. The main key factors were analysed includes Demographic (Age, income, education), Situational (Charging infrastructure, driving range), Contextual (Government policies, environmental concerns) and Psychological (Attitudes, perceptions, social influence). The findings showed that Age, income, and education level significantly influence EV adoption intentions and government incentives (highlighted in over 70% of studies), environmental concern (65%), and infrastructure availability (62%). Psychological factors like social influence and positive attitudes also significantly impacted consumer behavior across multiple regions. The study concludes by recommending that policymakers and the automobile industry should focus on these factors to increase EV adoption rates.

Meet et al. (2025) carried out a study comparing Ahmedabad City's EV and petrol vehicle owners' satisfaction levels. This study focuses on important aspects like performance, fuel economy, maintenance expenses, environmental issues, and the availability of infrastructure. This study also considers Demographic variables like Consumers' age, income bracket, educational background, and level of environmental consciousness. Data was collected from EV and petrol vehicle owners with the help of structured questionnaires regarding their satisfaction level. In-depth interviews were also conducted with a select group of consumers to obtain qualitative insights. Statistical

analysis technique was used to compare satisfaction levels across different groups. The results show that other criteria like cost-effectiveness, convenience, and infrastructure availability have a greater influence on consumer choices than age, which has a little impact on satisfaction levels. The study concludes that as age and satisfaction are not strongly correlated, EV marketing tactics should target a wider range of demographics and pragmatic factors like cost, convenience, and long-term savings rather than just age.

Siregar et al. (2024) explored Battery Electric Vehicle User Satisfaction: Moving Jakarta towards Green Transportation. The research aimed to identify key factors influencing user satisfaction and provide insights for enhancing BEV adoption in the region. Data was collected through structured questionnaire from 30 respondents. Data was analysed using Weighted Average Method and Factor Analysis to identify key factors influencing satisfaction. Findings showed that through Likert scale the overall satisfaction score was 4.38 out of 5, with highest ratings for environmental sustainability (4.37) and government policy (4.35), while charging location scored lowest at 3.67. The study concludes that users are broadly satisfied especially due to eco-friendliness and supportive policies, improving charging infrastructure remains critical to enhancing the overall user experience.

2.1 Research Gap

A review of the existing literature on electric vehicle (EV) adoption reveals several significant gaps that this present study aims to address:

Geographical and Contextual Bias: The preponderance of existing research on EV adoption in India is heavily concentrated on tier-1 "megacities" such as Delhi, Mumbai, and Bangalore. There is a conspicuous scarcity of empirical, region-specific studies focusing on tier-2 industrial and urban centers like Ludhiana. These cities possess unique economic structures, demographic profiles, pollution challenges, and infrastructural limitations that prevent the direct application of findings from larger metropolitan areas.

Lack of Vehicle Segment Differentiation: Much of the academic literature, particularly from Western contexts, treats "EVs" as a monolithic category, often defaulting to four-wheeler passenger cars. In the Indian market, and specifically in a city like Ludhiana, the electric two-wheeler and three-wheeler segments are critical components of the mobility ecosystem. A significant gap exists in understanding the distinct behavioral drivers, information sources, and adoption barriers specific to these different, high-volume vehicle categories.

Insufficient Integration of Information Channels and Behavioral Factors: While separate streams of research have identified key behavioral factors (e.g., environmental concern, technological trust) and key information sources (e.g., social media, word-of-mouth), there is a notable lack of research that integrates these two concepts. Few studies have empirically investigated how the most dominant information channels (as identified in Table 1) directly influence the formation and relative importance of the core psychological factors (as identified in Table 2).

Focus on Pre-Adoption over Post-Adoption: The bulk of consumer behavior research is concentrated on pre-adoption factors, such as purchase intention, awareness, and perceived barriers. There is a comparative lack of localized, post-purchase studies in the Indian context that analyze the actual user experience, satisfaction levels, and lived challenges of early EV adopters. This gap obscures the critical feedback loop from existing users to potential adopters.

Limited Linkage to Demographic and Psychographic Variables: Many studies provide a generalized list of adoption drivers and barriers but fail to adequately segment these findings across essential demographic variables (e.g., age, income, education) or psychographic profiles (e.g., tech-savviness, environmental consciousness). A deeper understanding is needed of how the relative importance of factors like environmental concern, technological confidence, and social influence shifts across different consumer profiles within a specific urban population.

3. Research Methodology

3.1 Need and Significance of the Study

Growing Importance of Sustainable Mobility: The increasing environmental challenges, depletion of fossil fuels, and urban pollution have necessitated a shift from conventional fuel-based vehicles to electric mobility solutions.

Low Penetration of Electric Vehicles in Punjab: Despite government initiatives such as the FAME II Scheme, electric vehicles constitute only around 0.26% of total registered vehicles in Punjab, indicating a slow rate of adoption.

Emerging EV Market in Ludhiana: As Punjab's industrial capital, Ludhiana has witnessed the registration of over 60,000 electric vehicles, with nearly 80% of these registered in the last three years. However, the adoption rate remains uneven due to multiple behavioral and infrastructural barriers.

Lack of Regional Consumer Behaviour Studies: Existing research on electric vehicles in India often focuses on metropolitan areas. There is limited empirical evidence exploring consumer attitudes, perceptions, and behavioral drivers specific to semi-urban industrial centers like Ludhiana.

Bridging the Gap between Awareness and Adoption: Many consumers are aware of EV benefits but remain hesitant to purchase due to misinformation, cost perceptions, and performance uncertainties. Hence, there is a need to study how awareness translates into actual purchase intention.

Academic Contribution: The study adds to the existing body of knowledge on consumer behavior, environmental psychology, and sustainable mobility, providing empirical evidence from a regional Indian context.

Policy Implications: Findings will aid government authorities and policymakers in framing effective communication strategies, awareness campaigns, and incentive structures to accelerate EV adoption.

Support for Local Urban Planning: The research outcomes can assist Ludhiana Municipal Corporation and other local bodies in developing infrastructure such as EV charging stations and promoting sustainable urban transport.

Contribution to Sustainable Development Goals (SDGs): By promoting EV adoption, the study aligns with India's commitment to reducing carbon emissions and achieving the UN Sustainable Development Goals related to climate action and sustainable cities.

Foundation for Future Research: The findings of this study provide a framework for further academic exploration into consumer psychology, green marketing, and electric mobility adoption in other regions of India.

3.2 Objectives

To determine the primary determinants of consumer behaviour in Ludhiana with regard to the adoption of electric vehicles.

To investigate how customer knowledge and attitudes towards electric vehicles are shaped by different information sources.

To examine the difficulties in implementing electric vehicles.

3.3 Research Design

This study follows a descriptive and analytical research design. The descriptive aspect focuses on describing the current level of awareness, attitudes, and perceptions of consumers regarding electric vehicles (EVs) in Ludhiana. The analytical aspect involves identifying the underlying behavioural factors influencing consumer adoption and examining the role of various information sources through statistical analysis such as Weighted Average Score (WAS) and Exploratory Factor Analysis (EFA).

3.4 Scope of the Study

The study focuses on consumers residing in Ludhiana, Punjab, and examines their behavior, perceptions, and awareness regarding electric vehicles. The scope is limited to four-wheeler and two-wheeler electric vehicles available in the market. The research emphasizes behavioral and informational aspects rather than technical or mechanical attributes of EVs.

3.5 Collection of data

Primary data were collected through a structured questionnaire, consisting of both closed-ended and Likert scale questions. The questionnaire was divided into four sections: Demographic Profile – age, gender, income, occupation, education, etc. Behavioral Factors – environmental concern, technological perception and social concern. Information Sources – influence of social media, advertising, and interpersonal communication. Purchase Intention – willingness to adopt EVs, satisfaction, and future

purchase plans. The data were collected personally and through online forms over a two-month period.

Secondary data were obtained from: Academic journals, research papers, and dissertations; Government and policy reports (e.g., NITI Aayog, Ministry of Heavy Industries); Industry publications and EV market reports; Online EV databases and media articles related to Punjab and Ludhiana.

3.5 Sampling Method

Sampling Technique: Time and accessibility constraints led to the adoption of convenience sampling. The selection of respondents was based on their desire to participate and availability. **Sample Unit:** residents of Amritsar who are electric vehicle owners, users, or plan to buy one.

3.6 Statistical Tools and Techniques

The collected data was analyzed using both simple and advanced statistical tools to meet the objectives of the study effectively.

1. **Simple Statistical Tools.** To summarize and interpret the primary data collected from respondents, simple tools were employed such as: Percentages and Frequencies: To describe respondent characteristics, awareness levels, and behavioral patterns toward electric vehicles. Weighted Average Score (WAS): To rank factors influencing consumer behavior (such as price, charging infrastructure, environmental concern, and technological trust) according to their relative importance. These tools helped in presenting a clear and concise picture of respondents' opinions and preferences.

2. **Advanced Statistical Tools.** To gain deeper analytical insights, advanced statistical techniques were also used: Exploratory Factor Analysis (EFA): To identify the underlying dimensions influencing consumer behavior toward electric vehicles and to reduce a large set of observed variables into fewer, interpretable factors. All analyses were conducted using SPSS software, ensuring accuracy, reliability, and validity of results.

3. **Significance of the Tools Used.** The combination of simple descriptive and advanced inferential techniques enabled the researcher to: Accurately interpret consumer perceptions toward EV adoption in Ludhiana; Identify statistically significant factors affecting purchase decisions; Draw practical conclusions beneficial for EV manufacturers, policymakers, and urban planners.

3.7 Reliability and Validity of the Instrument

Reliability: Cronbach's Alpha coefficient was calculated for each construct, with values exceeding the acceptable threshold of 0.70, indicating strong reliability. **Validity:** Content validity was ensured by consulting academic experts and reviewing existing literature. Construct validity was verified through factor analysis.

4. Results and discussion

4.1 Role of Various Information Sources on Level of Awareness among Consumers Regarding Electric Vehicles in Ludhiana

4.1.1 Application of weighted average score (WAS)

The following table presents the Weighted Average Scores (WAS) calculated to assess the influence of various information sources on consumer awareness about Electric Vehicles (EVs) in Ludhiana. Respondents ranked 11 different sources based on their perceived importance in shaping awareness.

Table 1: Showing Awareness Level of Consumers

Information Source	1 (1)	2 (1)	3 (9)	4 (8)	5 (7)	6 (6)	7 (5)	8 (4)	9 (3)	10 (2)	11 (1)	Tot al	W AS	RK
Mobile(text messages)	25	54	38	35	41	24	26	54	38	60	55	450	250 3	5.56 22
EV news magazine	46	64	43	41	45	30	43	26	26	34	52	450	288 3	6.40 67
Salesperson	34	44	34	43	40	49	54	47	53	43	9	450	275 3	6.11 78
Family/friends	57	29	41	45	43	56	45	19	34	49	32	450	282 4	6.27 56
Television	30	52	34	55	40	43	30	57	41	39	29	450	273 6	6.08 00
Radio	44	22	26	56	17	43	41	24	36	56	85	450	236	5.24

													1	67
Social Media	40	44	46	53	44	43	65	37	23	22	33	450	2903	6.4511
Posters	41	26	36	47	44	42	37	49	43	46	39	450	2617	5.8156
Newspapers	49	34	50	31	55	39	46	35	60	23	28	450	2825	6.2778
Dealership & Test-drive Events	44	31	21	23	41	39	32	71	43	58	47	450	2426	5.3911
Reference Groups	40	50	81	21	40	42	31	31	53	20	41	450	2886	6.4133
Total	450	450	450	450	450	450	450	450	450	450	450			
	0	0	0	0	0	0	0	0	0	0	0			

(Source: Researcher's own compilation)

4.1.2 Interpretation

Rank 1: Social Media (WAS: 6.4511): This emerges as the single most dominant source for EV awareness. It indicates that platforms such as Facebook, Instagram, YouTube, and Twitter are the primary channels where consumers are first encountering information, seeing user reviews, and being exposed to targeted advertising about EVs. Its top rank underscores a significant shift in how information is consumed, moving from passive, top-down media to interactive, peer-driven networks.

Rank 2: Reference Groups (WAS: 6.4133): Ranking a very close second, "Reference Groups" (which include professional networks, community forums, or groups one aspires to join) highlights the powerful role of social influence. This suggests that consumer awareness is not just built individually but is heavily shaped by the opinions and discussions within their social and professional circles.

Rank 3: EV news magazine (WAS: 6.4067): The high ranking of a specialized media source indicates that a significant segment of the consumer base is actively seeking in-depth, credible information. This is likely a high-involvement group that goes beyond casual awareness to understand the technology, new models, and policy changes.

Rank 4: Newspapers (WAS: 6.2778): Despite the rise of digital media, newspapers maintain a strong position as a trusted source of information. This suggests that formal advertisements, automotive sections, and news articles in print media are still highly effective for building credible awareness.

Rank 5: Family/ friends (WAS: 6.2756): Almost identical in score to newspapers, this confirms the critical importance of word-of-mouth. Information from family and friends carries a high degree of trust, making these personal conversations a powerful channel for shaping perceptions and validating information found elsewhere.

Rank 6: Salesperson (WAS: 6.1178): The salesperson at a dealership ranks in the middle. This source is more likely to be influential during the consideration or purchase phase rather than the initial awareness phase. By the time a consumer speaks to a salesperson, their foundational awareness has likely already been built by other sources.

Rank 7: Television (WAS: 6.0800): As a traditional mass-media channel, television's moderate rank suggests it serves as a broad-based awareness tool but is less targeted or influential than the top-tier digital and social channels.

Rank 8: Posters (WAS: 5.8156): Out-of-home advertising, such as billboards and posters, has a comparatively minor impact on building initial awareness for a high-consideration product like an EV.

Rank 9: Mobile (text messages) (WAS: 5.5622): Direct SMS marketing is ranked as a very ineffective channel. This is likely perceived by consumers as intrusive or "spam," leading to it being ignored.

Rank 10: Dealership & Test-drive Events (WAS: 5.3911): This is a crucial finding. Like the salesperson, test-drive events are critically important for the final decision but are not a primary source of initial awareness. Consumers seek out test drives after their awareness and interest have already been piqued by social media, news, or peer groups.

Rank 11: Radio (WAS: 5.2467): Radio is the least effective awareness-building channel in this study. This indicates that for a complex, visual, and technology-driven product like an EV, audio-only media has the lowest penetration and impact on consumer consciousness.

4.1.3 Practical Implications

For Marketers and Manufacturers:

Invest in integrated social media campaigns featuring local influencers, customer stories, and interactive ads.

Encourage peer referrals and reward existing EV owners for advocacy.

Improve dealership engagement by combining physical test drives with digital outreach.

Use EV-specific magazines and online forums for in-depth information dissemination.

For Policymakers:

Partner with media houses and online platforms to spread awareness about government incentives and charging infrastructure.

Combine traditional channels (radio/newspaper) with targeted digital promotions for maximum reach.

4.2 Application of exploratory factor analysis

The primary objective is to use the Exploratory Factor Analysis (EFA) technique to evaluate and group the key variables (statements) that influence the level of awareness, perception, and intention to adopt Electric Vehicles (EVs) among consumers in Ludhiana, Punjab.

4.2.1 Extraction of Factors

The fundamental features of various information sources were ascertained through the application of Exploratory Factor Analysis. Using a Likert scale with a maximum score of five and a range from strongly disagrees to strongly agree, the respondents were asked to rank ten different factors. As it can be seen from Table 2, all components with loadings more than 0.5 were considered good. In the particular situation, loadings ranged from .741 to .878. Items that had loading factors below 0.5 were excluded. The Eigen values of the three resultant factors range from 1.117 to 5.429, as shown in Table 2.

Table 2: Factor Analysis Results for Electric Vehicles

Statements	F1	F2	F3
I prefer electric vehicles because they help in reducing air pollution.	.890		
I am concerned about the harmful effects of fuel-based vehicles on the environment.	.888		
I support the shift	.874		

toward sustainable
and clean mobility
solutions.

Environmental .856
benefits play a major
role in my decision to
purchase an EV.

I believe EVs require .847
less maintenance due
to their advanced
technology.

I am confident in the .844
long-term
performance and
battery life of electric
vehicles.

Electric vehicles are .821
technologically
advanced compared to
conventional vehicles.

My family and friends .842
encourage me to
consider purchasing
an electric vehicle.

Owning an EV .823
improves my social
image and reflects a
modern lifestyle.

Positive word of .786
mouth about EVs
affects my awareness

and interest.

Eigen Value	5.429	1.540	1.117
% Variance	54.290	15.702	11.167
Cumulative Variance	% 54.290	69.992	81.159
Scale Alpha (Cronbach's Alpha)	Reliability .941	.884	.826

Cronbach's Alpha = .895, Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .880, Bartlett's Test of Sphericity (Approx Chi-Square) = 3345.707, DF = 45, Sig. = .000, Mean = 36.99

Environmental Factor (F1)

The first extracted factor, identified as the Environmental Factor, exhibited the highest Eigen value of 5.429 and explained 54.29 percent of the total variance, indicating that it is the most influential dimension shaping consumer awareness toward electric vehicles in Ludhiana. The items with high loadings (ranging from .856 to .890) reflect consumers' strong concern for environmental protection and their belief that electric vehicles contribute to reducing air pollution and promoting sustainable mobility. Respondents expressed agreement that the ecological benefits of EVs significantly influence their purchase decisions. This demonstrates that environmental consciousness is deeply embedded in consumer behavior, aligning with global sustainability trends where individuals increasingly prioritize green alternatives to mitigate the negative effects of conventional fuel-based transportation.

Technological Factor (F2)

The second factor, named the Technological Factor, obtained an Eigen value of 1.540 and accounted for 15.70 percent of the total variance. The loadings for this factor ranged between .821 and .847, showing high internal consistency with a Cronbach's alpha of 0.884. This factor captures consumers' perceptions of electric vehicles as technologically advanced, reliable, and efficient. Respondents acknowledged that EVs require less maintenance due to modern engineering and are confident in their long-term battery performance and durability. The findings suggest that technological trust plays a critical role in awareness formation and purchase intention, as consumers evaluate the practicality, innovation, and dependability of EV technology before adoption. Hence, technological confidence acts as a bridge between curiosity and actual buying behavior.

Social Factor (F3)

The third factor, termed the Social Factor, yielded an Eigen value of 1.117 and explained 11.17 percent of the total variance. With factor loadings between .786 and .842 and a Cronbach's alpha of 0.826, this dimension highlights the influence of interpersonal communication and social image on consumer awareness of electric vehicles. Respondents agreed that encouragement from family and friends, as well as the perception of EVs as a modern and prestigious choice, significantly affects their level of interest and awareness. Moreover, positive word-of-mouth and peer recommendations act as persuasive tools in shaping attitudes toward EV adoption. This indicates that EV awareness in Ludhiana is not only shaped by personal evaluation but also by social validation, where collective opinions and social prestige strongly influence individual decision-making.

4.3 To analyze the challenges related to the adoption of electric vehicles in Ludhiana

4.3.1 High Initial Cost of Electric Vehicles

One of the most prominent challenges in the adoption of electric vehicles (EVs) in Ludhiana is their high upfront cost compared to conventional petrol and diesel vehicles. The primary reason behind this price gap lies in the expensive lithium-ion battery technology, which accounts for a significant share of the vehicle's total cost. Although EVs offer lower running and maintenance costs in the long term, the higher initial investment discourages middle-income consumers from purchasing them. Studies from NITI Aayog and SIAM (2023) indicate price sensitivity as a major deterrent.

4.3.2 Lack of Charging Infrastructure

A major infrastructural barrier is the limited availability of public charging stations across Ludhiana. The shortage of charging points contributes to "range anxiety" among potential users, as they fear running out of battery power during travel. According to the Ministry of Power (2024), Punjab has less than one public charger per 100 EVs, which severely limits convenience and practicality for EV users. The absence of fast-charging facilities and inadequate coordination between municipal authorities and private service providers further worsen the problem.

4.3.3. Battery Performance and Replacement Concerns

Battery-related issues, such as uncertainty about performance, durability, and replacement costs, also act as deterrents to EV adoption. Consumers are often concerned about the long-term efficiency of batteries and the high expense involved in replacing them after a few years of use. Moreover, secondary data from TERI (2023) indicate that the lack of proper battery recycling and disposal mechanisms adds to environmental and economic concerns, reducing consumer confidence in the technology.

4.3.4 Low Consumer Awareness and Information Gaps

Another crucial challenge is the limited awareness among consumers regarding EV benefits, available models, government incentives, and maintenance requirements. Many potential buyers in Ludhiana remain unfamiliar with financial subsidies, tax rebates, and state-level incentives under the Punjab Electric Vehicle Policy (2022). The lack of targeted awareness campaigns and limited visibility of EV success stories contribute to the slow pace of adoption.

4.3.5 Inadequate After-Sales Service and Technical Support

The unavailability of trained technicians and specialized service centers in Ludhiana presents a significant operational challenge. Many automobile workshops and dealerships are not yet equipped to handle EV-specific repairs or maintenance. As noted in FADA's (2023) industry report, this lack of technical readiness makes consumers hesitant to invest in EVs, fearing post-purchase complications and delays in service.

4.3.6 Policy Implementation and Procedural Challenges

Although the Punjab government introduced the Punjab Electric Vehicle Policy (2022) with various incentives, the ground-level implementation remains limited. Consumers often face procedural hurdles in availing of subsidies, tax exemptions, or registration benefits. The complexity and lack of clarity in the policy's communication reduce its effectiveness in encouraging adoption.

4.3.7 Long Charging Time and Practical Inconvenience

Another technical limitation is the long time required to fully charge an electric vehicle compared to the quick refueling of petrol or diesel vehicles. This poses a major inconvenience, especially for individuals who depend on their vehicles for daily commuting or commercial use. The absence of rapid charging infrastructure further adds to this inconvenience, making EVs less suitable for users seeking flexibility and efficiency.

5. Findings

5.1 Factors Influencing Consumer Behaviour

Environmental concern emerged as the most dominant factor (Eigen value = 5.429), explaining 54.29% of total variance.

Technological trust and social influence followed, contributing 15.70% and 11.17% variance respectively, confirming their significant role in EV adoption.

5.2 Role of Information Sources on Awareness

Social media (WAS = 6.44) and reference groups (WAS = 6.42) were the most impactful awareness channels.

Traditional media like TV and newspapers still contributed moderately, while SMS and radio had minimal impact.

5.3 Challenges to EV Adoption (Secondary Data)

Major barriers identified include high initial cost, inadequate charging infrastructure, limited driving range, and battery replacement issues.

Lack of awareness about government subsidies and incentives further restricts adoption in Ludhiana.

6. Conclusion

The research concludes that consumers in Ludhiana are showing a positive inclination toward electric mobility, driven largely by environmental consciousness and growing technological trust. However, this inclination does not always translate into purchase decisions due to persistent challenges in infrastructure, affordability, and awareness.

To promote higher adoption rates, policymakers, automobile manufacturers, and local authorities need to collaborate in improving charging infrastructure, enhancing public awareness campaigns, and making EVs more financially accessible. Social media and peer networks can serve as powerful tools in promoting behavioral change and strengthening consumer confidence.

Overall, the study emphasizes that a balanced approach addressing both psychological motivations and practical constraints will be essential to achieving sustainable EV adoption and advancing Ludhiana's transition toward green mobility.

References

- Axsen, J., & Kurani, K. S. (2008). The Early U.S. Market for PHEVs: Anticipating Consumer Awareness, Recharge Potential, Design Priorities and Energy Impacts.
- Lee, K., Moon, S., & Lee, J. (2021). Demographic influence on user satisfaction with electric vehicle charging. *Transportation Research Part D: Transport and Environment*, 91, 102709.
- Meet, P., Alka, P., & Vidani, J. (2025). A Comparative Study on Consumer Satisfaction Regarding EV vs Petrol Vehicle Owners in Ahmedabad City. *International Journal of Applied Research and Sustainable Sciences*, 3(1), 113-132.
- Singh, V., Singh, V., & Vaibhav, S. (2020). A review and simple meta-analysis of factors influencing adoption of electric vehicles. *Transportation Research Part D-Transport and Environment*, 86, 102436. <https://doi.org/10.1016/J.TRD.2020.102436>

Siregar, A., Astari, F. I., Maharani, N. F. R., Lazuardy, A., Nurcahyo, R., & Habiburrahman, M. (2024). Analysis of User Satisfaction with Battery Electric Vehicles: Toward Green Transportation in Jakarta. 1178–1182. <https://doi.org/10.1109/icetsis61505.2024.10459567>