Electric Vehicles in India: A Boon for Transportation or a Challenge for Consumer

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Abstract— *India, like many nations, faces the dual challenge of increasing transportation demands and growing environmental concerns. In this context, electric vehicles (EVs) have emerged as a potential game-changer, promising a cleaner and more sustainable alternative to traditional fossil fuel-powered vehicles. This study explores perceptions and experiences of 30 electric vehicle (EV) users, focusing on socio-demographics, usage patterns, challenges and satisfaction. The sample was predominantly male (83.3%), with a balanced age distribution and a high proportion of private-sector employees. Most respondents owned electric two-wheelers, auto-rickshaws and cars, with over 40% using EVs for more than three years. Cost savings on fuel emerged as the primary motivation for EV adoption. While most users reported home charging as convenient, issues such as high initial costs, limited fast-charging infrastructure and range anxiety were noted. Respondents generally recognized EVs' environmental benefits and lower running costs. A majority expressed satisfaction with their EV experience and recommended them to others. The findings highlight the importance of enhancing affordability, technological reliability and policy support to accelerate EV adoption in India.*

Keywords— Electric Vehicles, Technology, Environment, Cost Effective, Government Policies.

I. INTRODUCTION

India, like several other countries, is grappling with rising transportation needs alongside escalating environmental issues. In this scenario, electric vehicles (EVs) have surfaced as a promising solution, offering a cleaner and more sustainable alternative to conventional fossil fuel driven transportation. With advancements in technology and growing public awareness, EVs are gaining momentum as a viable option for future mobility. Their adoption is further supported by government initiatives, financial incentives, and the increasing need to reduce carbon emissions and dependence on fossil fuels. EVs offer a multitude of potential benefits for India. They hold the promise of reducing air pollution in congested urban centers, decreasing the nation's reliance on imported oil and mitigating the effects of climate change.

1.1 Electric Vehicle Types:

1.1.1 Vehicles powered by batteries (BEVs):

Battery electric vehicles are full electric cars without an exhaust pipe, fuel storage or a petrol or diesel engine that run solely on electricity. They are also referred to as "plug-in electric vehicles (PEVs)" since they use an external charging outlet to charge the battery. BEVs come in a variety of forms, including electric vehicles, trucks many more.

1.1.2 Hybrid electric vehicle:

A hybrid electric vehicle improves fuel economy and operates at peak efficiency by producing far fewer emissions than a pure gasoline-powered vehicle. Additionally, plug in hybrid vehicles (PHEVs) exist. Even so, they make less noise than fully hybrid cars.

1.2 India's Battery Technology:

1.2.1 Lead-Acid Battery:

Most automakers choose to employ lead-acid battery technology in their cars because of its low cost and great efficiency, which lowers the vehicle's overall cost and increases customer profitability. Lead-acid batteries composition includes a number of environmentally hazardous chemical compounds. Researchers created novel batteries such as nickel-cadmium, nickel-metal hydride, sulphur-containing lithium, air containing lithium, lithium-ion, etc. to get around these drawbacks. However, scientists began employing.

1.2.2 Lithium-ion Battery:

Rechargeable batteries are made of lithium-ion material. Most electric vehicles in India and other nations utilise it because of its enormous capacity. Due to the high cost and weight of lithium-ion batteries, the price of electric vehicles rises.

1.2.3 Fuel Cell:

A fuel cell is an electrical device made up of an anode and a cathode. Fuel and oxide make up the majority of the fuel cell, which uses a redox reaction to produce energy. Fuel cells were employed by Korea for their e-buses, which had a positive effect on the auto sector. India also introduced a fuel cell-powered electric bus in 2018; it debuted in New Delhi.

1.3 Policy Initiatives:

1.3.1 FAME India Scheme: April 1, 2015

The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme provides financial incentives for EV buyers and manufacturers.

1.3.2 Battery Waste Management Rules, 2022

Mandates Extended Producer Responsibility (EPR), requiring manufacturers to take back used batteries and ensure their safe disposal or recycling.

1.3.3 PM E-Drive (Electric Drive Revolution in Innovative Vehicle Enhancement):

Launched in October 2024, this ₹10,900 crore scheme offers upfront purchase subsidies for electric two-wheelers, three-wheelers, buses, trucks, and ambulances. It also supports the development of EV charging infrastructure and aims to replace polluting vehicles with electric alternatives.

1.4 Disposal of lithium Iron batteries in India:

Over 90% of India's battery recycling occurs in the informal sector, using rudimentary techniques like open burning and acid leaching. These practices are harmful to workers' health and the environment. Companies like Attero Recycling and Lohum Cleantech are setting up advanced facilities for LIB recycling. These companies use environmentally friendly processes to extract valuable metals and ensure safe disposal of waste.

In Hisar, Haryana, notable electric vehicle brands include Zelio (Eeva ZX, Eeva, Gracy, Gracy i, Gracy Pro, Speed X), Elesco (Aqua, Big Show, Broch, Classic, Craze, Eroyal, Eroyal Pro, Etorq, Thunder), and YUKIE (specific model names not listed). In the electric three-wheeler segment, SKYRIDE is active, though specific model names are not detailed. While there are no electric four-wheeler manufacturers directly in Hisar, Haryana is home to brands like Mahindra Electric (e-Verito, e-Supro) and Okinawa (Ridge+, iPraise+, Praise Pro, Lite, R30, Okhi-90, Ridge100, Dual100).

II. MATERIAL AND METHODOLOGY

2.1 Locale of study:

For the study, one district from Haryana state were selected randomly for carrying out the research objectives.

2.2 Sample procedure:

30 people were purposively selected for the study who own electric vehicles from selected district. Results Table 1: Demographics Summary.

III. RESULTS

TABLE 1
DEMOGRAPHICS SUMMARY

Variable	Frequency (n)	Percentage (%)
Gender		
Male	25	83.30%
Female	5	16.70%
Age Group		
Below 25 years	8	26.70%
25-40 years	12	40%
Above 40	10	33.30%
Occupation		
Student	6	20%
Private Sector	17	56.60%
Government Employee	7	23.30%
Household Income		
Below ₹40,000	5	16.70%
₹40,000-₹80,000	12	40%
Above ₹80,000	13	43.30%
Type of EV Owned		
Electric Auto-rickshaw	10	33.30%
Electric Bike/Scooter	10	33.30%
Electric Car	10	33.30%

In table 1 showed that the study sample consisted of 30 respondents, predominantly male (83.3%) with a smaller proportion of females (16.7%). The age distribution was fairly balanced, with 26.7% below 25 years, 40% between 25–40 years, and 33.3% above 40 years. In terms of occupation, the majority were employed in the private sector (56.6%), followed by government employees (23.3%) and students (20%). Most respondents belonged to medium- to high-income households, with 40% earning between ₹40,000–₹80,000 and 43.3% earning above ₹80,000 per month. Electric vehicle ownership was evenly split, with 33.3% each owning an electric auto-rickshaw, an electric bike/scooter, and an electric car, providing a diverse perspective on EV usage across different vehicle types.

TABLE 2
EV OWNERSHIP AND USAGE

Variable	Frequency (n)	Percentage (%)
Duration of EV Ownership		
Less than 1 year	8	26.70%
1 year – 3 years	10	33.30%
More than 3 years	12	40.00%
Primary Reason for Purchase		
Environmental Concerns	9	30.00%
Cost Savings on Fuel	12	40.00%
Government Subsidy	6	20.00%
New Technology Enthusiast	3	10.00%
Frequency of Driving		
Daily	18	60.00%
2-3 times a week	10	33.30%
Occasionally (weekends)	2	6.70%
Charging Location		
Home Charging	25	83.30%
Public Charging Stations	2	6.60%
Workplace Charging	3	10.00%

Table 2 showed that the duration of EV ownership, the majority (40%) had been using their EVs for more than 3 years, followed by 33.3% who owned them for 1–3 years, and the lowest (26.7%) had less than 1 year of ownership. As for the primary reason for EV purchase, cost savings on fuel was the leading factor (40%), followed by environmental concerns (30%), government subsidies (20%), and the lowest (10%) were motivated by interest in new technology. In terms of driving frequency, most respondents (60%) drove their EVs daily, followed by 33.3% who drove 2–3 times a week, and the least (6.7%) used them occasionally on weekends. Among the 30 respondents, the majority (83.3%) reported charging their electric vehicles at home, followed by 10% who used workplace charging, and the lowest, 6.6%, relied on public charging stations.

TABLE 3
SUSTAINABLE TRANSPORTATION AND ENVIRONMENTAL BENEFITS

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	WMS
EVs reduce air pollution in India	2 (6.7%)	3 (10.0%)	6 (20%)	12 (40%)	7 (23.3%)	3.6 (III)
Lower carbon footprint with EV use	1 (3.3%)	1 (3.3%)	20 (66.6%)	3 (10.0%)	5 (16.7%)	3.3 (VI)
EVs combat climate change effectively	1 (3.3%)	4 (13.3%)	8 (26.7%)	11 (36.7%)	6 (20.0%)	3.5 (IV)
EVs reduce fossil fuel dependency	2 (6.7%)	1 (3.3%)	7 (23.3%)	14 (46.7%)	6 (20.0%)	3.7 (II)
EVs reduce noise pollution	1 (3.3%)	3 (10.0%)	4 (13.3%)	13 (43.3%)	9 (30.0%)	3.8 (I)
Government promotes EV adoption adequately	5 (16.7%)	7 (23.3%)	9 (3%)	6 (20.0%)	3 (10.0%)	2.8 (VII)
EVs help achieve India's sustainability goals	2 (6.7%)	4 (13.3%)	8 (26.7%)	12 (40.0%)	4 (13.3%)	3.4 (V)

Table 3 indicate generally positive perceptions toward electric vehicles (EVs) in terms of environmental benefits, though opinions vary across specific aspects. A majority (40%) agreed that EVs reduce air pollution in India, with 23.3% strongly agreeing, while only a small portion (6.7%) strongly disagreed. On the statement that EVs help reduce fossil fuel dependency, 46.7% agreed and 20% strongly agreed, making it one of the most supported views, with minimal disagreement. Similarly, the idea that EVs reduce noise pollution was supported by 43.3% agreeing and 30% strongly agreeing. However, the statement regarding EVs lowering carbon footprints received the highest neutrality (66.6%), suggesting uncertainty or lack of awareness, though 16.7% did strongly agree and 10.0% were agree. Regarding the role of EVs in combating climate change, 36.7% agreed and 20% strongly agreed, with limited disagreement. The statement on EVs supporting India's sustainability goals saw 40% agreement and 13.3% strong agreement, with 26.7% remaining neutral. In contrast, the government's role in promoting EV adoption was viewed more critically—only 20% agreed and 10% strongly agreed, while 40% either disagreed or strongly disagreed, indicating public skepticism about policy effectiveness.

TABLE 4
CHALLENGES IN EV ADOPTION

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	WMS
High initial EV cost	2 (6.7%)	4 (13.3%)	5 (16.7%)	12 (40%)	7 (23.3%)	3.6 (I)
Government subsidies make EVs affordable	3 (10.0%)	4 (13.3%)	13 (43.3%)	7 (23.3%)	3 (10.0%)	3.1(IV)
Difficulty finding suitable EV models	2 (6.7%)	3 (10%)	8 (26.7%)	11 (36.7%)	6 (20.0%)	3.5 (II)
Uncertain resale value of EVs	4 (13.3%)	5 (16.7%)	6 (20%)	10 (33.3%)	5 (16.7%)	3.2 (III)
Inadequate EV charging infrastructure	1 (3.3%)	3 (10.0%)	13 (43.3%)	7 (23.3%)	6 (20.0%)	3.5 (II)
Difficulty finding fast- charging stations	2 (6.7%)	3 (10.0%)	15 (50.0%)	6 (20.0%)	4 (13.3%)	3.2 (III)
Home charging facilities are convenient	2 (6.7%)	4 (13.3%)	6 (20.0%)	12 (40.0%)	6 (20.0%)	3.5 (II)

Table 4 reveal varying levels of agreement regarding the challenges and conveniences associated with electric vehicles (EVs). For the statement on high initial EV cost, the majority (40%) agreed, followed by 23.3% who strongly agreed, while the lowest (6.7%) strongly disagreed, indicating that cost is widely seen as a significant barrier. On whether government subsidies make EVs affordable, 43.3% remained neutral—the highest response—while the lowest (10%) strongly agreed or strongly disagreed, showing mixed sentiments. Regarding difficulty in finding suitable EV models, the majority (36.7%) agreed, followed by 26.7% who were neutral, while the lowest (6.7%) strongly disagreed. On the uncertainty of EV resale value, the highest proportion (33.3%) agreed, followed by 20% who were neutral, while the lowest (13.3%) strongly disagreed. Concerning inadequate charging infrastructure, 43.3% remained neutral—the majority—followed by 23.3% who agreed, and the least (3.3%) strongly disagreed, suggesting uncertainty or mixed experiences. For difficulty in finding fast-charging stations, 50% were neutral, the majority, followed by 20% who agreed, and the lowest (6.7%) strongly disagreed. Lastly, when asked about the convenience of home charging, the majority (40%) agreed, 20% strongly agreed, and the lowest (6.7%) strongly disagreed, reflecting overall positive sentiment toward home-based charging facilities.

TABLE 5
INFRASTRUCTURE AND CHARGING CHALLENGES

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	WMS
Experience range anxiety (fear of running out of charge) while driving an EV	3 (10.0%)	5 (16.7%)	6 (20.0%)	10 (33.3%)	6 (20.0%)	3.3 (II)
EV charging time is too long	2 (6.7%)	4 (13.3%)	7 (23.3%)	7 (23.3%)	11 (36.7%)	3.6 (I)
Charging costs are reasonable compared to fuel costs	4 (13.3%)	5 (16.7%)	6 (20.0%)	10 (33.3%)	5 (16.7%)	3.2 (III)
Lack of charging stations discourages long-distance travel	3 (10.0%)	4 (13.3%)	9 (30.0%)	8 (26.7%)	6 (20.0%)	3.3 (II)
EV maintenance costs are lower than fuel-based vehicles	2 (6.7%)	4 (13.3%)	5 (16.7%)	12 (40.0%)	7 (23.3%)	3.6 (I)
Battery replacement costs are a major concern for EV owners	4 (13.3%)	5 (16.7%)	8 (26.7%)	10 (33.3%)	3 (10.0%)	3.1 (IV)

Table 5 reflect diverse user experiences and concerns regarding the practicality and economics of electric vehicles (EVs). On the issue of range anxiety, the majority (33.3%) agreed they experience it, followed by 20% who were neutral or strongly agreed, while the lowest (10%) strongly disagreed. Regarding the statement that EV charging time is too long, the majority (36.7%) strongly agreed, followed by 23.3% who were neutral, and the lowest (6.7%) strongly disagreed, indicating that slow charging remains a concern for many users. On whether charging costs are reasonable compared to fuel costs, 33.3% agreed—the highest—followed by 20% neutral and 13.3% strongly disagreeing, showing that while many find charging economical, some remain unconvinced. Concerning the lack of charging stations discouraging long-distance travel, 30% remained neutral—the majority—followed by 26.7% agreeing, and the lowest (10%) strongly disagreed, reflecting moderate concern. On EV maintenance costs being lower than fuel-based vehicles, 40% agreed—the highest—followed by 23.3% strongly agreeing, while the lowest (6.7%) strongly disagreed, suggesting positive perceptions about maintenance savings. Finally, regarding battery replacement costs being a major concern, 33.3% agreed—the majority— followed by 26.7% neutral, and the lowest (10%) strongly agreed, showing it remains a financial worry for many owners.

TABLE 6
TECHNOLOGICAL AND PERFORMANCE CONCERNS

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	WMS
EV performance is satisfactory in extreme weather conditions (hot/cold)	4 (13.3%)	5 (16.7%)	9 (30.0%)	7 (23.3%)	5 (16.7%)	3.1 (IV)
Lack of trained mechanics for EV repairs is a problem	3 (10.0%)	5 (16.7%)	4 (13.3%)	14 (46.6%)	4 (13.3%)	3.3 (II)
I face issues with EV software updates and battery management	4 (13.3%)	5 (16.7%)	7 (23.3%)	9 (30.0%)	5 (16.7%)	3.2 (III)
EVs offer a comfortable and smooth driving experience	2 (6.7%)	6 (20.0%)	12 (40%)	4 (13.3%)	6 (20%)	3.2 (III)
I have experienced a significant reduction in running costs after switching to an EV	3 (10%)	5 (16.7%)	7 (23.3%)	11 (36.7%)	4 (13.3%)	3.2 (III)
The government should increase investment in EV charging infrastructure	2 (6.7%)	4 (13.3%)	5 (16.7%)	12 (40%)	7 (23.3%)	3.6 (I)

Table 6 highlight mixed perceptions regarding electric vehicle (EV) performance, support infrastructure and overall experience. For the statement on EV performance in extreme weather conditions, the majority (30%) remained neutral, followed by 23.3% who agreed, while the lowest (13.3%) strongly disagreed, indicating uncertainty or variable experiences. Regarding the trained mechanics for EV repairs, the highest proportion (46.6%) agreed. On issues with EV software updates and battery management, 30% agreed the majority followed by 23.3% who were neutral, and the lowest (13.3%) strongly disagreed. In terms of driving experience, 40% remained neutral the highest response followed by 20% who strongly agreed, while only 6.7% strongly disagreed, showing general satisfaction with EV driving comfort. For reduction in running costs after switching to EVs, 36.7% agreed the majority followed by 23.3% who were neutral, and the lowest (10%) strongly disagreed, indicating a largely positive cost-saving perception. Lastly, on whether the government should increase investment in EV charging infrastructure, the majority (40%) agreed, followed by 23.3% who strongly agreed, while the lowest (6.7%) strongly disagreed, highlighting strong public support for infrastructure development.

TABLE 7
POLICY AND AWARENESS ISSUES

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	WMS
Public awareness campaigns about EV benefits should be improved	2 (6.7%)	4 (13.3%)	5 (16.7%)	12 (40%)	7 (23.3%)	3.6 (III)
Financial incentives (subsidies, tax benefits) are crucial for increasing EV adoption	3 (1%)	5 (16.7%)	6 (20%)	6 (20%)	10 (33.3%)	3.5 (IV)
India is ready for a complete transition to electric mobility	4 (13.3%)	6 (20%)	8 (26.7%)	9 (30%)	3 (10%)	3.0 (VII)
The resale market for EVs needs improvement to make them more attractive	3 (10%)	5 (16.7%)	6 (20%)	11 (36.7%)	5 (16.7%)	3.3 (VI)
The government should introduce stricter policies to phase out petrol/diesel vehicles	2 (6.7%)	4 (13.3%)	10 (33.3%)	7 (23.3%)	7 (23.3%)	3.4 (V)
I would recommend an EV to my friends and family	1 (3.3%)	3 (1%)	5 (16.7%)	12 (40.0%)	9 (30.0%)	3.8 (I)
More automakers should invest in affordable EV models	2 (6.7%)	4 (13.3%)	6 (20.0%)	7 (23.3%)	11 (36.7%)	3.7 (II)
Despite challenges, I am satisfied with my decision to own an EV	3 (10%)	4 (13.3%)	6 (20.0%)	12 (40.0%)	5 (16.7%)	3.4 (V)

Table 7 reflect strong support for electric vehicle (EV) promotion, affordability, and user satisfaction, despite some challenges. For the statement that public awareness campaigns about EV benefits should be improved, the majority (40%) agreed, followed by 23.3% who strongly agreed, while the lowest (6.7%) strongly disagreed. Regarding the importance of financial incentives for EV adoption, 33.3% strongly agreed the highest followed by equal proportions (20%) who were neutral or agreed, and the lowest (10%) strongly disagreed. On whether India is ready for a complete transition to electric mobility, the majority (30%) agreed, followed by 26.7% who were neutral, and the lowest (10%) strongly agreed, indicating a cautious optimism. Concerning the resale market for EVs, 36.7% agreed the majority followed by 20% neutral, and 10% strongly disagreed, suggesting room for improvement in resale confidence. For stricter government policies to phase out petrol/diesel vehicles, agreement and strong agreement were equal at 23.3%, while the majority (33.3%) remained neutral and the lowest (6.7%) strongly disagreed. On recommending EVs to others, 40% agreed and 30% strongly agreed the highest while the lowest (3.3%) strongly disagreed, showing overall user satisfaction. Regarding investment by automakers in affordable EVs, the majority (36.7%) strongly agreed, followed by 23.3% who agreed, and the lowest (6.7%) strongly disagreed. Finally, despite challenges, 40% agreed and 16.7% strongly agreed that they are satisfied with their decision to own an EV, while only 10% strongly disagreed, highlighting positive ownership experiences overall.

IV. CONCLUSION

The study reveals a generally positive perception and growing acceptance of electric vehicles (EVs) among respondents, despite certain concerns. Environmental benefits such as reduced air and noise pollution, lower fossil fuel dependency, and alignment with sustainability goals received strong support. However, skepticism remains regarding the government's role in EV promotion and policy enforcement. Key challenges identified include high initial costs, inadequate charging infrastructure, slow charging times, and uncertain resale value, although home charging is viewed positively. Most respondents cited fuel cost savings as the primary motivator for EV purchase, with many using their EVs daily and charging at home. While range anxiety and battery replacement costs remain concerns, maintenance costs and driving experience are generally viewed favorably. Mixed responses were noted about software updates and performance in extreme weather. Respondents strongly endorsed the

need for increased government investment in charging infrastructure, public awareness, and affordability through subsidies. Overall, while barriers persist, user satisfaction and willingness to recommend EVs reflect a favorable shift in public attitude, signaling the potential for broader EV adoption in India with the right policy and infrastructural support.

RECOMMENDATION

- Government should continue and expand financial incentives (subsidies, tax breaks) to make EVs more accessible.
- Develop mechanisms or policies that can stabilize and improve the resale value of EVs, potentially through battery health standards or buy-back programs.

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