

## Unpacking India's EV Transition: A Study on Consumer Perspectives, Adoption Constraints, and Fuel Cost Dynamics

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### Abstract:

India's shift to EVs is gradually gaining momentum, but consumer related issues still remain. The research has been aimed at understanding what drives EV sales by emphasising on consumer perceptions, barriers to EV adoption and the impact of a rise in fuel prices. Applying a mixed method research framework consisting of descriptive statistics and correlation analysis, the research investigates key factors like affordability, charging infrastructure, range anxiety etc. The results provide insights into the behavioural and economic barriers to mass adoption along with examining how Indian consumers perceive the concept of EVs. It also provides a correlation of rising fuel prices and EV sales in India.

**Keywords:** Electric Vehicles (EVs), Consumer Perceptions, Barriers, EV Adoption, Fuel Prices, EV Sales

### Introduction

The automotive sector is witnessing a profound change, with electric vehicles (EVs) gradually replacing internal combustion engine vehicles (ICEVs) across the globe. Many countries have declared ambitious deadlines to ban ICEVs, with Norway and the Netherlands taking the lead by prohibiting their sale from 2025, to be followed by India in 2030, France and the UK in 2040. This transformation is fueled by the pressing imperative to address climate change, given that the transportation industry continues to be the second-largest emitter of carbon in the world, accounting for close to 24% of global CO<sub>2</sub> emissions. Conventional vehicles are a major cause of global warming and environmental air pollution. All types of vehicles produce dust from brakes, tires, and road wear. The average diesel vehicle has a worse effect on air quality than the average gasoline vehicle. But both gasoline and diesel vehicles pollute more than electric vehicles (Neupane et al., 2023).

The transportation sector stands at a critical juncture in the transition towards sustainable mobility solutions. This transformation is characterized by the gradual displacement of internal combustion engine vehicles (ICEVs) by electric vehicles (EVs), driven by mounting environmental concerns and technological advancements.

Public acceptance continues to be the key driver of successful market penetration of electric vehicles (EVs), and there is a need for extensive research into consumer attitudes and adoption challenges. Indian urban centers such as Delhi and Kolkata have shown initial success, with more than 1 million electric rickshaws combined, as evident indicators of the economic (30-40% lower operating cost) and environmental advantages of EVs. This mass adoption is increasingly affecting private car buyers, though issues such as range anxiety, high initial expenses, and lack of charging points remain. In 2023, electric vehicle sales in India saw a significant increase of 49.25%, reaching 1.52 million units. Although the sector is still in its early stages, it is steadily gaining traction. According to Fortune Business Insights, the Indian EV market is forecasted to expand from US\$ 3.21 billion in 2022 to US\$ 113.99 billion by 2029, with a 66.52% CAGR.

This research bridges this gap by rigorously exploring the psychological and situational drivers of EV acceptance. Aiming specifically at the Indian market, our study seeks to: 1) Consumer Perceptions of EVs (2) Barriers to EV adoption and (3) Impact of fuel prices on EV sales.

## **Literature Review:**

A lot of research with respect to the growth of the EV sector in India has emerged and continues to emerge. The EV industry in India is at a key turning point, sitting between bold sustainability objectives and infrastructure, consumer adoption, and policy framework realities. India, being the third largest automobile market, needs to undertake the shift to electric vehicle mobility from an environmental, economic, and geopolitical perspective. In addition to government subsidies, developments in technology, and increased recognition of sustainability, the EV sector faces other major challenges such as: high adoption costs, insufficient charging infrastructure, and consumer doubt.

## **Consumer Perceptions:**

Electric vehicles are being seen as a promising potential solution to the growing environmental problems, especially air pollution in urban Indian cities (Chandra Prakash Rao et al., 2023). This has given a rise to both demand and consequently sales. With an increase in consumers there is a clear rise in the various perceptions that consumers may have about EVs. Majority of Indian consumers believe that EVs are environmentally friendly but at the same time come with a heftier price tag compared to traditional vehicles (Gupta et al., 2024).

While most consumers do understand the environmental benefits along with the benefits provided to EV buyers by the government, they also agree that India is still not ready for a major shift towards EV due to technological and infrastructure issues such as lack of charging stations, range anxiety, higher cost and charging time (Thomas Varghese et al., 2021).

## **Barriers to EV Adoption:**

India is still a growing market when it comes to EVs and there is a long way to go due to the various technological and infrastructural issues and these give rise to numerous barriers when it comes to purchasing EVs. (Dhankhar et al., 2024) identifies barriers to be of 4 types, (i) physical, (ii) technological, (iii) financial and (iv) policy. Technological factors exert the most significant impact on EV adoption, and major barriers in this category are their limited driving range and lengthy charging time (Pamidimukkala et al., 2024). The battery packs of an electric vehicle are expensive, and it also needs replacement more than once in its lifetime making most gas-powered cars comparatively cheaper (Goel et al., 2021). The government

should allocate significant resources to the research and development of battery technology and the expansion of charging infrastructures to reduce uncertainties and consumers' anxiety of using EVs thus enhancing the growth of this sector in India even further. (Pamidimukkala et al., 2023).

## **Impact of Fuel Prices on EVs:**

Fuel prices in India have been on a steep rise given the various global and domestic factors having a direct impact on it. India happens to be the third largest importer of crude oil globally but the current trend in the price rise may propel Indian consumers to consider alternatives and move more towards EVs, however the only thing stopping this seems to be range anxiety and battery charging issues (Ashok et al., 2023).

## **Research Problem:**

This study aims to evaluate how EV sales are impacted due to factors such as consumer perceptions, barriers to EV adoption and the impact of rising fuel prices.

## **Research Objectives:**

- (i) To study the consumer perceptions of EVs in India.

- (ii) To evaluate the various barriers that exist when it comes to EV adoption in India.
- (iii) To study the impact of rising fuel prices on EV sales in India.

### **Research Methodology-**

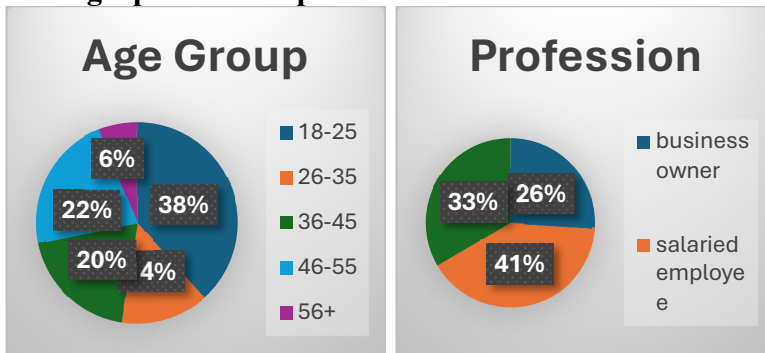
In order to identify the factors affecting the EV sales in India, this study has employed a conclusive research design with a cross-sectional approach. The quantitative nature of the study is represented through the statistical techniques applied to analyse the three objectives. The primary data collection method was used to gain an understanding of how people perceive EVs in India and was gathered using an online survey conducted via Google Forms and distributed through social media platforms and WhatsApp groups. Secondary data was used to analyse the barriers affecting sales of EVs and impact of fuel prices on sales of EVs.

The survey collected a variety of data, including some demographic details from the respondents, such as their age and profession. Perception of EVs was measured using multiple choice questions and a five-point Likert scale. A total of 227 responses were collected from users, potential users and non-users of EVs. The collected responses were systematically coded to run the tests. For familiarity, the options- 1)Very familiar, 2)Familiar, 3)Somewhat familiar and 4)Not familiar at all were coded as 4,3,2,1 respectively. To compare the EVs with petrol/diesel cars, the options- 1)Superior, 2)comparable and 3)inferior were coded as 3,2,1 respectively. For trust, the options- 1)Complete trust 2)Neutral and 3)Distrust were coded as 3,2,1 respectively. Descriptive statistics and correlation test were used to analyse the data. While this procedure may not yield a fully representative sample, it provided valuable insight of how Indians perceive EVs.

Correlation test was performed to analyse the objective of impact of fuel prices on EVs. This test helped to indicate the relationship between fuel prices and sales of EVs in the Indian market. Dematel test was performed to analyse which barrier according to the Indian consumers was ranked the highest and stopped the consumers from buying an EV. The researchers utilised Microsoft Excel for preliminary data planning and statistical analysis, including descriptive statistics, correlation and dematel.

### **Findings:**

#### **Demographics of Respondents:**



#### **Consumer Perceptions of EVs:**

To analyze this, the researchers used a variety of descriptive statistic methods with a combination of correlation and regression for some variables.

The survey conducted for the purpose of the study captures the sentiment of 227 respondents who are cautiously optimistic about electric vehicles (EVs) but have differing opinions. Respondents moderately rated the ESG impact of EVs at 3.58 which shows some optimism, however, with a standard deviation of 1.10 there some respondents are clearly sceptical

(min: 1) and others overly confident (max: 5). Trust in EV safety features rests at neutral to 3.13 while confidence in these features shows even greater divergence (SD: 1.07). Performance is viewed as similar to petrol/diesel vehicles (mean: 2) with low divergence (SD: 0.65) which shows agreement. EVs performance in cost effectiveness scores 3.13, revealing moderate but spread out agreement (SD: 1.09). Range anxiety is significantly worrying with a mean of 3.61 and with mode 4 and SD 1.16 shows how concerning this is to people. The probability of next buying an EV rests at neutral waiting for a score of 3.03 but high divergence (SD: 1.29) shows mixed feelings. Preference of Indian brands like Tata and Mahindra hover around moderately high of 3.37 at a mode of 4, bolstered by scepticism (SD: 1.22). EV's dominance take a score of 3.11 depicting little hope but moderate agreement (SD: 1.01). General awareness about EVs is placed at a reasonable 3.01 with most respondents being somewhat familiar with these vehicles (S.D. 0.90). Trust in manufacturers' claims is low at 1.88, leaning toward neutrality with slight distrust and tight clustering (SD: 0.51). Overall, respondents are familiar and see potential in EVs but are held back by concerns like range anxiety, cost, and trust, with confidence intervals (e.g., 2.86-3.20 for purchase likelihood) reinforcing these mixed sentiments.

The perception and attitude that respondent have regarding the Electric Vehicles (EVs) is captured in the correlation analysis of the data collected.

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	<i>On a scale of 1 to 5, what do you think the environmental impact of EVs has been?</i>	<i>On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?</i>
On a scale of 1 to 5, what do you think the environmental impact of EVs has been?	1	
On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?	0.268261927	1

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The data reveals that the respondents regard the effect EVs have on the environment positively and this aspect was rated highly by most. This indicates that there is an understanding that EVs do a better job at emission and pollution reductions in comparison to the traditional vehicles with internal combustion engines. A sense of appreciation as well as understanding the environmental advantages is what the high ratings depicts.

However, when it comes to the likelihood of purchasing an EV as the next vehicle, the responses varied, but there was a significant inclination towards higher ratings. Which means a moderate to high adoption interest exists considering the responses. Those anticipating making the decision are likely to have found the appeal of advanced environmentally friendly technology EVs, concern for environment, and makes them save money on fuel. The data suggests there are positive indicators but, like other prospective buyers, EV purchasers are not devoid of serious thoughts that they need to take into their consideration.

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	<i>On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?</i>	<i>On a scale of 1 to 5, how cost effective do you think EVs are?</i>
On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?	1	

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On a scale of 1 to 5, how cost effective do you think EVs are? 1  
 0.390920398

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Regarding the cost-effectiveness of EVs, it is clear that people had differing views. Some respondents, in particular, appeared to have a more positive view, responding towards the favourable side of the scale. This mixed perception can likely explain the higher initial investment required to purchase EVs as compared to conventional vehicles and the savings in running and maintenance expenses. While some respondents regard EVs as cost-effective investments over time, several others remain cautious with the capitalization outlay and the state of charging infrastructure available.

	<i>On a scale of 1 to 5, how likely do you think EVs are to dominate the Indian automobile market?</i>	<i>On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?</i>
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On a scale of 1 to 5, how likely do you think EVs are to dominate the Indian automobile market?	1	
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On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?	0.402859491	1
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It is also noteworthy that respondents feel that EVs will be the most preferred type of automobile in India in the years to come. A lot of respondents marked this trait quite high, showing that they are positive towards the adoption and expansion of EV’s in India. This is most likely fuelled by enhanced awareness of climate change, strong government support, and the ongoing development of technology and infrastructure for EVs.

	<i>On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?</i>	<i>On a scale of 1 to 5 how confident are you in the safety features of EVs compared to traditional vehicles?</i>
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On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?	1	
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On a scale of 1 to 5 how confident are you in the safety features of EVs compared to traditional vehicles?	0.276088608	1
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Users are generally confident in the safety features of EVs compared to conventional vehicles, this trust is essential for the transition to EVs due to the safety concerns that many consumers have. The positive evaluations indicate that manufacturers are addressing safety issues which further increases consumers’ confidence.

*On a scale of 1 to 5, how concerned are you about range anxiety (the fear of running out of battery before reaching a charging station) as a potential EV consumer?*

*On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle?*

On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle? 1

On a scale of 1 to 5, how concerned are you about range anxiety (the fear of running out of battery before reaching a charging station) as a potential EV consumer? 0.042417865 1

Range anxiety, or the fear of running out of battery before reaching a charging station, remains a concern among respondents, but it is not overwhelmingly dominant. The responses were spread across the scale, indicating that while range anxiety is a barrier to EV adoption, it is not the primary concern for most respondents. This suggests that improvements in battery technology and the expansion of charging infrastructure could further alleviate these concerns and encourage more people to consider EVs.

**Barriers to EV Adoption:**

Degree of prominence and net causal effect					
	R + C	Prominenc	R - C	Causal	Cause /
B <sub>1</sub>	1.47	7	0.45	3	C
B <sub>2</sub>	1.41	10	0.39	5	C
B <sub>3</sub>	1.51	6	0.25	7	C
B <sub>4</sub>	1.55	5	0.23	8	C
B <sub>5</sub>	0.69	23	0.11	14	C
B <sub>6</sub>	1.05	13	0.07	13	C
B <sub>7</sub>	1.43	8	0.25	6	C
B <sub>8</sub>	1.26	12	0.82	1	C
B <sub>9</sub>	0.94	16	0.08	12	C
B <sub>10</sub>	1.73	3	-1.01	24	E
B <sub>11</sub>	1.70	4	-0.96	23	E
B <sub>12</sub>	1.82	1	-1.24	25	E
B <sub>13</sub>	1.58	9	-0.52	22	E
B <sub>14</sub>	0.97	14	0.09	15	C
B <sub>15</sub>	0.91	17	-0.27	21	E
B <sub>16</sub>	1.70	2	0.58	2	C
B <sub>17</sub>	1.28	11	0.08	16	C
B <sub>18</sub>	0.68	24	0.04	17	C
B <sub>19</sub>	0.78	21	0.16	10	C
B <sub>20</sub>	0.63	25	0.15	11	C
B <sub>21</sub>	0.76	22	0.04	18	C
B <sub>22</sub>	0.94	15	0.40	4	C
B <sub>23</sub>	0.93	18	-0.09	19	E
B <sub>24</sub>	0.84	19	-0.14	20	E
B <sub>25</sub>	0.79	20	0.23	9	C

This table represents the degree of prominence and net casual effect of various barriers B1 to B25 to the adoption of electric vehicles in India by using the DEMATLE (DECISION MAKING TRIAL AND EVALUATION LABORATORY) which is a popular Multi Criteria Decision - Making Technique. In addition to identify the barriers' overall importance within the system, this analysis assists in classifying the barriers into cause - which is the driving factors and effect -which is the influence factors while also determining their overall significance within the system. Based upon the prominence Ri + Ci (global) scores, the barriers are ranked as follows: Family factor(B12), low confidence and electric vehicle(B16),social barriers as most of the consumers are not early adapters(B10), absence of social influence(B1), lack of human capital who can support repair and maintenance (B4), lack of supportive infrastructure facilities(B3), lack of repair and maintenance centres (B1), inability to handle failures during a journey( B7), lack of convenience for consumers(B 13) insufficient public charging stations, (B2), range

(B 17),uncertain policy or roadmap (B8),knowledge-technical and operational (B6),battery charging (B14), battery replacement cost (B22), lack of knowledge about battery hinders decision making (B9), easy availability of fossil fuels (B15), high maintenance cost (B23), uncertain resale value, (B 24),economic benefit is unclear (B25)insufficient incentives (B19)high initial cost (B21),high urban density as lack of space for Home charging points (B5), lack of promotion(B18), long waiting period (B20). Prominence represents the total interaction of a barrier with other barriers. A higher value and prominence indicate that the barrier is highly connected with the system. B12 i.e. family factors, has the highest prominence (score -1.82) which means it plays a crucial role in the EV adoption system. The inadequate faith in EV is due to the use of their emerging technology(B16), the social barriers, (B10) the lack of human capital to support the repair andmaintenance of EV (B4), and the lack of supporting infrastructure, (B3) were found to be the main obstacles to the purchases of EVs. Conversely, the barriers like (B20), (B5) and (B18) have the lowest prominence suggesting that they have comparatively lower impact on the purchase of EVs.

Two barriers mainly B4 and B3 out of the five top barriers are related to infrastructural aspects. Given that an EV cannot function without means of charging, these factors are vital for any buyer considering purchasing an EV. On the other hand, for the day-to-day maintenance of EV, repair and maintenance centres are equally necessary. The net casual effect (R-C) value helps in determining whether a barrier is a call (driving factor) or an effect (influenced factor). If  $R-C > 0$ , the barrier will be identified as a cause which indicates that it is strongly influences other factors. If  $R- C < 0$ , the barrier will be identified as an effect which indicates that it is primarily influenced by other barriers rather than acting as a driver. B6(0.58), B8 (0.82), and B1(0.45) are positive R - C values, depicting that they are major causes of the barriers to purchase an EV. These barriers could have a ripple effect, therefore, removing these might improve the area adoption in multiple areas. On the other hand, barriers like B12(-1.24), B10 (-1.01) and B 11(-0.96) have negative R – C values. This depicts that they are effect barriers. They are more dependent on other factors and get influenced rather than influencing. Policy makers and industry, leaders should focus first on mitigating the cause barriers because this will have the greatest impact on reducing the other barriers. Each barrier is assigned an influence score by the casual ranking. Higher values indicate a stronger influence over the system. The EV adoption landscape is significantly shaped by the strong barriers. B25 (Rank 9),B16 (Rank 2), and B22 (Rank 4).However, when it comes to casual influence, B12 (Rank 25), B13 (Rank22) and B10 (Rank 24)are among the lowest rank in terms of casual influence, indicating that they are more likely to rely on other factors than to be the driving force behind changes.

**Impact of Fuel Prices on EV Sales:**

	<i>sales</i>	<i>average yearly diesel prices</i>
sales	1	
average yearly diesel prices	0.71709274	1

To investigate the impact of rising fuel prices on the sales of Electric Vehicles (EVs), correlation analysis was done. The data used encompasses the fiscal periods of 2017 to 2023, including EV sales for each year and average diesel prices. The correlation analysis is performed and valuable answer to how fuel prices affect EV sales.

As the correlation coefficient shows, 0.7170 directly confirms the strong relationship between average diesel prices and EV sales not limiting to only EV sales but also indicating a positive sale for the Electric Vehicles. The sales will increase on a higher side with an increase in diesel prices.

Overall analysis has shown that increase in diesel prices proportionally increase the sales of EVs and this impact is statistically significant. Such strong results from correlational show that with the continued rise in fuel prices, there will be an increase in demand for electric vehicles, transforming them into an ideal type of vehicle for cost-conscious drivers.

## **Limitations:**

- a) **Time Limitation:** The study is based on consumer data solely collected in March 2025.
- b) **Demographic:** The study is based on a sample of 227 respondents residing in urban cities and not the census of the entire population making it difficult to generalize the findings.
- c) **Possibility of Bias:** The sampling method used is that of convenience non-probability sampling making selection bias possible.
- d) **Objective:** The research only emphasizes on consumer perceptions of EVs, barriers to EV adoption and the impact of fuel prices on EV sales thus isolating other factors that may have a significant impact.

## **Conclusion:**

All in all, it was found that increasing fears regarding the environment, higher fuel costs and greater consumer knowledge, is anticipated to drive, albeit varied, positive EV adoption. The shift to EV technology is still obstructed by various impediments related to policies, systems, and general trust in the public.

### **1. Consumer Attitude Towards EVs**

The results suggest that Indian consumers are knowledgeable about the positive impacts that EVs have on the environment and most of them showed reasonable hope about their growing popularity in the future. The barriers of range anxiety (mean: 3.61) and trust in the manufacturer (1.88) are still dominant problems. Even though there were mixed to positive responses regarding safety features, cost-effectiveness still remains controversial, as only 15.28% of purchase decisions are attributed to the given/ perceived price. Despite optimistic feelings, people have a "wait-and-watch" attitude, where they are expecting better advanced technical changes and government support before shifting.

### **2. Adoption Barriers Relating to EVs**

The DEMATEL study indicates the greatest obstacles are social problems, parental control and a deficiency in trust towards EVs. Issues to do with the infrastructure have a great deal of impact on the purchasing of EVs. This encompasses the absence of repair and service (B3, B4), the insufficient number of public charging facilities (B2), and the high costs of battery replacement (B22). Further, customers are discouraged by vague policies (B8) and insufficient policies to promote adoption (B19). As it stands, spending more in government aid funds and dealing with infrastructure problems is vital for increasing adoption rates.

### **3. The Impact of Fuel Costs on Sales of Electric Vehicles**

As previously stated, fuel costs drive the significant amount of variability in sales of electric vehicles. These insights demonstrate the need for economic reasons to drive the use of electric vehicles and suggest that the price of fuel is an important determining variable for growth in business.

While India's EV industry has significant growth potential, widespread adoption depends on overcoming infrastructure, policy, and consumer trust challenges. Expanding charging networks, reducing EV costs, and ensuring stable incentives are key. While high fuel prices may drive short-term adoption, long-term success requires structural reforms, including stable policies and robust infrastructure, rather than relying solely on economic factors.

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### Contributions:

Shreyash Shrivastava (B033): Literature Review, Findings for 2 objectives, Limitations, Research Problem, Research Objectives, Data Collection, Survey Circulation, Editing and Compiling.

Arijeet Singh (B008): Data Collection, Data Analysis, Survey Circulation, Editing.

Neetya Somaiya (B023): Abstract, Data Collection, Findings for 1 objective, Survey Circulation.

Saksham Suneja (B029): Introduction and Survey Circulation.

Khushal Wadhwa (B015): Conclusion and Survey Circulation.

### Appendix 1- Blank Questionnaire

The image shows a screenshot of a web-based questionnaire form. It contains two sections of radio button options. The first section is titled "What is your age group?" and includes five options: "18-25", "26-35", "36-45", "46-55", and "56+". The second section is titled "Gender" and includes three options: "Male", "Female", and "Prefer not to say". The form is presented in a clean, white interface with a light blue border.

What is your profession? \*

Student

Salaried Employee

Business Owner

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How familiar are you with the concept of EVs? \*

Very Familiar

Familiar

Somewhat Familiar

Not familiar at all

---

On a scale of 1 to 5, how likely are you to purchase an EV as your next vehicle? \*

1 2 3 4 5

Not likely      Very likely

---

How do you perceive EVs compared to petrol/diesel vehicles in terms of performance? \*

Superior

Comparable

Inferior

---

On a scale of 1 to 5, what do you think the environmental impact of EVs has been? \*

1 2 3 4 5

Highly Negative      Highly Positive

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On a scale of 1 to 5, how cost effective do you think EVs are? \*

1 2 3 4 5

Not cost effective      Very cost effective

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On a scale of 1 to 5 how likely are you to opt for Indian EV brands such as Tata, Mahindra, Ola Electric etc. \*

1 2 3 4 5

Not likely      Very likely

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On a scale of 1 to 5 how confident are you in the safety features of EVs compared to traditional vehicles? \*

1 2 3 4 5

Not confident      Very confident

On a scale of 1 to 5, how concerned are you about range anxiety (the fear of running out of battery before reaching a charging station) as a potential EV consumer? \*

1      2      3      4      5

Not at all likely                        Very likely

How much do you trust EV manufacturers and their claims on battery life and performance? \*

- Complete trust
- Neutral
- Disturb

On a scale of 1 to 5, how likely do you think EVs are to dominate the Indian automobile market? \*

1      2      3      4      5

Not likely                        Very likely

If you are an EV owner, what were some of your primary reasons for buying one? \*

- Environmental concern
- Cost savings
- Government incentives
- Peer influence
- Not an EV owner

What are the factors stopping you from purchasing EVs? \*

- High upfront cost
- Limited charging infrastructure
- Range anxiety (concern about battery running out)
- Limited model options compared to petrol/diesel vehicles
- Performance concerns
- Already own an EV