

GREEN WHEELS: INVESTIGATING CONSUMER ATTITUDES AND PREFERENCES TOWARDS ELECTRIC VEHICLES IN INDIA

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ABSTRACT

Electric cars are becoming increasingly popular in India due to their environmental benefits and cost-effectiveness in the long run. The interest in electric transportation infrastructure has been renewed because of the ecological impact of fossil fuel-based transportation infrastructure and rising oil prices. Concerns about energy security and fuel diversity in the transportation sector are addressed by electrifying transportation and streamlining the switch to sustainable energy. Electric vehicles (EVs) have excellent efficiency, minimal noise, and nearly zero carbon emissions, making them a promising technology for developing a sustainable transportation sector. EVs are a technology that holds promise for creating a sustainable transportation industry. Electric vehicles (EVs) are the future of transportation, and governments worldwide are pushing for faster adoption. However, despite governments introducing EV policies, the market adoption of EVs is relatively low. The paper will examine Indian consumers' purchasing patterns and opinions on electric cars. This study assesses customer perceptions of electric vehicles and their potential market in India.

Keywords: EV, India, consumer behavior, government initiatives, Sustainability

INTRODUCTION

Transportation is 98% reliant on fossil fuels, and changes in energy resources significantly impact it. However, rising concerns by people and lawmakers have accelerated the electrification of the transportation sector. An electric motor replaces an internal combustion engine in an electric vehicle (EV). Electric cars are the leading technology for reducing carbon emissions in road transportation, which generates 16% of all emissions worldwide. It is quieter and delivers a smoother ride because it lacks a clutch, gearbox, and even an exhaust pipe. However, sales have been sluggish because of higher purchasing costs and the unavailability of charging infrastructure.

The automotive business, which has existed for over a century, is preparing for change. The rising cost of fossil fuels and the damaging consequences of their emissions on the environment require changes in people's transportation patterns. Transportation powered by internal combustion engines gradually moves toward electric vehicles (EVs). Electric vehicles (EVs) are a new technology with enormous potential for a sustainable transportation sector in the future because of their extremely low to zero carbon emissions, low noise levels, and high efficiency. Electric Cars are the primary technology for decarb. Due to their extremely low to zero carbon emissions, minimal noise, and high efficiency, electric vehicles (EVs) are an emerging technology that holds great promise for a sustainable transportation industry in the future. However, due to high demands, the widespread use of EVs is anticipated to impact the current power infrastructures.

EVs are not widely available in the market or on the roads in India. Some potential EV buyers/users may never have seen, driven, or charged such cars. The public does not know the features of these cars widely. Even though some Indian businesses introduced electric cars and two-wheeled tricycles in the 1990s, they were unsuccessful and did not endure long. The Indian government strives to have all-electric vehicles by 2030, a sign that the nation is rapidly approaching a bright future.

By 2030, India's energy import bill is expected to double from about \$150 billion to \$300 billion. We must switch to EVs to decrease our reliance on energy imports from India. A practical solution to the intermittent issues related to renewable energies will result from the increase in sales of electric vehicles, which

will increase demand for electricity, particularly renewable energy.

METHODOLOGY

The researcher gathered the primary data used in this study. Microsoft Forms was used to collect data utilizing a targeted and random sample strategy from various sites in India, primarily significant cities. 335 participants in total—59 female, 275 male, and one who identified as "Others" participated in the study.

LITERATURE REVIEW

In recent years, some studies have been conducted on the development of EVs, some of which are included below. In their research, Ali, I., & Naushad, M. (2022) aimed to determine the critical factors influencing the adoption of electric vehicles. The sole dependent variable in this study is the adoption of electrified automobiles. The other independent elements are financial incentives, charging infrastructure, social reinforcement, environmental concerns, and price. Thakre, S., and S. Bhattacharyya (2021). The study's objective is to conduct an in-depth examination of the Indian EV ecosystem. The researchers found 11 critical factors that influence EV adoption in this study.

Investigated the factors that lead buyers of electric vehicles. They looked into the various factors that influence consumers' decisions when buying a car and found that on the one hand, cost, infrastructure, and social acceptance hurt purchasing an electric vehicle. In contrast, environmental concerns and consumer trust in technology are precursors for positive perception. et al. Bansal (2021) By examining the EV attributes and attitudes of Indian car buyers that impact their tastes for EVs, determining Indian consumers' willingness to pay (WTP) to buy EVs with improved features, and calculating how the reference dependence affects the WTP estimates, the study adds to the body of knowledge on EV demand in the Indian context.

Chawla, Udit, et al. (2023) This study looks at how environmental consciousness affects EV adoption and usage in light of ecosystem benefits and a shift in emphasis from "traditionally perceived usefulness" to "green perceived usefulness." Digalwar, A. K., & Rastogi, A. (2023) The current study helps manufacturers and decision-makers understand EVs' social acceptability and sustainability, pinpoints social determinants, concludes the findings, and encourages a quicker uptake of EVs. Chidambaram, K. et al. (2023), in their article, investigate the consumer influencers of electric vehicle demand and acceptance and barrier analysis based on their opinion.

Deb, K. Tammi(2019) states that India's market for electric vehicles (EVs) is growing. Construction of the infrastructure for charging EVs is crucial for their widespread adoption. This study formulates and resolves the challenge of planning the charging infrastructure for Guwahati, India, which is rapidly becoming a smart city. Jaiswal, D. (2021) To understand and predict consumers' intention to buy electric vehicles (EVs), the research aims to operationalize and test an improved version of the "Technology Acceptance Model" (TAM) that incorporates perceived risk and financial incentives policies. This method is based on the integrative theory of "beliefs-attitude-intention." The study model also intends to explore the moderating effects of financial incentive policies and the mediating functions of attitudes toward electric vehicles (EVs) in a burgeoning market for sustainable mobility. Jena (2020) used deep learning algorithms to investigate Indian customers' attitudes toward the adoption of EVs.

A study by Khurana A. et al. (2020) looks into the several factors that affect a consumer's decision to choose an electric vehicle. Indian respondents to the study are now car owners. The data was evaluated using structural equation modeling, or SEM. Attitude (ATT), a potent mediator, arises regarding adopting electric vehicles.

In their study, Tarei, P. K., Chand, P., & Gupta, H. (2021) examine the obstacles to EV adoption in India. The adoption of EVs is greatly influenced by EV hurdles, including range and performance, total cost of

ownership, lack of infrastructure for charging, and low customer knowledge of EV technology. Varghese, A. T., Abhilash, V. S., & Pillai, S. (2021). The primary objective of this study is to investigate the perceptions and purchase intentions of Indian consumers about electric vehicles. In 2022, Bryła, P., Chatterjee, S., & Ciabiada-Bryła, B. undertook a systematic assessment of the literature on electric cars. This review aims to thoroughly analyze the approaches, ideas, and variables applied in 57 peer-reviewed studies covering the primary modes of consumer adoption of electric vehicles (EVs) published between 2015 and 2022. These modes of adoption include purchase as well as behavioral and usage intentions. Table 1

ANALYSIS AND DISCUSSION

Table 1
PROFILE OF RESPONDENTS

Sr. No.	Age and Gender	Yearly Income	1 lakh -	Five lakhs -	Ten lakhs -	above 20 lakhs	Total
		under 1 lakh	5 lakhs	Five0 lakhs	20lakhs		
1	under 25	6	16	33	38	33	126
	Female	-	5	3	8	5	21
	Male	6	11	30	30	27	104
	Other	-	-	-	-	1	1
2	26 - 30	4	7	16	13	21	61
	Female	-	-	1	-	2	3
	Male	4	7	15	13	19	58
3	31 - 40	-	3	4	11	16	34
	Female	-	1	1	2	2	6
	Male	-	2	3	9	14	28
4	41 - 50	-	2	6	10	18	36
	Female	-	2	-	1	5	8
	Male	-	-	6	9	13	28
5	51 - 60	-	2	4	19	41	66
	Female	-	2	1	8	10	21
	Male	-	-	3	11	31	45
6	above 60	2	-	1	3	6	12
	Male	2	-	1	3	6	12
	Total	12	30	64	94	135	335

This section will discuss consumers' fundamental requirements and preferences when looking for a car.

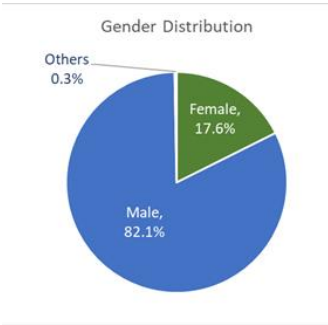


FIGURE 1
GENERAL DISTRIBUTION

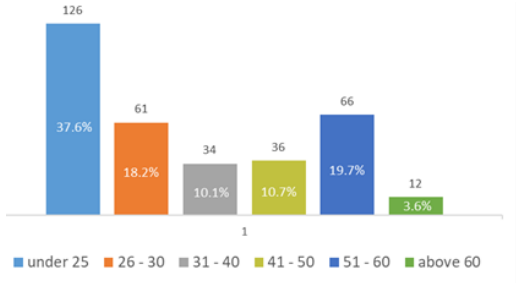


FIGURE 2
AGE DISTRIBUTION

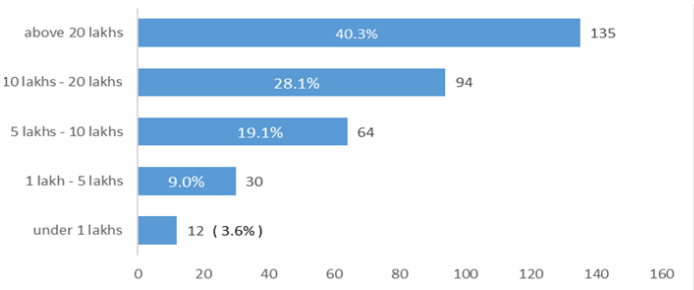


FIGURE 3
INCOME DISTRIBUTION

Types of cars they prefer

The first thing to consider is the type of vehicles that best meet their needs. The choices were from Hatchback, Sedan, Mini (Compact) SUV, Sports Car, and Others. Table 2

Table 2 TYPES OF CARS CONSUMER PREFER					
	Only 1 Preference	2 Preferences	Three or more Preferences	Total	%
Hatchback	18	33	25	76	14.Three%
Sedan	45	69	33	147	27.60%
Mini SUV	27	29	21	77	14.50%
SUV	82	71	31	184	34.60%
Sports Car	8	16	14	38	7.10%
Others	6	2	2	10	1.90%

Total	186	220	126	532	159
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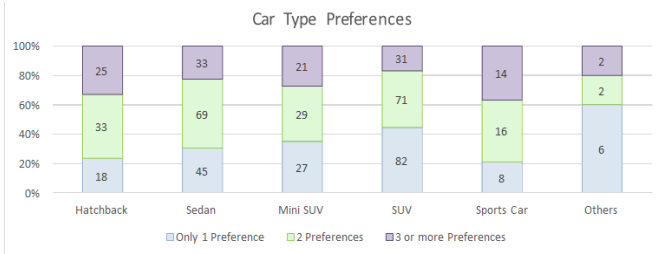


FIGURE 4
CAR TYPE PREFERENCES

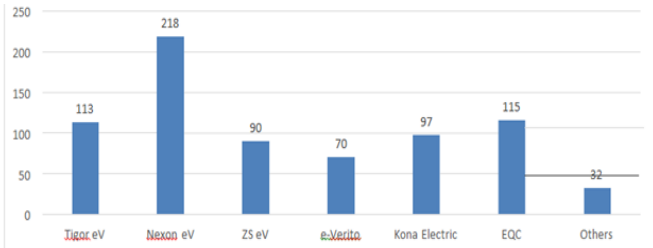


FIGURE 5
CAR MODELS

Early people wanted to buy a small compact car for congested Indian roads and sedans for the luxury feel. However, there has been a change in trend in recent times. From the responses, SUV is the most popular type of car preferred, followed by sedan. Among those who have only one preference, those who prefer only SUVs accounted for 44.1%. This shift in trend is because SUVs offer a better driving experience on rugged Indian roads and provide more safety. Sedans are still very famous for the same reason: they give a premium feeling Table 3.

The most common response in the other category was the Coupé, a mix of SUVs and Sedans. This was asked to understand their driving habits. Nowadays, many people prefer long drives to tourist locations on weekends Table 4.

Table 3 WHERE DO THEY EXPECT TO DRIVE THEIR VEHICLE?			
Sr. No.	Particulars	Responses	% of respondents
1	Off-Road	72	21.49%
2	Within City Limits	233	69.55%
3	Long Distances	267	79.70%
Average Number of choices selected per person:		1.71	

- I. Out of 267 people who prefer traveling Long Distances, 197 chose SUV or Mini SUV as their preferred type of car.
- II. Out of 233 people who want to drive Within City Limits, 139 chose a sedan or hatchback.
- III. Out of 72 people who want to drive Off-Road, 65 preferred SUV or Mini SUV.

Table 4 CAR MODELS THEY ARE AWARE OF AND WOULD CONSIDER BUYING				
Model	Company	Type	Awareness/Preference	%

Tigor EV	Tata Motors	Compact Sedan	113	33.70%
Nexon EV		Mini SUV	218	65.10%
ZS EV	MG Motors	SUV	90	26.90%
e-Verito	Mahindra	Sedan	70	20.90%
Kona Electric	Hyundai	Hatchback	97	29.00%
EQC	Mercedes Benz	SUV	115	34.30%
Others	NA	NA	32	9.60%
	Total	735	219%	

Tata Nexon and Mercedes EQC were the most following choices. The SUV and Mini SUV categories make up 57.6% of the total decisions Table 5.

Table 5 PREFERRED SOURCES OF INFORMATION			
Sr. No.	Particulars	Responses	% of respondents
1	Family and Friends	204	60.90%
2	Newspapers and Magazines	106	31.64%
3	Internet Sources	244	72.84%
4	Advertisements on TV	34	10.15%
5	Outdoor Advertisements	16	4.78%
6	Showroom Salesperson	64	19.10%
7	Other	18	5.37%
	Average Number of choices selected per person:	2.05	

On average, a person relies on at least two sources of information before purchasing an EV. Most of them want to do their research on the internet before buying a car and take input from their family and friends.

Opinion on Electric Cars

In this section, we will discuss people's opinions on Electric Cars and establish relations between why they would or would not consider buying an electric vehicle.

Electric cars are Environment Friendly

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) Strongly.

Nearly 38% disagree or Are neutral on this issue because emissions generated during the manufacture of electric vehicles tend to be higher than in traditional cars. This is due to the manufacture of lithium-ion batteries, which are crucial for electric cars.

However, the other 62% consider EVs a more environmentally friendly option because they produce fewer direct emissions than their IC engine counterparts, thereby contributing less to pollution and climate change. The emissions generated over the life of the vehicle are reduced.

Electric cars are more economical as compared to regular vehicles

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) strongly.

The cost of car operation is studied here. The cost of running an EV is almost 25%, and the maintenance cost is 60% of an IC engine car.

The price of Electric cars is high

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) Strongly.

The initial cost of EVs is very high, almost twice the price of their IC engine counterparts. For Example, an IC Engine Tata Tigor starts from Rs. 6L (ex-showroom price), whereas a Tigor EV starts from Rs. 12.5L (ex-showroom price). This is why 78.8% of people agree that the initial cost of Electriccars is high.

Among those who strongly disagreed (4), three earned above 20L, and one earned between 10 – 20 L. Among those who disagree (21), 16 earned above 10L.

The infrastructure surrounding electric cars is well-developed

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) strongly.

Most EV infrastructure involves Plug-in charging stations and Battery Swapping stations, the former being more essential for 4-wheelers. As per Central Electric Authority, there were 927 publiccharging stations in India as of June 2022. Most of these charging stations and significant highways/expressways are in major cities. This is not sufficient to support the mass adoption of EVs in India. India also lacks a standardized charging pin/connector for all vehicles, which adds to its woes. However, public charging stations (PCS) are de-licensed activities, and private players can participate, which is an advantage. Over 76% of people disagree that EV infrastructure is well developed precisely because of the reasons above. However, people have privatecharging stations in their homes and societies, which is helpful for users who want to drive within city limits over limited distances. All three people who strongly agreed to this wanted to drive their vehicles only within city limits.

Electric cars are safer than regular cars.

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) strongly.

There have been many cases of electric vehicles (primarily 2-wheelers) combusting in the Indian summer heat, which has raised concerns about the safety of electric cars. However, it was later cleared that to save money on batteries, the battery suppliers to OEMs compromised on the battery casing, which led to short circuits, eventually catching fire. The primary threat that they pose is the sparking of lithium-ion batteries. Otherwise, EVs have very high safety standards and are just as safe as their IC Engine counterparts. The responses would be based mainly on one's exposure to news and the surrounding facts. Most people were neutral and considered that IC and EV cars rank equally regarding safety. However, over 27% of people disagreed and considered EVs unsafe.

Factors that would encourage the purchase of an electric car

Establishing correlation to previous responses, we get the following:

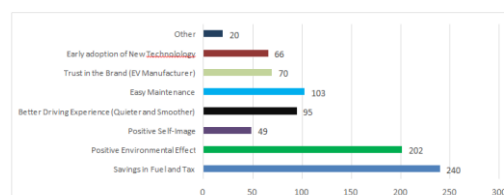


FIGURE 6
FACTORS THAT WOULD ENCOURAGE THE PURCHASE OF AN ELECTRIC CAR

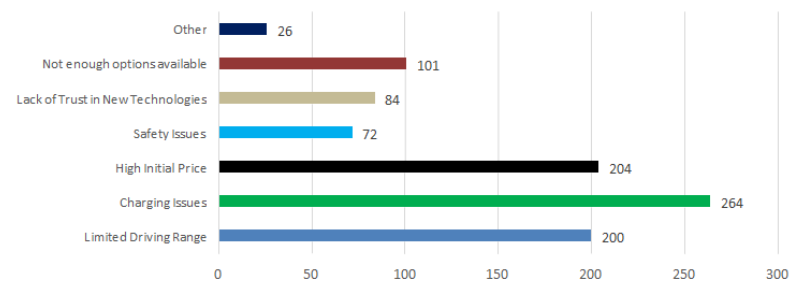


FIGURE 7
FACTORS THAT WOULD ENCOURAGE THE PURCHASE

Out of 240 responses in Savings in Fuel and Tax, 140 agreed (incl. strongly agree), 54 were neutral, and 46 disagreed (incl. strongly disagree) that EVs are more economical than regular cars.

Out of 202 responses in Positive Environmental Effect, 160 had agreed (incl. strongly agree), and 32 were neutral that EVs are environmentally friendly Table 6.

Out of 70 Trust in the Brand responses, 55 people chose Tata Motors, 35 from Mercedes, 26 from Hyundai, and 25 from Mahindra were among the top choices.

Out of 66 responses in early adoption of New Technology, 14 want to buy a car within two years, 25 from 2 - 5 years, 19 between 5 - 10 years, and four each in over ten years and no EV. This indicates how people inclined to adopt new technologies still consider EVs as not developed enough to be adopted so quickly.

Table 6 FACTORS THAT WOULD DISCOURAGE THE PURCHASE OF AN ELECTRIC CAR			
Sr. No.	Particulars	Responses	% of respondents
1	Limited Driving Range (Range Anxiety)	200	59.70%
2	Charging Issues	264	78.81%
3	Average Number of choices selected per person:	204	60.90%
4	Safety Issues	72	21.49%
5	Lack of Trust in New Technologies	84	25.07%
6	Not enough options are available	101	30.15%
7	Other	26	7.76%
	Average Number of choices selected per person:	2.84	

Establishing correlation to previous responses, we get the following:

Out of 200 responses in the Limited Driving Range, 170 wanted to drive their car over a long range.

Out of 264 responses in Charging Issues, 219 wanted to drive their car over a long range. Also, 213 disagreed (incl. strongly disagree) about the infrastructure surrounding electricity. Cars are well developed.

The options available in the market are pretty expensive, and there are insufficient options for every price range. For example, the sedan segment has the Tata Tigor EV, a compact sedan. This car starts from Rs. 12.5L (ex-showroom price), whereas one can get a proper sedan like the Maruti Suzuki Ciaz and Hyundai Verna for a similar price or lessor get a compact sedan for Rs. 6 – 7L.

On average, people had more reasons to discourage them from buying an electric car (2.84) than reasons that would encourage them (2.52) Table 7.

Table 7 HOW SOON WOULD THEY CONSIDER BUYING AN ELECTRIC CAR?	
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Sr.No.	Particulars	Responses	% of respondents
1	Within the next two years	56	16.72%
2	Next 2 to 5 years	120	35.82%
3	Next 5 to 10 years	102	30.45%
4	Over ten years	25	7.46%
5	Don't want to buy an electric car	32	9.55%

Over 80% of people who responded to the survey do not want to buy an electric car in the next two years by 2025. Primary reasons include low income, poor charging infrastructure, time-consuming charging, battery technology being new and needing development, and people being unsure of how long the life of an EV is.

Government Initiatives

The Government of India has developed several policies and initiatives to promote and support Electric Cars, such as the "National Electric Mobility Mission Plan (NEMMP)," "FAME-I and II," "National Mission for Transformative Mobility and Battery Manufacturing," the "Phased Manufacturing Program," "Advanced Chemistry Cell Production Linked Incentive Scheme."

The main incentive program to promote EV adoption is called "FAME (Faster Adoption and Manufacturing of Electric (and Hybrid Vehicles))." The government has suggested exempting battery-operated/electric vehicles from registration fees (exempted road tax). It provides incentives to EV buyers in the form of a decrease in the initial cost of the cars. The incentive is related to battery capacity, i.e., Rs 10,000 per kWh of battery capacity is reduced for 4-wheeler EVs (Rs. 15,000 for 2-wheelers). The incentive is capped at 20% of the cost of the vehicle.

Other benefits for passenger vehicles include:

GST on passenger electric vehicles is reduced from 12% to 5% (22% for commercial).

Electricity can be purchased as a "service" for charging EVs, per the Ministry of Power.

Is the Government supporting the transition to Electric vehicles

A 5-point Likert scale was used from Strongly Disagree (in red) to Agree (in green) Strongly Table 8.

While nearly 55.5% agree that the government supports the transition to EVs, the remaining 44.5% feel there is insufficient support or that there could be more support.

Table 8 LEVEL OF UNDERSTANDING ABOUT THE GOVERNMENT INITIATIVES TO PROMOTE ELECTRIC VEHICLES (LIKE SUBSIDIES, TAX BENEFITS, ETC.) – ON A SCALE OF 1 – 5	
Government Initiatives Understanding	# of People
1	25
2	42
3	126
4	100
5	42
Average	3.275

Comparing the responses in this table with the reactions on Likert scale before,

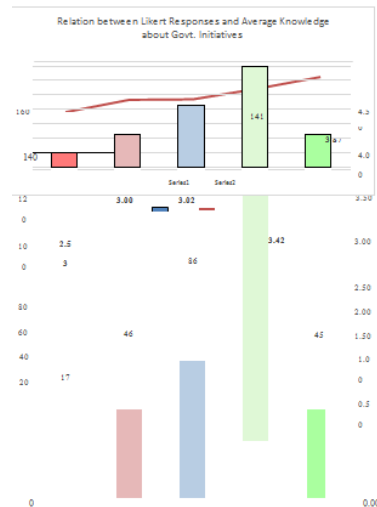


FIGURE 8

RELATION BETWEEN LIKERT RESPONSES AND AVERAGE KNOWLEDGE ABOUT GOVT. INITIATIVES

Bar ChArt represents Likert (Strongly Disagree to Agree Strongly), and the line chart indicates the average knowledge of the government—initiatives for people giving the following response.

CONCLUSION

The results of this study shed light on the key positive and negative variables that affect EV purchase decisions. While underdeveloped Charging Infrastructure and charging issues seemed to be the biggest obstacle, it was interesting to note that concerns about high initial cost and range anxiety were also addressed. Even those who can afford the expensive price tags are deterred from purchasing EVs at this point. Mass adoption among other consumers is only possible if the acquisition cost is reasonable compared to IC Engine cars and the surrounding infrastructure is developed.

The study also intended to study how much people know about the Government Initiatives that could help in the mass adoption of EVs. From the results, many people are unaware of the incentives provided by the Government, and most of these people strongly feel that there is no support from the government. These schemes and initiatives must be advertised publicly to facilitate the mass adoption of EVs in India. However, over 90% of the respondents will consider purchasing an EV in the future because of its low operational cost and positive environmental effect, which is a positive sign.

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Received: 21-Dec-2025, Manuscript No. AEJ-25-15613; **Editor assigned:** 24-Dec-2025, PreQC No. AEJ-25-15613 (PQ); **Reviewed:** 09-Jan-2025, QC No. AEJ-25-15613; **Revised:** 14-Jan-2025, Manuscript No. AEJ-25-15613 (R); **Published:** 21-Jan-2025