# A STUDY ON PROSPECTS OF ELECTRIC VEHICLE IN INDIA

Project reports

Submitted for the partial fulfilment of the

Bachelor degree (Hons.) In Statistics


**Under the supervision of** :

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# CERTIFICATE

This is to certify that the data given in this report has been collected, tabulated, analyzed, and presented by "Jaya Bharadwaj" student of B.A. VI semester, Statistics (hons.).
The title of the project is "*A Study on Prospects of Electric Vehicles in India.*" This project has been completed successfully under my supervision and guidance in the session 2023-2024.

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# ACKNOWLEDGEMENT

I express my sincere gratitude to Dr. Abhimanyu Singh Yadav and all other professors in Statistics Department of Banaras Hindu University for the constant encouragement and support throughout project work. The phenomenal support and style of advice from my guide has helped me a lot to exemplify the needs of the project and to cater out my enquiries as well.

I shall be failing in my duty if I don't express my sincere thanks and gratitude to the respondents who were very cooperative and were kind enough to give some of their valuable time to fill in the questionnaire.

I also thank my brother Shubham Bharadwaj and batchmate Manami Das for their invaluable support and suggestions which they delivered whenever I felt the need.

Again, I want to say my sincere thanks to my supervisor and Head of Department, Department of Statistics, for providing facilities existing in the dept. during my project work.

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# ABSTRACT

Over the years, the exploitation and pollution of natural resources have created the need for renewable and environment-friendly products. One of these products is Electric Vehicles. Electric Vehicles are the replacement for conventional fossil fuel-based vehicles. They are one of the emerging technologies as well as eco-friendly and viable. The transition from internal combustion engines to electric engines promises a significant reduction in pollution and presents a profitable option for consumers. Numerous countries around the globe have adopted this technology and are actively contributing towards preservation of the environment. India, as a nation has a lot of potential and scope in this field. Through this project, we aim to explore the opportunities and challenges associated with implementing electric vehicles in India.

In this survey, in total 150 individuals of different age groups, different family background, with varying educational and economic background have participated from different parts of Varanasi through offline questionnaire filling.

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# CHAPTER 1:

# INTRODUCTION TO ELECTRIC VEHICLES

# 1.1 INTRODUCTION

With the current depletion of fossil fuels and its price hike, there is a need for another energy resource to run the vehicle. The automobile sector is considering Electric Vehicle as a solution to the industry and environment in India. Electric Vehicles are the replacement for petroleum-based vehicles. They are one of the emerging technologies as well as eco-friendly and viable. There is zero emission in these vehicles. Many countries around the globe have implemented this technology and are contributing towards preservation of the environment.

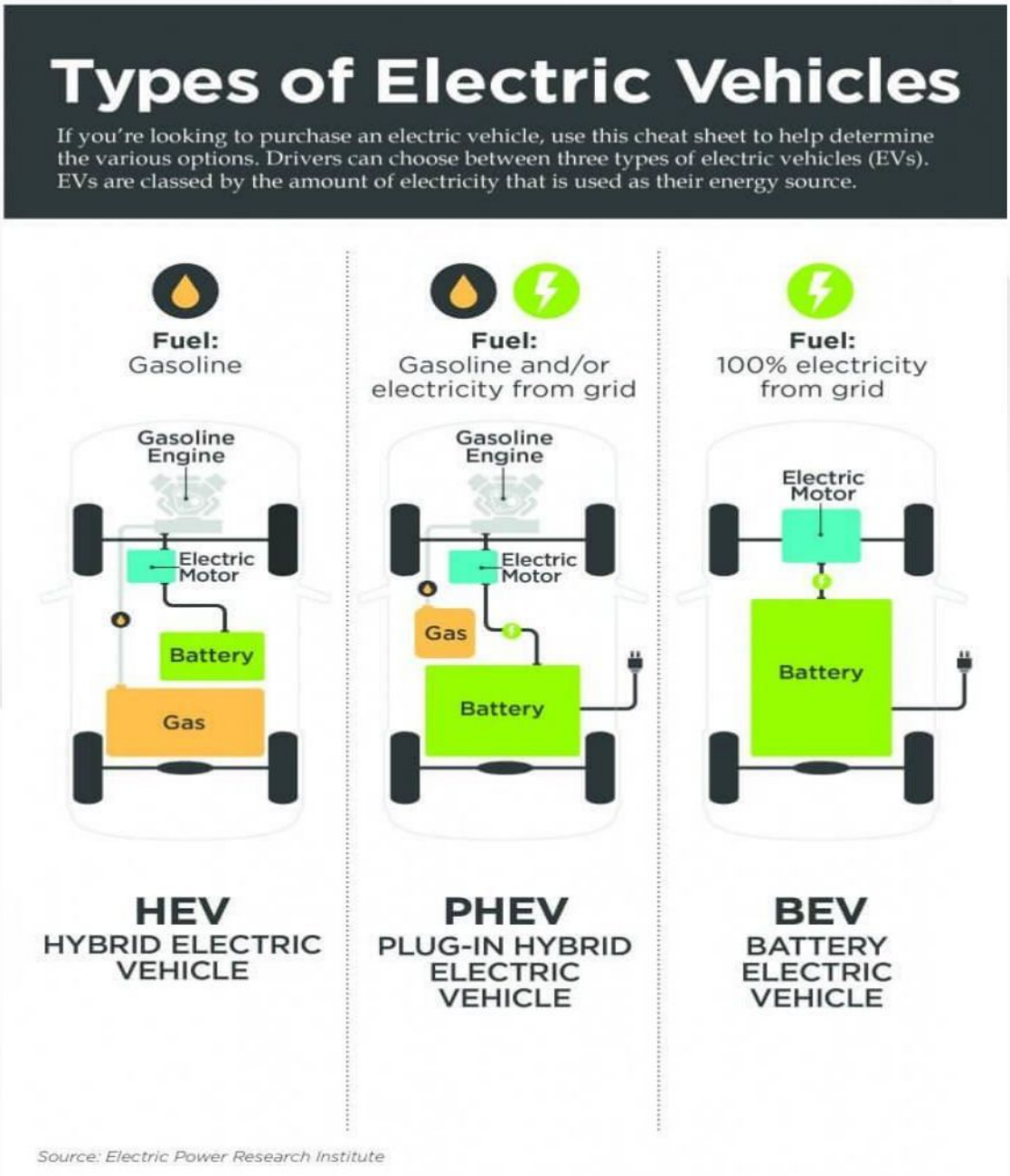


Figure 1

# 1.2 TYPES OF ELECTRIC VEHICLES

## 1. Battery Electric Vehicle (BEV)

- These are the ones which you call a fully electric vehicle. This electric vehicle type does not contain any other source of actuation other than motors and batteries. There is zero emission in these vehicles. The battery is charged through an external source of power such as DC fast chargers or AC chargers. On average, the BEVs take around 8 hours to get fully charged using an AC charger. This time can be reduced to 1 hour using a DC fast charger. These electric vehicles have a range from 250kms to 500kms depending upon the battery capacity and the motor.
- Some of the 4-wheeler BEVs in India are Tata Nexon EV, Hyundai Kona Electric, Mahindra eKUV100, MG ZS EV and more. 2-wheeler BEVs in India include Ather 450, TVS iQube, Bajaj Chetak Electric.

## 2. Hybrid Electric Vehicle (HEV)

- These types of electric vehicles are powered by both fuel as well as electricity. The electricity is generated by the vehicle's own braking system. The heat produced by the brakes is converted into electrical energy. This process of conversion is called Regenerative Braking. The electric motor is used to start off the HEVs. Then the propulsion is taken care of by the IC engine. This ensures better fuel economy. The operation of the engine as well as the motor is controlled by the ECU.
- Some HEVs in India are Toyota Prius Hybrid, Honda Civic Hybrid and Toyota Camry Hybrid. Maruti Suzuki recently introduced its hybrid system in a few models too.

## 3. Plug-in Hybrid Electric Vehicle (PHEV)

- These are types of hybrid electric vehicles which can recharge the batteries through regenerative braking or through the external source of power. The HEVs travel about 3-4kms before the engine is switched on, PHEVs can go up to 65kms before the engine provides the required assistance for the propulsion of the vehicle.
- Some PHEVs in India are Mahindra e-Verito, BMW i8 and the Volvo XC90 T8

# 1.3 OPPORTUNITIES OF ELECTRIC VEHICLES

### 1.Environment Friendly

EVs are less polluting, as they have zero exhaust emissions. If you opt to use renewable energy to charge your EV, you can reduce greenhouse gas emissions even more. Some EVs are made of eco-friendly materials such as the Ford Focus Electric, which is made of recycled and bio-based materials and the Nissan Leaf, which is partly made of recycled plastic bottles, old car parts and secondhand appliances.

### 2. Cheaper to operate

EVs are cheaper to operate since they have high efficiencies and fuel economies thereby reduce cost for the owner. The electricity to charge an EV is about one third as much per kilometer to purchase fuel for vehicle.

### 3. Cheaper to maintain

BEVs have fewer moving parts than those had by conventional combustion engine vehicles. There is less servicing and no expensive systems such as fuel injection and exhaust systems, which are not needed in an EV. PHEVs have petrol engines and need servicing hence costing more than BEVs, but they also have an electric propulsion system, which requires fewer moving parts leading to less depletion of petrol engine parts.

### 4. Safer

EVs have a low center of gravity thereby making them less likely to capsize. They also have low risk of fires and explosions. Their body construction gives them more durability hence making them safer during collisions.

### 5. Health Benefits

The reduced harmful emissions will lead to better air quality, which is good for our health. EVs also produce much less noise compared to petrol/diesel-based vehicles.

# 1.4 CHALLENGES TO BE FACED

### 1. Cost of EVs

The cost of EVs should be reasonable and the EVs produced should hold proper value for money.

### 2. Efficiency of EVs in India

The EVs in India on an average provide around 120 km on a full charge in turn making them unsuitable for long drives. EVs in India lack speed, which may turn off buyers. The top two India made EVs have speed of 85 km/hr.

### 3. Demand for EVs

Increase in demand of EVs will lead to increase in requirement for energy and raw materials for the battery.

### 4. Vehicle Quality

Good vehicle quality will lure more customers. Better quality vehicles ensure trust among customers.

### 5. Batteries

The batteries used by electrics are cars made up of nickel, aluminum, cobalt, graphite and lithium, which are all rare earth materials. The availability of these materials is scarce and the amount of these materials available may not be able to produce enough batteries to power the expected amount of electric vehicles to be produced. The increasing demand for lithium around the globe given its scarcity on the Earth's surface will make it challenging to meet India's EV requirement.

### 6. Electricity Generation

There must be enough electricity generation capacity to meet the increasing demands for charging infrastructure and local consumer utilization. There is presently shortage of electricity in many parts of India and a major part of energy generation of the country is still dependent on fossil fuels.

### 7. Land Availability

Availability of land to setup charging stations in urban areas where land scarcity is present is a difficult task. Moreover, a substation nearby is a requirement for a charging station.

## 1.4 GLOBAL SCENARIO OF ELECTRIC VEHICLES

The global Electric vehicle (EV) market has reached further symbolic landmarks, as sales continue to flourish in many countries. According to the Global EV Outlook 2023, Electric car markets are seeing exponential growth as sales exceeded 10 million in 2022. Globally, around 1-in-7 new cars sold was electric in 2022 In Norway, the share was well over 4-in-5, and in China, it was around 1-in-3.A total of 14% of all new cars sold were electric in 2022, up from around 9% in 2021 and less than 5% in 2020. Total BEV sales in 2023 in all twenty analyzed markets amounted to 9.97 million.

More than half of the electric cars on roads worldwide are now in China and the country has already exceeded its 2025 target for new energy vehicle sales. EV sales in China exceeded the two million mark in Q4 2023, an unprecedented achievement in that country in any quarter.

In Europe, the second largest market, electric car sales increased by over 15% in 2022, meaning that more than one in every five cars sold was electric. Electric car sales in the United States – the third largest market – increased 55% in 2022, reaching a sales share of 8%.

A overview for world-wide distribution of electric vehicles is shown below.

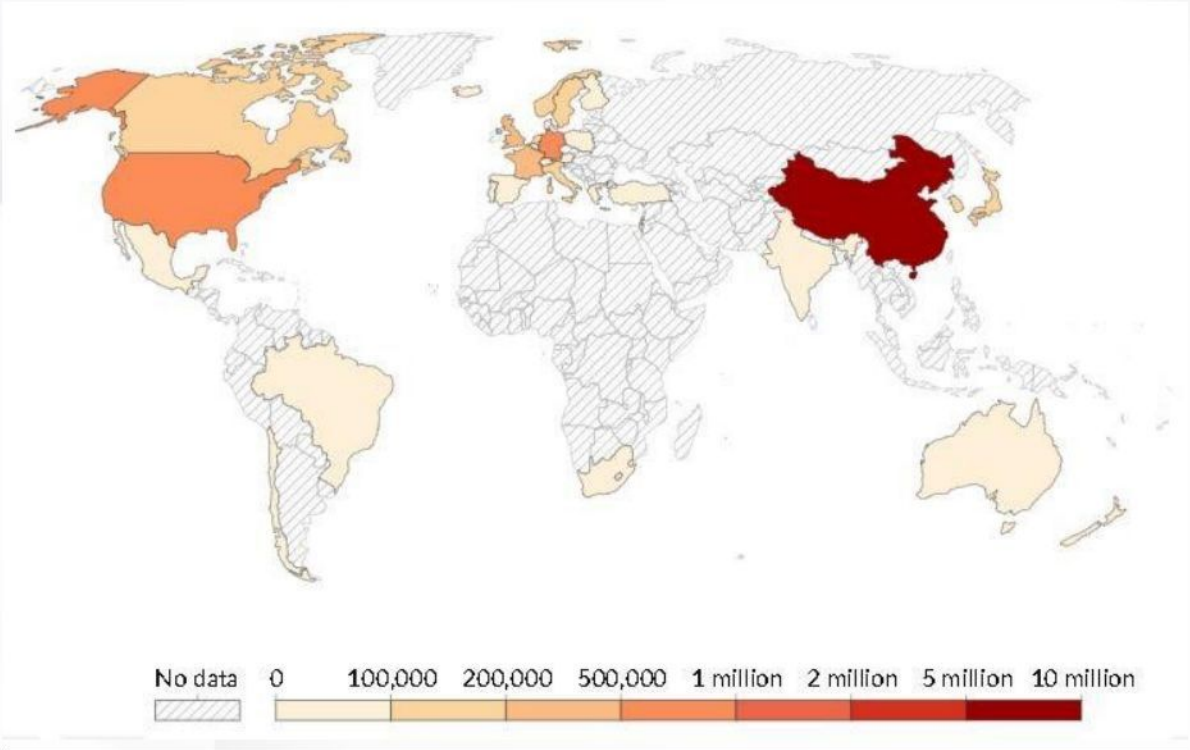


Figure 2

# 1.5INDIAN SCENARIO OF ELECTRIC VEHICLES

India is an emerging market for the electric vehicles with a lot of unrealized potential for its development. Endowed with a huge population and greater dependence on fossil fuels to meet its energy requirements, EV's have appeared as more appealing alternative to traditional vehicles throughout the nation.
In the fiscal year 2022-2023, India registered EV sales for 12,47,120 units making a 174% year on year growth over FY 2021-2022 sales numbers i.e, 4,55,773 units across all vehicle segments. EV sales for the FY 2022-2023 accounted for almost 5.59% of overall automobile sales. The major competitors in the current market place include Ola Electrics, Hero Electric, Okinawa Autotech, TVS motors, Ather Energy, Tata Motors and many more.

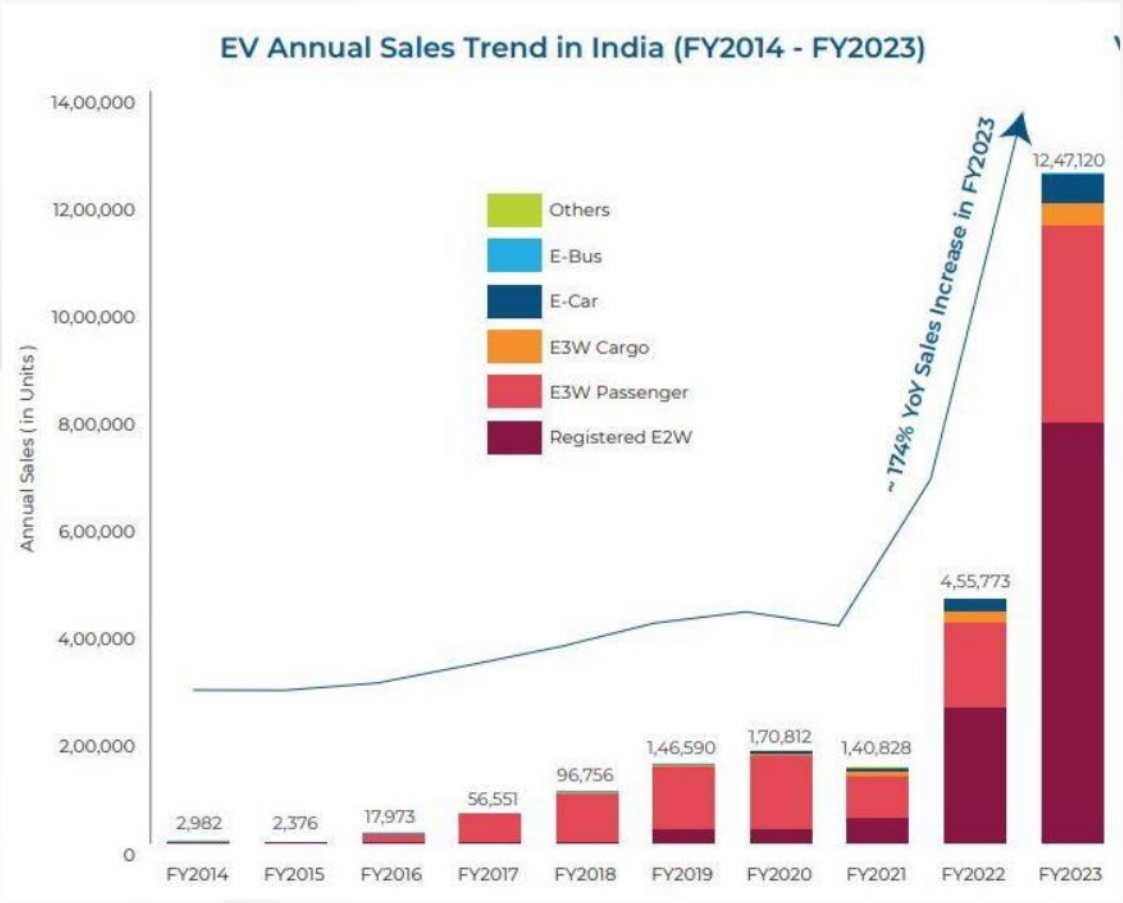


Figure 3

States like Uttar Pradesh and Maharashtra have provided various opportunities for development of infrastructure for smooth usage of Electric Vehicles. The state-wise current presence of electric vehicle in India is shown below.

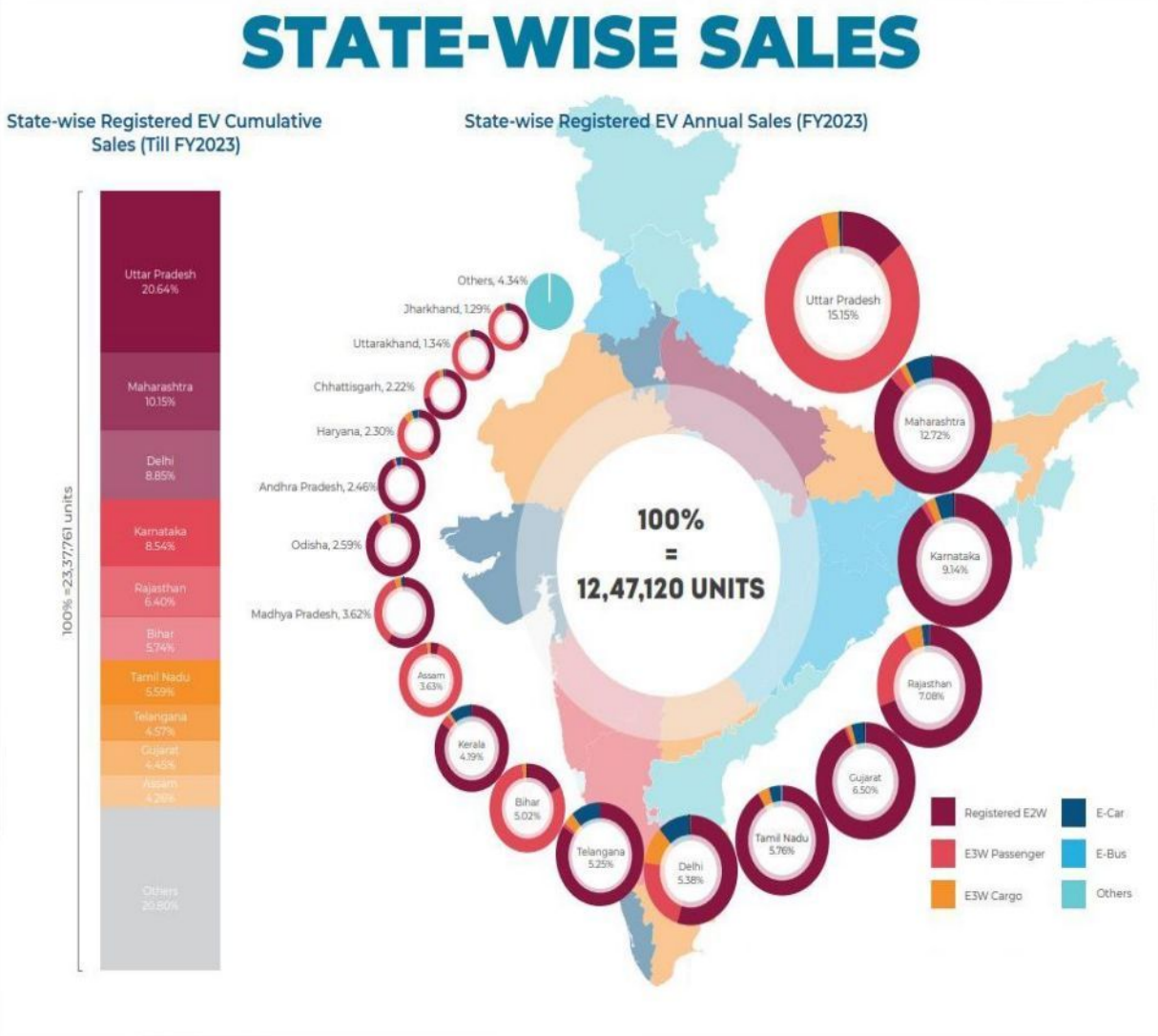


Figure 4

According to a report published earlier this year, in January 2024, electric vehicle (EV) sales in India exhibited varying trends across different categories. Electric two-wheelers (E2W) continued to dominate the market with 81.476 units sold, showing a positive growth from the previous month's figure of 75,723. However, the E- rickshaw category experienced a slight decline, registering 40,499 units compared to 45,068 in December 2023. Electric three-wheelers (E3W) in the L5 Passenger segment saw a modest increase, rising

from 6,487 to 6,891 units. The E3W L5 Cargo category, on the other hand. witnessed a decrease from 2,337 units to 2,164. Electric four-wheelers (E4W) displayed growth, reaching 8,079 units in January, up from 7.420 in the previous month. Electric buses (E. Bus) and other categories reported a decline, with E-Bus sales dropping from 573 to 506 units. Overall, the EV market in India showcased a mixed performance across different segments in January 2024.

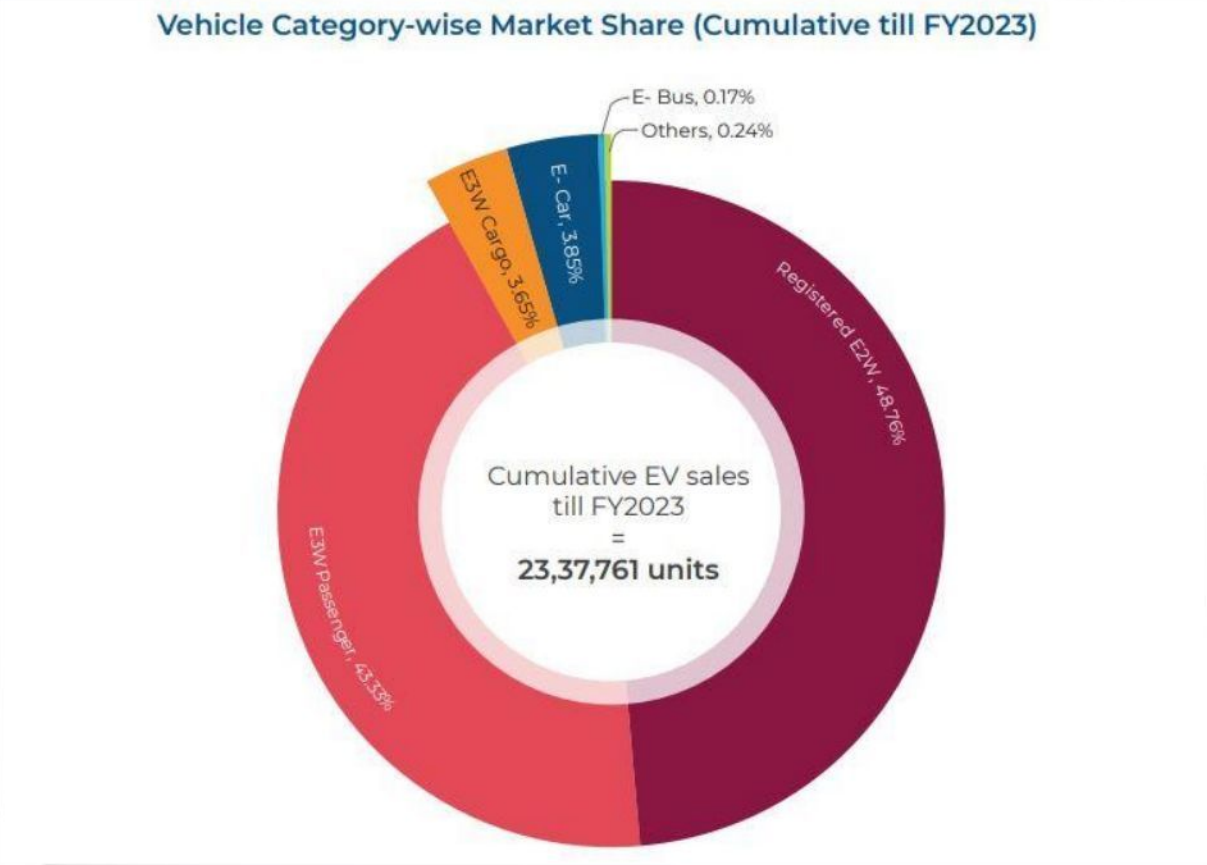


Figure 5

# CHAPTER 2:

# BUSINESS ENVIRONMENT OF ELECTRIC VEHICLES

# 2.1 GOVERNMENT INITIATIVES FOR PROMOTING EVs IN INDIA

India, like many other countries, is actively promoting electric vehicles (EVs) as a key component of its sustainable transportation strategy. Government policies play a crucial role in incentivizing the adoption of EVs and building the necessary infrastructure to support their growth. Here's an overview of the government policies aimed at supporting electric vehicles in India:

1. **FAME India Scheme:** The Faster Adoption and Manufacture of (Hybrid &) Electric Vehicles (FAME) India scheme was launched in 2015 to promote the adoption of EVs and hybrid vehicles in the country. It provides financial incentives for purchasing electric vehicles and setting up charging infrastructure. The scheme has been extended multiple times and has undergone revisions to align with the changing needs of the EV ecosystem.

2. **Incentives for EV Buyers:** Under the FAME India scheme, buyers of electric vehicles are eligible for subsidies to offset the higher upfront costs of EVs compared to conventional vehicles. These subsidies are provided directly to manufacturers, who then pass on the benefits to customers in the form of reduced prices. Additionally, EV buyers may also enjoy exemptions from road tax and registration fees in certain states.

3. **Reduced GST Rates:** The Goods and Services Tax (GST) rates for electric vehicles have been reduced from 12% to 5%, making EVs more affordable for consumers. This reduction in tax rates aims to make electric vehicles more competitive with traditional vehicles and stimulate demand.

4. **Customs Duty Exemption:** The government has exempted customs duty on certain components used in the manufacturing of electric vehicles. This measure is intended to encourage domestic manufacturing of EVs and promote the growth of the electric vehicle industry in India.

5. **Electric Vehicle Infrastructure Development:** The government is actively investing in the development of electric vehicle charging infrastructure across the country. Various initiatives, including the installation of charging stations along highways and in urban areas,

are being undertaken to address range anxiety and facilitate EV adoption.

6. **EV Manufacturing Incentives:** In addition to incentives for EV buyers, the government also provides incentives for manufacturers to invest in the production of electric vehicles and components. These incentives may include subsidies, tax breaks, and other financial support to encourage the establishment of EV manufacturing facilities in India.

7. **State-level Policies:** Several states in India have also implemented their own policies and incentives to promote electric vehicles. These may include additional subsidies, tax benefits, and preferential treatment for EVs in government procurement contracts. States like Karnataka, Maharashtra, and Delhi have been particularly proactive in promoting EV adoption through their policies.

8. **Research and Development Support:** The government supports research and development initiatives aimed at improving battery technology, vehicle design, and other aspects of electric vehicle technology. This support is intended to drive innovation and make Indian EVs more competitive in the global market.

In conclusion, government policies play a crucial role in shaping the trajectory of electric vehicle adoption in India. By providing incentives for both consumers and manufacturers, investing in infrastructure, and supporting research and development, the government aims to accelerate the transition to electric mobility and reduce the country's dependence on fossil fuels.

# CHAPTER 3:

# RESEARCH METHODOLOGY

## 3.1 RESEARCH PROBLEM STATEMENT

With the current depletion of fossil fuels and its price hike, there is a need for another energy resource to run the vehicle. The automobile sector is considering Electric Vehicle as a solution to the industry and environment in India. Electric Vehicles are the replacement for petroleum-based vehicles. They are one of the emerging technologies as well as eco-friendly and viable.

## 3.2 OBJECTIVE OF RESEARCH

1.To know about the Opportunities and Challenges of EVs in India.
2.To know people's opinions and stereotypes about electric vehicles.
3.To know about the consumer's motives to purchase EVs in India.
4.To gain an insight about people's awareness towards environment.
5.To know about which states of India have adopted Electric Vehicles the most.
6.To know if the Government initiatives for promoting EVs have been successful or not.

## 3.3 METHODOLOGY OF SURVEY

The aim of the methodology section is to describe the research procedure. The following are the steps that describe the marketing research process:
1.Problem identification & Research objectives
2.Research Design
3.Sampling Plan & Data Collection
4.Data Analysis & Interpretation
5.Research Report Preparation

## 3.3.1 RESEARCH DESIGN

"Research Design is the plan, structure, & strategy of investigation to obtain answers to the Marketing Problem". It indicates the methods and procedures for conducting a research study. There are three types of Research Design.

- Exploratory Research Design
- Descriptive Research Design
- Causal or Experimental Research Design

The Research design carried out in this project was Descriptive in nature

## 3.3.2 PLANNING OF THE SURVEY:

A full proof planning is an essential part of any statistical survey to complete it in a successful manner at minimum cost, labour and time. Planning of survey includes selection of topic and preparation of a short questionnaire covering almost all the area. From this questionnaire, I selected those questions which seem to be relevant in context of the mentioned topic for further analysis.

## 3.3.3 AREA OF SURVEY:

For performing any survey, a sample is selected from a population. I decided to collect my sample from the residents of Varanasi and nearby region. I conducted the survey of total 150 respondents.

## 3.3.4 TARGET POPULATION:

The target population included all the individuals who are beyond the age of 18, i.e., minimum age criteria for possessing a driving -license.

## 3.4 DATA COLLECTION :

Data can be collected by 2 methods:

- **PRIMARY DATA:** When secondary data is not sufficient for the purpose the firsthand data i.e., Primary Data is to be collected. Following are the instruments of primary data given as follows:
  - Observation
  - Personal Interview
  - Telephonic Interview
  - Questionnaire

  I have collected Primary Data through Structured Questionnaire.
- **SECONDARY DATA:** This data has been collected through Websites, Project Reports, and various Journals of Marketing etc.

## 3.5 SAMPLING PLAN

1. **Sample Unit** – People of age 18 or above
2. **Sample Size-** 150 Respondents
3. **Sampling Methods -** Non- probability sampling:
   a. Judgmental Method
   b. Convenience Method

# 3.6 DATA ANALYSIS AND INTERPRETATION

Once the survey is over and Questionnaire has been received from respondents the data collection has to be properly tabulated. I have analyzed the data with the help of various statistical methods i.e., Average, Percentage, Correlation and Graphical methods like pie-chart, bar chart table and others.

## TYPES OF CHARTS:

- ***Bar Graph:***

  The pictorial representations of a grouped data, in the form of vertical or horizontal rectangular bars, where the lengths of the bars are equivalent to the measure of data, are known as bar graph. The bars drawn have uniform width, and the variable quantity is represented on one of the axes. Also the measure of the variable depicted on the other axes. The heights or the lengths of the bars denote the value of the variable. These graphs can be used to compare various quantities.

- ***Pie Chart.***

  A pie chart is a circular staistical graphic, which is divided into slices to illustrate numerical proportion. In a pie chart, the arc length of each slice is proportional to the quantity it represents.

- ***Other charts***

## TESTS USED FOR ANALYSIS:

- ***Chi square test for independence of attributes***

Chi-Square Test is applied to find out whether the two variables in bivariate contingency table under study are dependent and independent. Our two hypotheses:

**1. Null Hypothesis, H0**
**2. Alternate Hypothesis, H1**

**H0: The two attributes are independent.**
**H1: The attributes are dependent**.

Let r and s be the number of rows and columns of the contingency table and i=1,2,3,…..,r ; and j=1,2,3,…..,s Computation is done using formula:
fij: observed frequency of the (i,j)th cell
eij: expected frequency of the (i,j)th cell $=\frac{(ni*nj)}{N}$
Where i and j are marginal totals and N is the total number of observations such that
$\sum_{i=1}^{r} ni = \sum_{j=1}^{s} nj = N$
The $\chi$ 2value is calculated as:

$$\chi 2 = \frac{(Oi - Ei)^2}{Ei}$$

The test statistic follows, under H0, a chi-square distribution with (r-1)(s-1) degrees of freedom.

The null Hypothesis can be tested either at 5% or 1% level of significance, if **$\chi$ 2 cal > $\chi$2 tab** then, **we reject H0**, which shows that the two variables are not independent of each other. Otherwise, **we fail to reject H0** at the given level of significance, which shows that the two random variables are not independent, i.e., dependent on each other.

Further, if the expected frequency is less than 5, we apply pooling of the test.

***Large sample test for significance of single proportions***

If x is the number of success in n independent trials with constant probability P of success for each trial, then
$E(x) = nP$ and $V(x)=nPQ$ .
where Q=1-P, is the probability of failure.

It has been proved that for large n, the binomial distribution tends to normal distribution. Hence for large n,
$X \sim N(nP, nPQ)$

i.e. $\frac{Z= (X-E(x))}{\sqrt{v(x)}} \sim N(0,1)$

In a sample size n, let x be the number of persons possessing the given attribute. Then ,
Observed proportion of success=x/n=p,
E(p)=E(x/n)= nP/n=P
Thus sample proportion 'p' gives an unbiased estimate of the population proportion P.
V(p)=V(x/n)=nPQ/n^2=PQ/n
Hence for large n

$\frac{Z=p-E(p)}{\sqrt{PQ/n}} \sim N(0,1)$.

# 3.7 RESEARCH REPORT PREPARATION

Once the data has been tabulated interpreted and analyzed it is requiring to prepare research report based on findings, conclusion and recommendation.

# 3.8 LIMITATIONS

- The responses of the questionnaire are as per the limited understanding of the respondents.
- The size of sample was limited because of limited factor and hence the results cannot be generalized.
- The analysis and conclusions are as per our limited understanding of the concern subject.

# CHAPTER 4:

# DATA ANALYSIS

# 4.1 TOOLS USED FOR TABULATION AND ANALYSIS-FREQUENCY TABLES, GRAPHS

## 1. Distribution of age:

| Age Group | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| 18-25 | 57 | 38 | 38 |
| 25-40 | 36 | 24 | 62 |
| 40-50 | 40 | 26.667 | 88.667 |
| 50+ | 17 | 11.333 | 100 |
| **Grand Total** | **150** | | |

Table 1

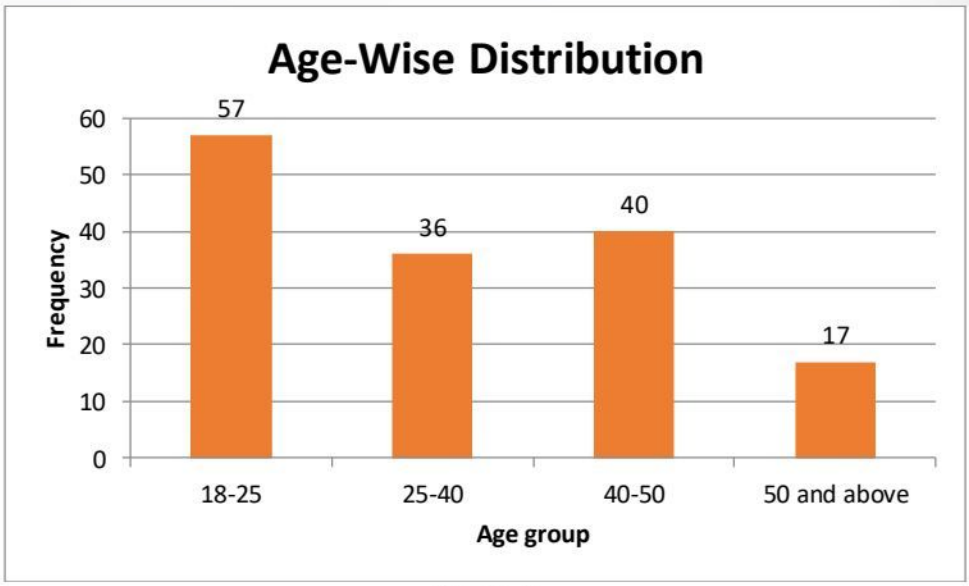


Figure 6

## Interpretation:

From the above Bar Graph and table, we can observe that the maximum no. of respondents belongs to the age group of 18-25 (57) while the least number of respondents belongs to the age group of 50 and above (17).

## 2. Distribution of gender:

| Gender | Frequency | Percentage | Cumulative % |
|---|---|---|---|
| **Female** | 63 | 42 | 42 |
| **Male** | 87 | 58 | 100 |
| **Grand Total** | **150** | **100** | |

Table 2

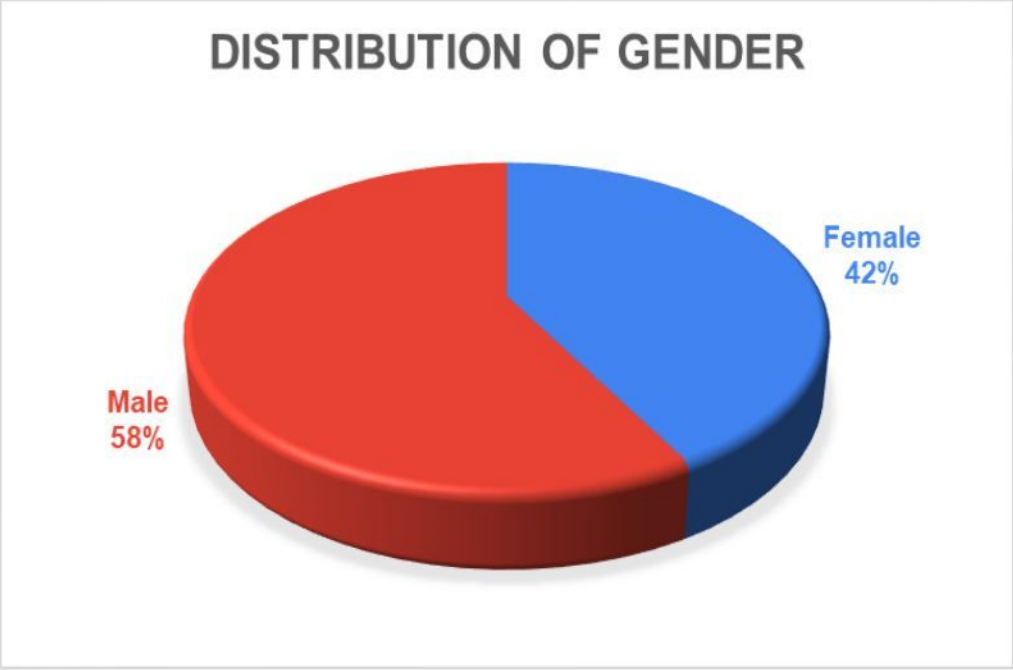


Figure 7

## Interpretation:

From the above Pie chart, we can observe that 42% respondents out of 150 were Female while the other 58% were Male.

## 3. Distribution of Income:

| Income Group | Frequency | Percentage | Cumulative % |
|---|---|---|---|
| 10 lakhs- 15lakhs | 25 | 16.667 | 16.667 |
| 15 lakhs and above | 18 | 12 | 28.667 |
| 3 lakhs-6 lakhs | 38 | 25.333 | 54 |
| 6 lakhs-10 Lakhs | 33 | 22 | 76 |
| Less than 3 lakhs | 36 | 24 | 100 |
| **Grand Total** | **150** | | |

Table 3

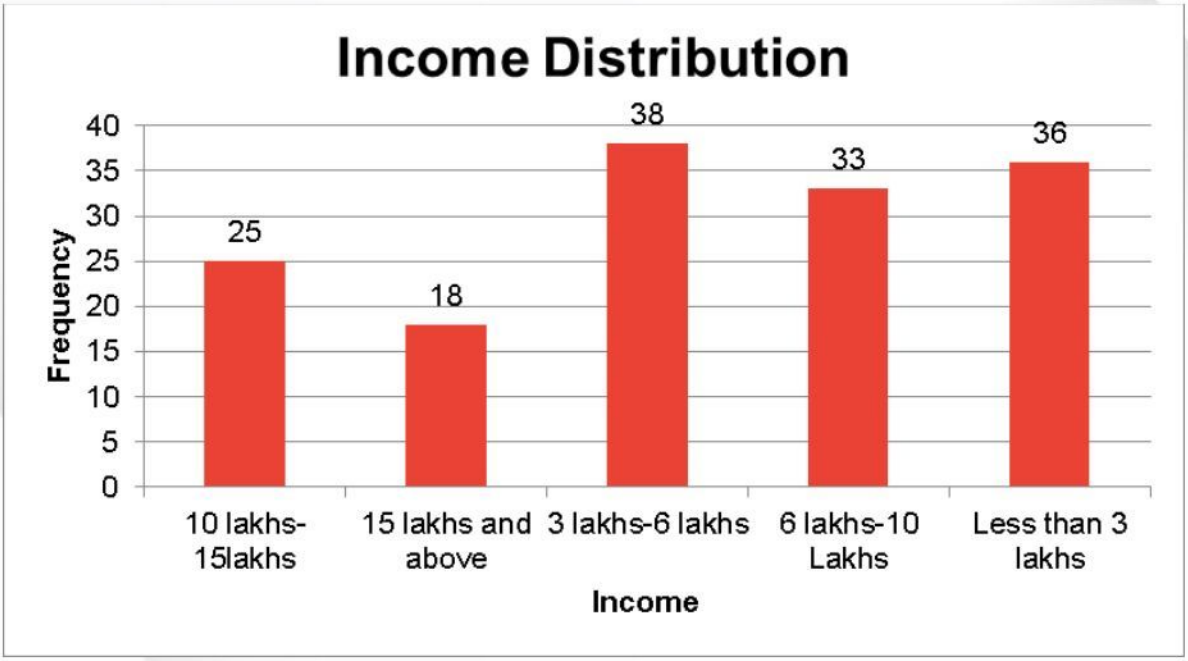


Figure 8

## Interpretation:

From the above Bar Graph and table, we can observe that the income level of maximum number of respondents was 3,00,000 to 6,00,000 (38) while the income level of least number respondents was more than 15,00,000 (18).

## 4. Distribution of educational classification:

| Educational Qualification | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| Below Primary | 2 | 1.333 | 1. 333 |
| Matriculation | 1 | 0.667 | 2 |
| Intermediate | 35 | 23.333 | 25.333 |
| Graduate | 66 | 44 | 69.333 |
| Postgraduate | 36 | 24 | 93.333 |
| PhD | 10 | 6.667 | 100 |
| Total | 150 | | |

Table 4

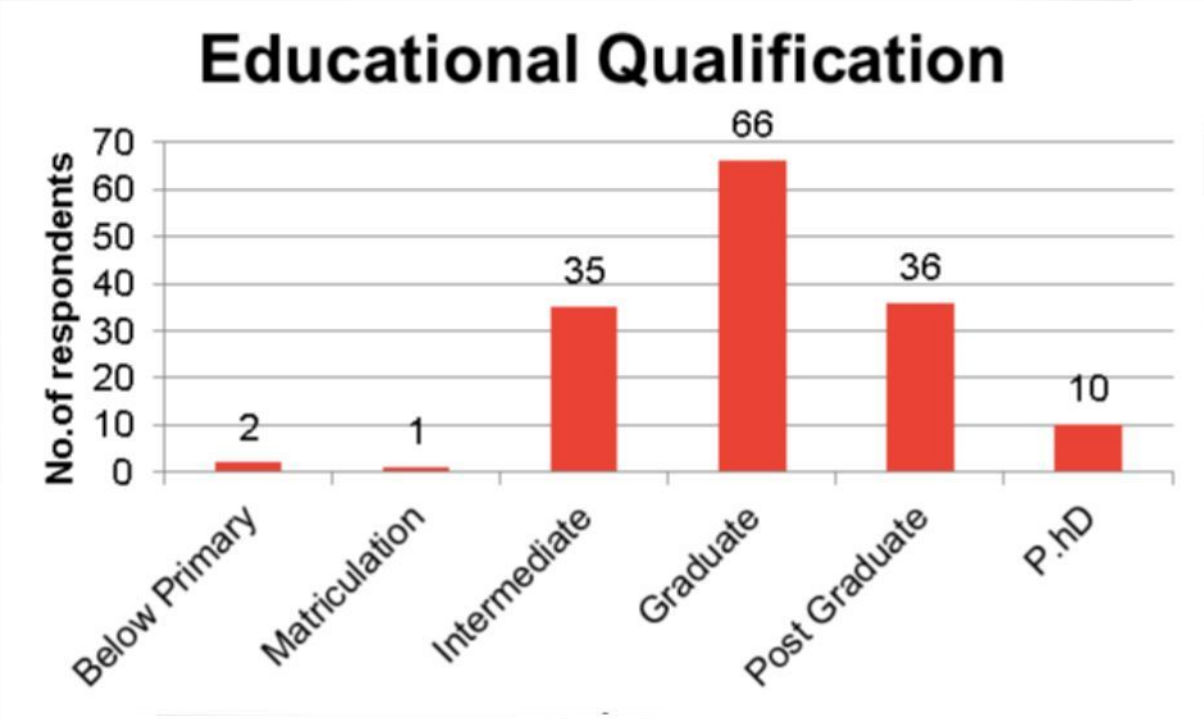


Figure 9

## Interpretation:

From the above Bar Graph, we can observe that the educational qualification of maximum number of respondents was Graduation (66) while the educational qualification of least number respondents was Matriculation (1).

## 5.Distribution of occupation:

| Occupation | Frequency | Percentage | Cumulative % |
|---|---|---|---|
| Student | 50 | 33.333 | 33.333 |
| Government Employee | 27 | 18 | 51.333 |
| Private Employee | 35 | 23.333 | 74.667 |
| Self Employed | 38 | 25.333 | 100 |
| **Total** | **150** | | |

Table 5

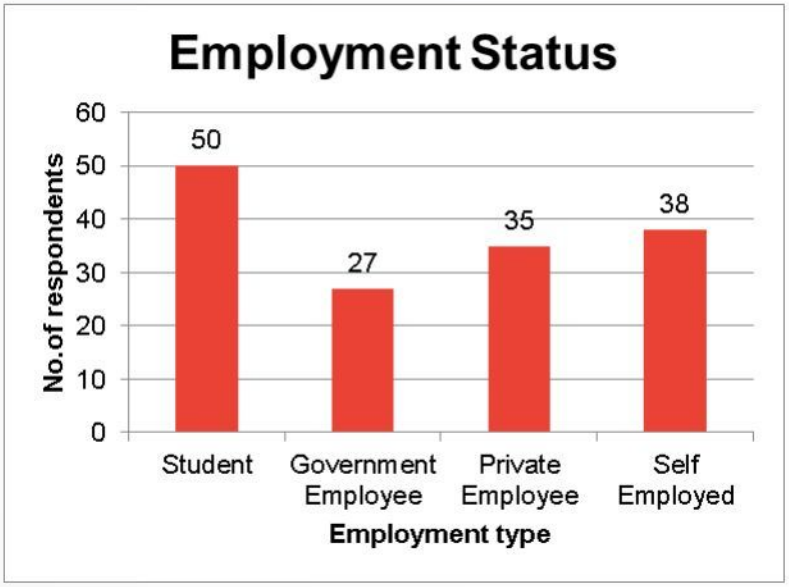


Figure 10

## Interpretation:

From the above Bar Graph and table, we can observe that out of 150 respondents the employment status of 50 respondents is student, 27 respondents are government employees, 35 respondents are private employees, and the last 38 respondents are self-employed.

## 6. Distribution of residence:

| Place of Residence | Frequency |
|---|---|
| Rural | 58 |
| Urban | 92 |
| Grand Total | 150 |

Table 6

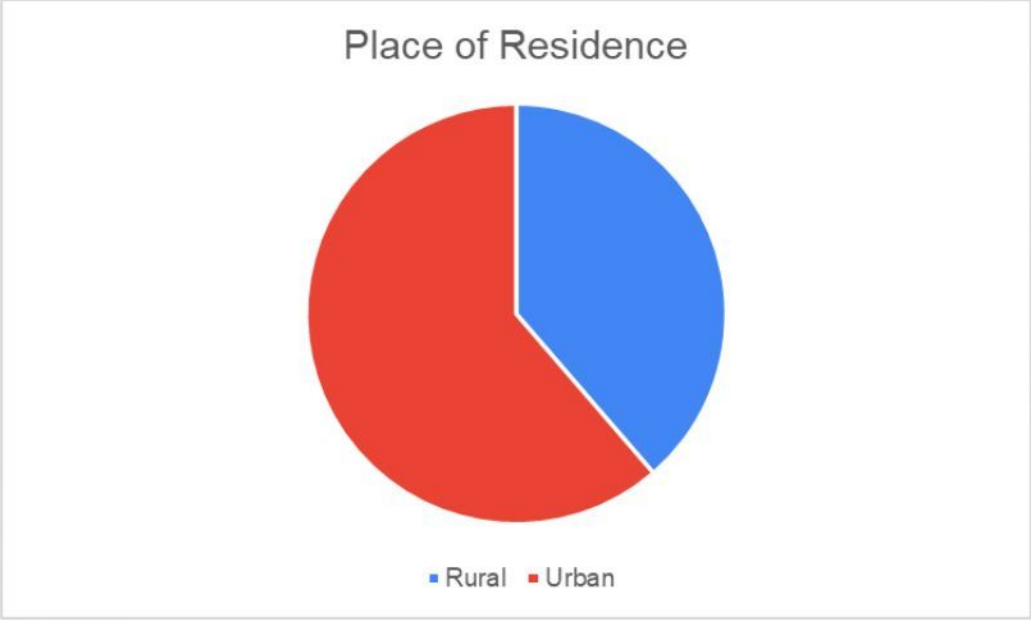


Figure 11

## Interpretation:

From the above Bar Graph, we can observe that out of 150 respondents 58 (38.67%) belong to rural residence whereas the remaining 92(61.33%) belong to urban residence.

## 7. Distribution of family:

| Type of Family | Frequency |
|---|---|
| Joint | 70 |
| Nuclear | 80 |
| Grand Total | 150 |

Table 7

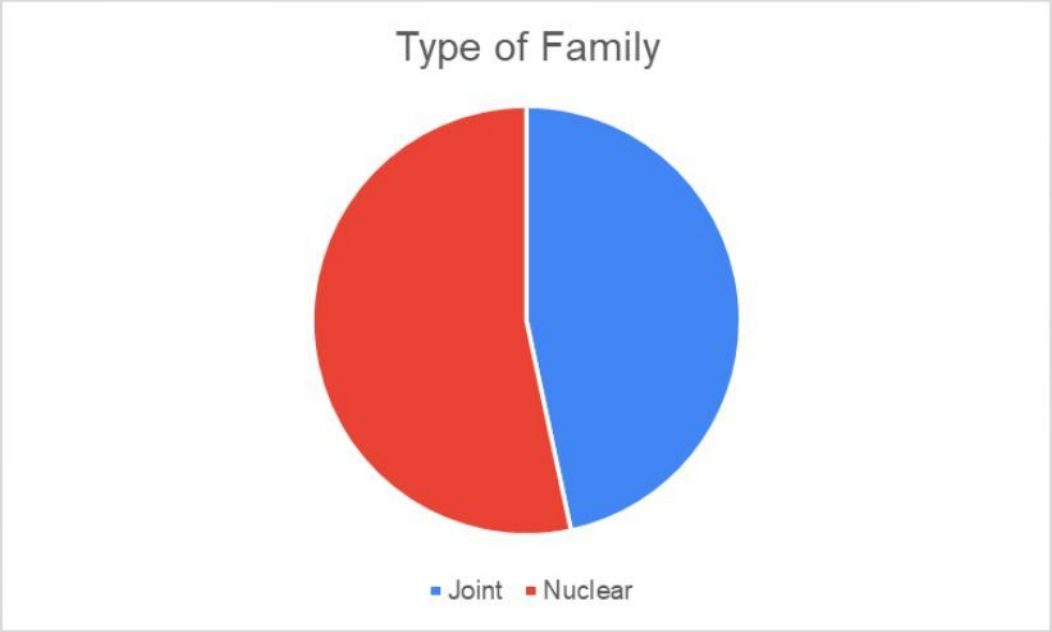


Figure 12

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 70 (46.67%) come from joint families whereas 80 (53.33%) come from nuclear families.

## 8. Share of different types of vehicles among the respondents:

| Type of Vehicle | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| None | 15 | 9.433 | 9.433 |
| Cycle | 15 | 9.433 | 18.867 |
| Bike | 57 | 35.849 | 54.716 |
| Scooter | 54 | 33.962 | 88.679 |
| Car | 18 | 11.320 | 100 |
| **Total** | **159** | | |

Table 8

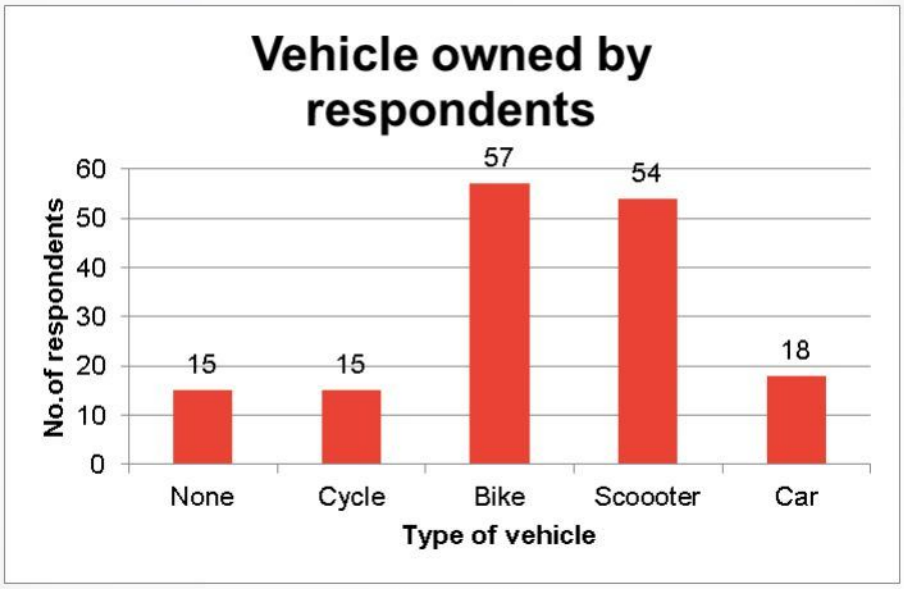


Figure 13

## Interpretation:

From the above Bar Graph and table, we can observe that out of 150 respondents, bike was the most common vehicle owned (57) and is followed by scooter, car and cycle.

## 9. Number of vehicles owned by respondents:

| Type of Vehicle | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| 0 | 24 | 16 | 16 |
| 1 | 76 | 50.667 | 66.667 |
| 2 | 37 | 24.667 | 91.333 |
| 3 | 7 | 4.667 | 96 |
| 4 | 4 | 2.667 | 98.667 |
| 6 | 1 | 0.667 | 99.333 |
| 7 | 1 | 0.667 | 100 |
| **Total** | **150** | | |

Table 9

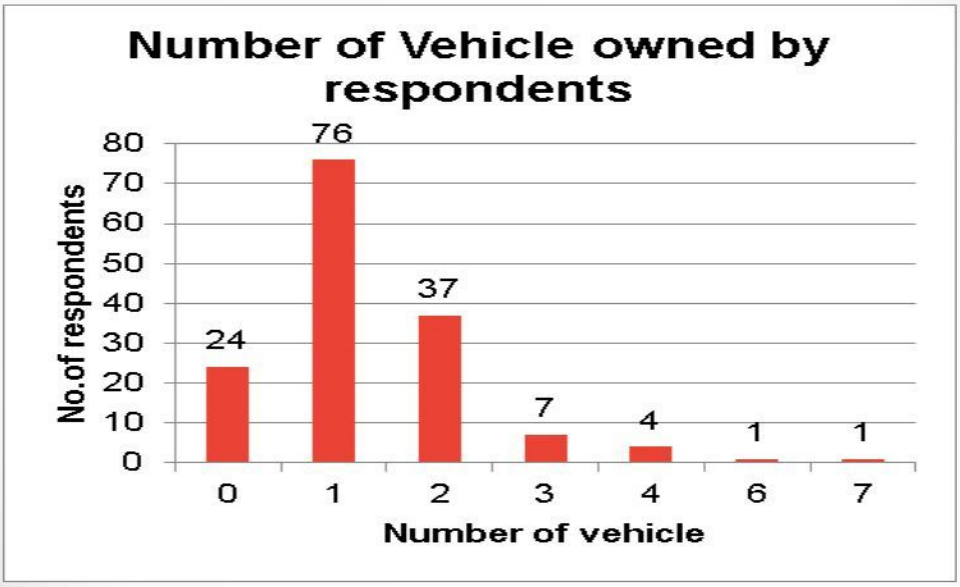


Figure 14

## Interpretation:

From the above Bar Graph and table, we can observe that out of 150 respondents the maximum number of 76 (50.667%) respondents have 1 vehicle followed by 37(24.667%) respondents having 2 vehicles, 24(16%) having 0 vehicle, 7 (4.667%) having 3 vehicles, 4 (2.667%) having 4 vehicles and 1(0.667%)-1 respondent to 6 and 7 vehicles.

## 10.Different fuels used by respondents for their vehicles:

| Type of Fuel | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| Petrol | 81 | 54 | 54 |
| Diesel | 12 | 8 | 62 |
| Electricity | 26 | 17.33333333 | 79.33333333 |
| CNG | 1 | 0.666666667 | 80 |
| None | 30 | 20 | 100 |
| **Total** | **150** | | |

Table 10

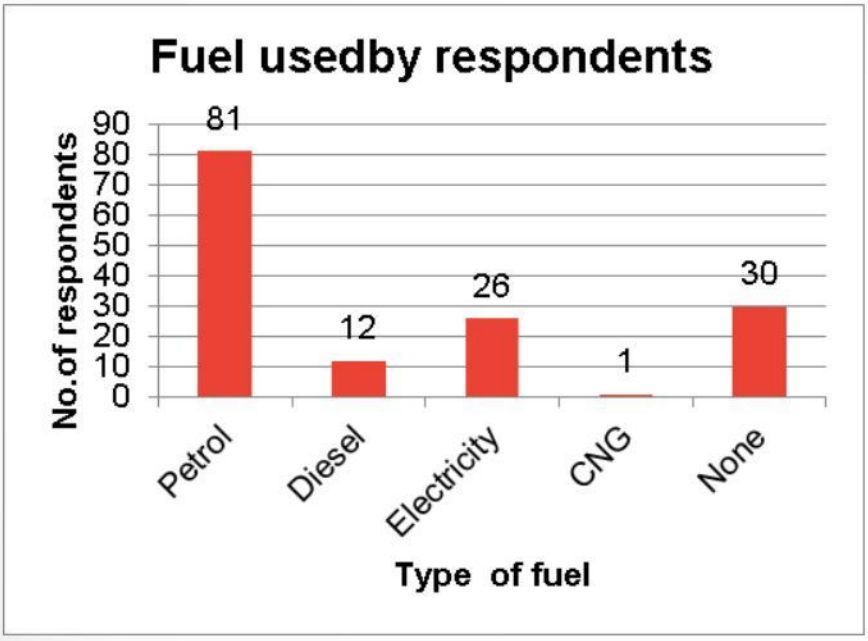


Figure 15

## Interpretation:

From the above Bar Graph and table, we can observe that out of 150 respondents 81 (54%) have petrol-fueled vehicles, 26(17.33%) possesses electric power vehicles, 30(20%) are muscle powered,12(8%) is diesel powered and 1(0.667%) is CNG.

## 11. Overall opinion about electric vehicles:

| Overall Opinion | Frequency |
|---|---|
| Negative | 18 |
| Neutral | 37 |
| Positive | 60 |
| Very negative | 4 |
| Very positive | 31 |
| Grand Total | 150 |

Table 11

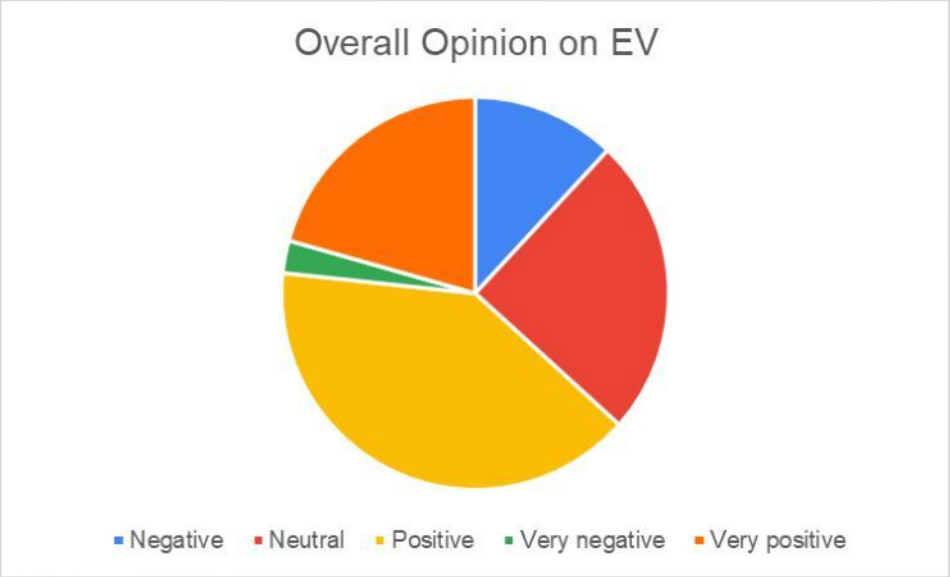


Figure 16

**Interpretation:**

From the above pie chart and table, we can observe that out of 150 respondents, 60 (40.00%) have a positive opinion about EVs, 37(24.66%) have neutral opinion, 31(20.66%) have very positive opinion, 18(12.00%) have negative whereas 4 (2.66%) have very negative opinion.

## 12. Ownership of electric vehicles along with type of electric vehicle:

| EVs Owned | Frequency |
|---|---|
| Bike | 17 |
| Car | 14 |
| Scooter | 32 |
| No | 87 |
| Grand Total | 150 |

Table 12

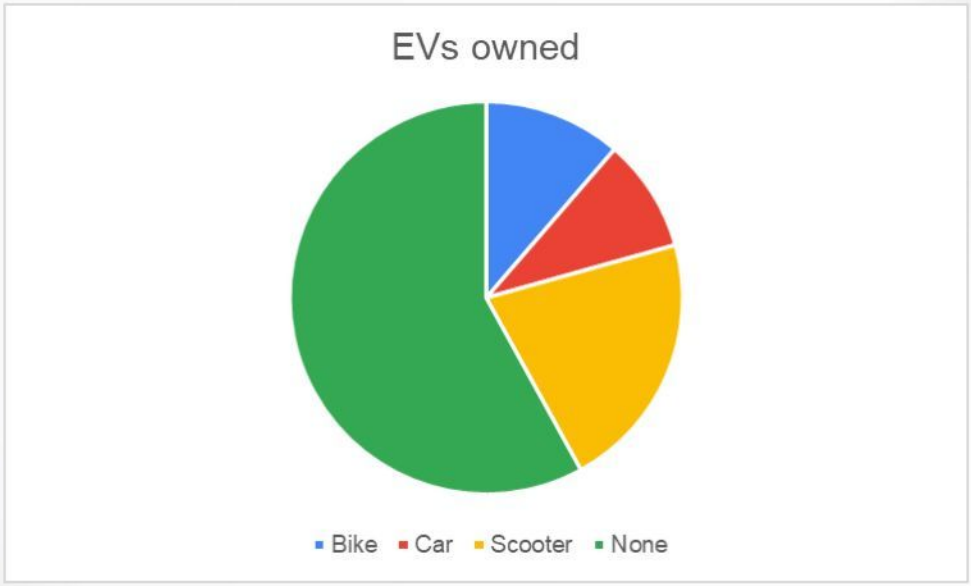


Figure 17

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 63 (42.00%) own an electric vehicle (bike, car, scooter) whereas 87 (58.00%)do not own any electric vehicle.

## 13. Most widespread brand for EVs according to respondents:

| Commonly seen EVs | Frequency |
|---|---|
| Ather Energy | 11 |
| Hero Electric | 17 |
| Hyundai | 9 |
| Mahindra Electric | 23 |
| Morris Garage | 7 |
| Okinawa | 2 |
| Ola Electrics | 47 |
| Tata Motors | 34 |
| Grand Total | 150 |

Table 13

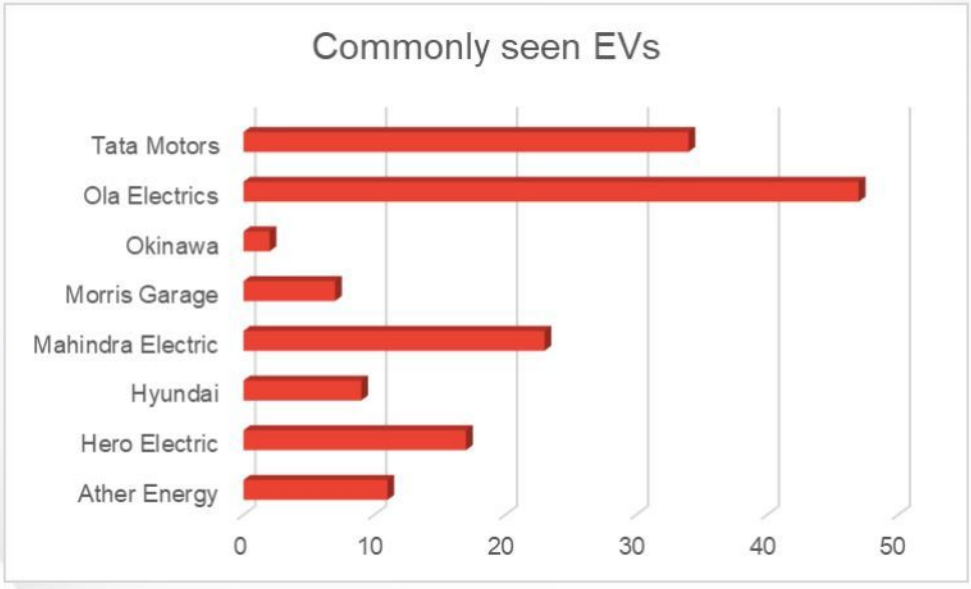


Figure 18

## Interpretation:

From the above Bar Graph and table, we can observe that the most popular company for Electric vehicle is OLA Electrics followed by TATA Motors and Mahindra Electric.

## 14. Opinion about buying Electric Vehicles:

| Opinion | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| Yes | 98 | 65.333 | 65.333 |
| No | 20 | 13.333 | 78.667 |
| Maybe later | 32 | 21.333 | 100 |
| **Total** | **150** | | |

Table 14

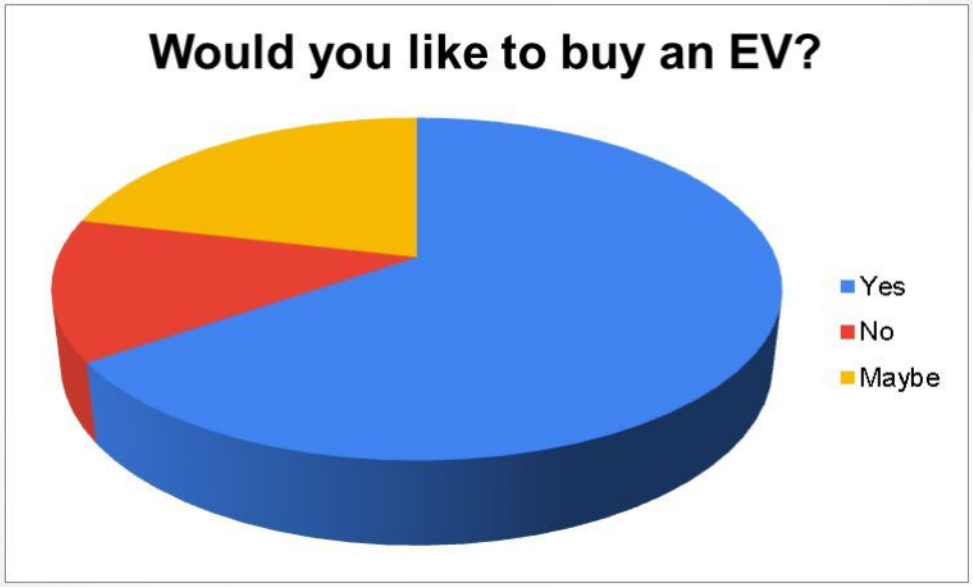


Figure 19

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 98 (65.33%) wish to buy an electric vehicle whereas 20 (13.33%)do not agree on buying electric vehicles. 32(21.33%) respondents showed interest in buying electric vehicles later.

## 15. Factors influencing opinion of buying an electric vehicle the most:

| Opinion | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| Environmental impact | 91 | 36.991 | 36.991 |
| Cost-effectiveness | 47 | 19.105 | 56.097 |
| Price hike of petrol and diesel | 57 | 23.170 | 79.268 |
| Performance (speed, acceleration, etc.) | 18 | 7.3170 | 86.585 |
| Design and aesthetics | 12 | 4.878 | 91.463 |
| Government incentives and policies | 20 | 8.130 | 99.593 |
| Others | 1 | 0.406 | 100 |
| **Total** | **246** | | |

Table 15

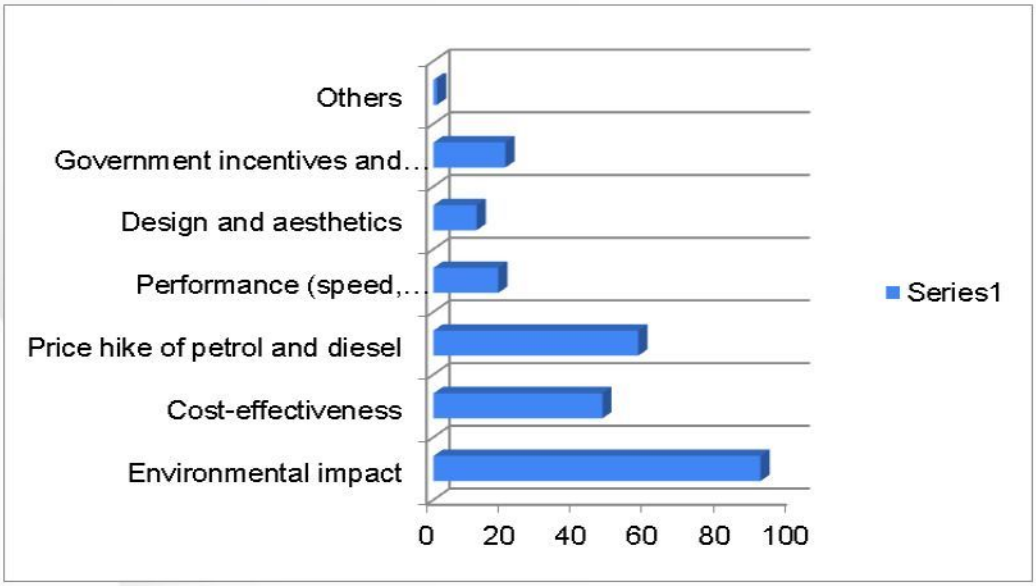


Figure 20

## Interpretation:

From the above bar chart and table, we can observe that the most common reason to buy EV is their positive environmental impact. The least favored option includes design and aesthetics.

## 16. Opinion about whether electric vehicles can significantly reduce carbon emissions compared to traditional gasoline/diesel vehicles:

| EVs better in reducing carbon emission than fossil fuel vehicles | Frequency |
|---|---|
| Yes | 119 |
| Not sure | 19 |
| No | 12 |
| Grand Total | 150 |

Table 16

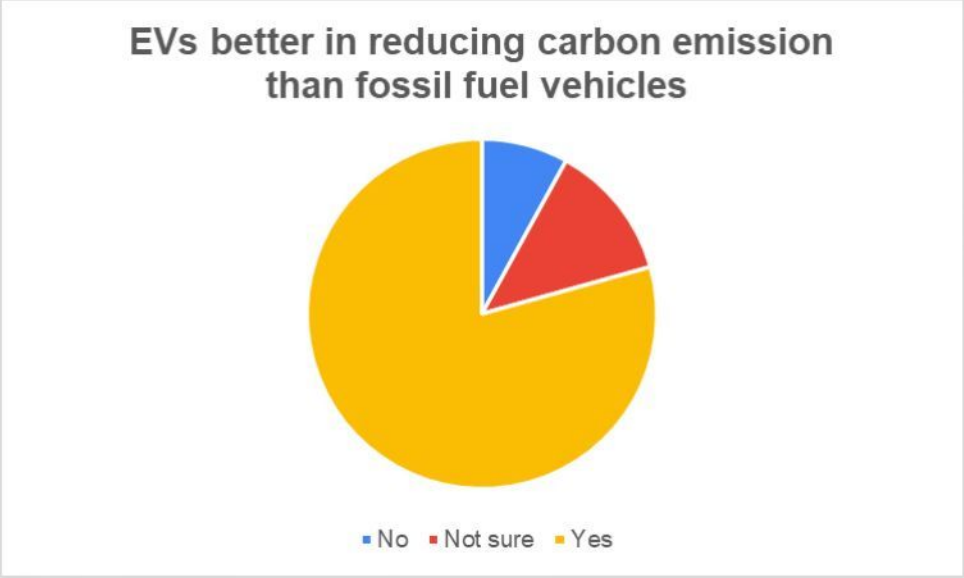


Figure 21

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 119 (79.33%) believe electric vehicles can significantly reduce carbon emissions compared to traditional gasoline/diesel vehicles whereas 12 (8%) believe electric vehicles cannot significantly reduce carbon emissions compared to traditional gasoline/diesel vehicles.

## 17. Factors preventing respondents from purchasing or using an electric vehicle:

| Opinion | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| High initial cost | 56 | 19.787 | 19.787 |
| Limited driving range | 53 | 18.727 | 38.515 |
| Lack of charging infrastructure | 70 | 24.734 | 63.250 |
| Long charging times | 35 | 12.367 | 75.618 |
| Uncertainty about battery lifespan and replacement costs | 43 | 15.194 | 90.812 |
| Lack of vehicle options (e.g., desired model not available as an EV) | 25 | 8.833 | 99.646 |
| Others | 1 | 0.353 | 100 |
| **Total** | **283** | | |

Table 17

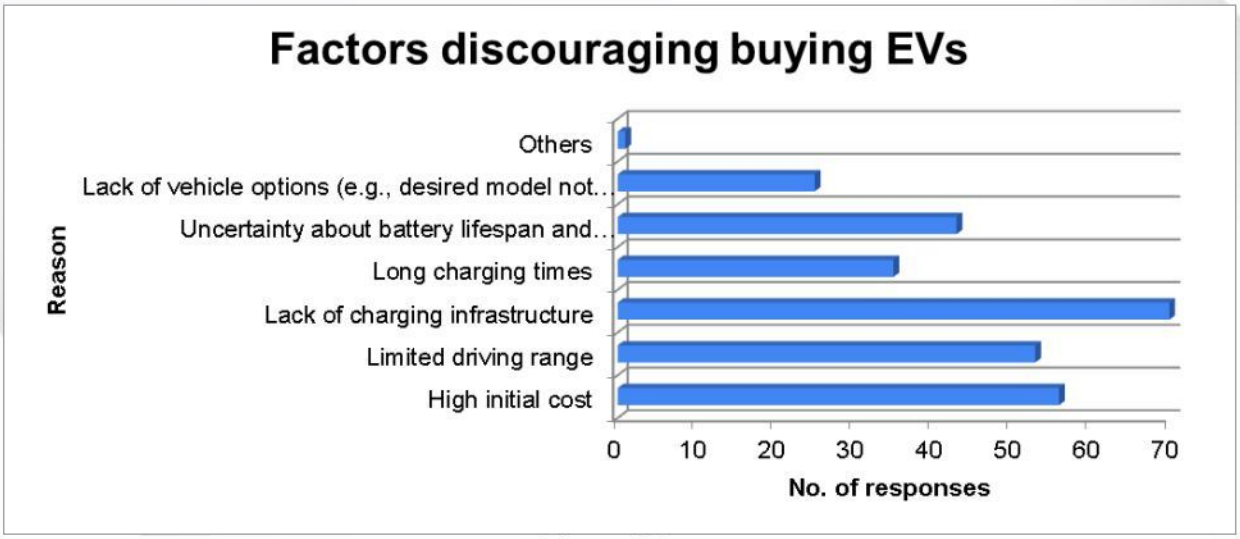


Figure 22

## Interpretation:

From the above bar chart and table, we can observe that the respondents are reluctant reason to buy EV because of the lack of charging infrastructure in the area. Also EVs have very high initial cost which contributes to people's decision of not purchasing them.

**18. Opinion about whether the government should increase the incentives (e.g., tax credits, rebates, subsidies) for promoting the adoption of electric vehicles:_**

| Opinion | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|
| Maybe | 27 | 18 | 18 |
| No | 32 | 21.333 | 39.333 |
| Yes | 91 | 60.667 | 100 |
| **Total** | **150** | | |

Table 18

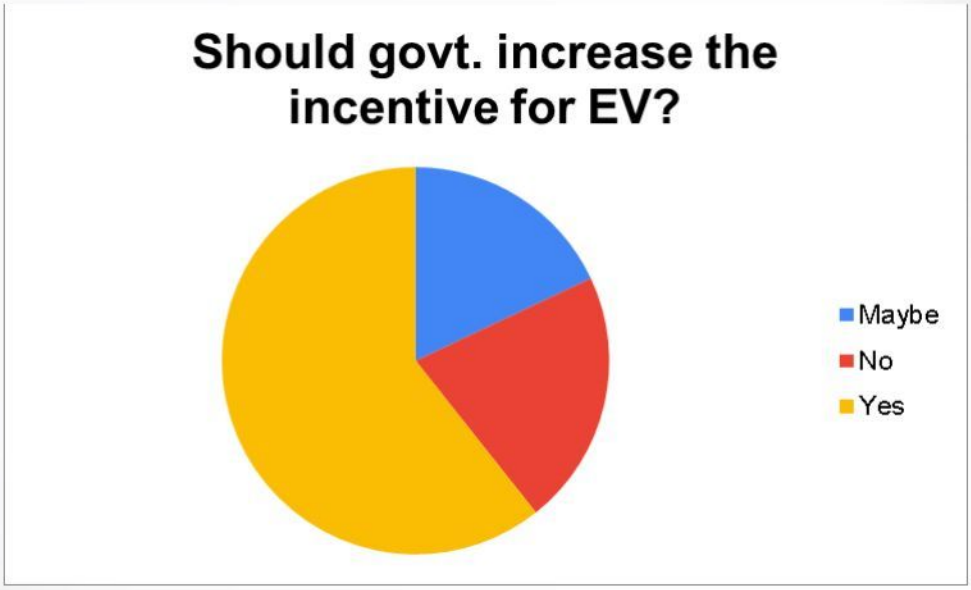


Figure 23

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 91 (60.66%) believe that government should increase the incentives on EVs whereas 32 (21.33%) believe that government should not increase incentives for purchasing EVs.

## 19. Opinion about whether electric vehicles will eventually replace traditional internal combustion engine vehicles as the primary mode of transportation:

| EVs will replace fossil-fuel vehicles? | Frequency |
|---|---|
| Yes | 82 |
| Maybe after few years | 34 |
| No | 34 |
| | 150 |

Table 19

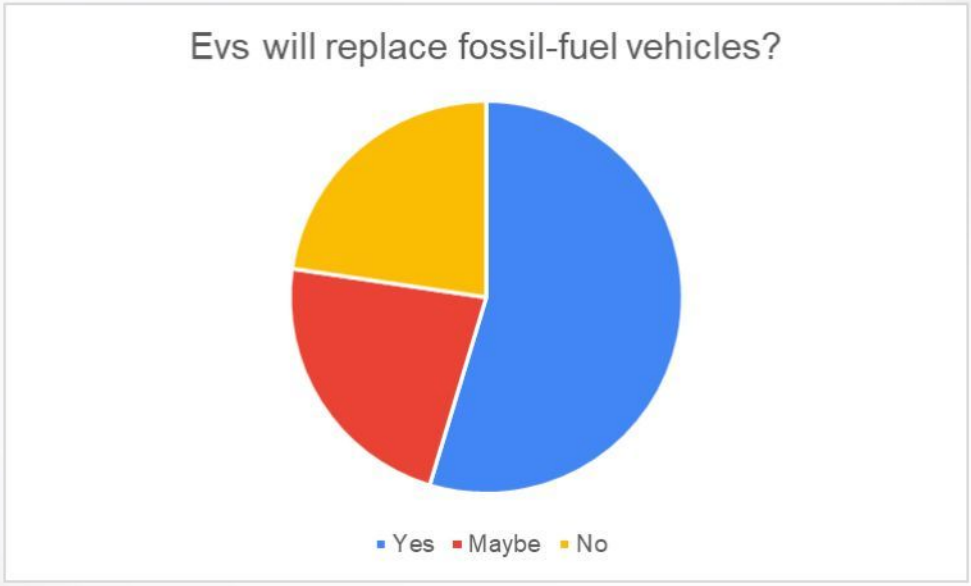


Figure 24

## Interpretation:

From the above pie chart and table, we can observe that out of 150 respondents, 82 (46.67%) believe that electric vehicles will eventually replace traditional internal combustion engine vehicles as the primary mode of transportation whereas 34 (53.33%)do not believe that electric vehicles will eventually replace traditional internal combustion engine vehicles as the primary mode of transportation .

# 4.2 STATISTICAL ANALYSIS: CHI-SQUARE ($\chi^2$) FOR HYPOTHESIS

## 1.To find relationship between gender and willingness to purchase electric vehicle

**Hypothesis:**

$H_0$:There is no significant relationship between gender and willingness to buy electric vehicles.

$H_1$:There is a significant relationship between gender and willingness to buy electric vehicles.

Tabulation

| | Observed Frequency | | | |
|---|---|---|---|---|
| | **Maybe** | **No** | **Yes** | **Grand Total** |
| **Male** | 18 | 11 | 58 | **87** |
| **Female** | 14 | 9 | 40 | **63** |
| **Total** | **32** | **20** | **98** | **150** |

| | Expected Frequency | | | |
|---|---|---|---|---|
| | **Maybe** | **No** | **Yes** | **Grand Total** |
| **Male** | 18.56 | 11.6 | 56.84 | **87** |
| **Female** | 13.44 | 8.4 | 41.16 | **63** |
| **Total** | **32** | **20** | **98** | **150** |

| Calculation of Ch-square Value | | |
|---|---|---|
| **Observed Frequency $(O_i)$** | **Expected Frequency $(E_i)$** | $(\mathrm{O_i}-\mathrm{E_i})^2/\mathrm{E_i}$ |
| 18 | 18.56 | 0.016 |
| 11 | 11.6 | 0.031 |
| 58 | 56.84 | 0.023 |
| 14 | 13.44 | 0.023 |
| 9 | 8.4 | 0.042 |
| 40 | 41.16 | 0.032 |
| | $\chi$ 2 calculated | **0.170** |
| | **Degree of freedom** | **2** |
| | $\chi$ 2 **tabulated** | **5.991** |

Table 20

**Result:** From the above calculations, we observe that $\chi$ 2 calc < $\chi$2 tab at 5% level of significance. Hence, we fail to reject Ho.

**Conclusion:** There is no effect of gender on willingness to buy electric vehicles.

## 2. To find relationship between Income group and willingness to buy.

**Hypothesis:**

$H_0$: There is no significant relationship between income and willingness to buy electric vehicles.

$H_1$: There is a significant relationship between income and willingness to buy electric vehicles.

Tabulation

| | | Observed Frequency | | |
|---|---|---|---|---|
| **Income** | **Maybe** | **No** | **Yes** | **Grand Total** |
| **10 lakhs- 15lakhs** | 6 | 5 | 14 | **25** |
| **15 lakhs and above** | 5 | 6 | 7 | **18** |
| **3 lakhs-6 lakhs** | 8 | 4 | 26 | **38** |
| **6 lakhs-10 Lakhs** | 6 | 3 | 24 | **33** |
| **Less than 3 lakhs** | 7 | 2 | 27 | **36** |
| **Grand Total** | **32** | **20** | **98** | **150** |
| | | | | |
| | Expected Frequency | | | |
| **Income** | **Maybe** | **No** | **Yes** | **Grand Total** |
| **10 lakhs- 15lakhs** | 5.333 | 3.333 | 16.333 | **25** |
| **15 lakhs and above** | 3.84 | 2.4 | 11.76 | **18** |
| **3 lakhs-6 lakhs** | 8.107 | 5.067 | 24.827 | **38** |
| **6 lakhs-10 Lakhs** | 7.04 | 4.4 | 21.56 | **33** |
| **Less than 3 lakhs** | 7.68 | 4.8 | 23.52 | **36** |
| **Grand Total** | **32** | **20** | **98** | **150** |

Table 21

| Calculation for $\chi$ 2 | | |
|---|---|---|
| **Observed Frequency(Oi)** | **Expected Frequency(Ei)** | $(O_i - E_i)^2/E_i$ |
| 26 | 24.827 | 0.055 |
| 27 | 23.52 | 0.514 |
| 24 | 21.56 | 0.276 |
| 14 | 16.333 | 0.333 |
| 7 | 11.76 | 1.927 |
| 8 | 8.107 | 0.001 |
| 7 | 7.68 | 0.060 |
| 6 | 7.04 | 0.153 |
| 6 | 5.333 | 0.083 |
| 4 | 5.067 | 0.224 |
| 21 | 18.773 | 0.350 |
| | **$\chi$ 2 calculated** | 3.980 |
| | **Degree of freedom** | 4 |
| | $\chi$ 2 **tabulated** | 9.48 |

Table 22

**Note:** 4 degree of freedom is lost as there are 5 expected frequencies are less than 5.
**Result:** From the above calculations, we observe that $\chi$ 2 calc $< \chi$2 tab at 5% level of significance. Hence, we fail to reject Ho.

**Conclusion:** There is no effect of income of individual on willingness to buy electric vehicles.

## 3. To find relationship between Age group and willingness to buy.

**Hypothesis:**

$H_0$: There is no significant relationship between age and willingness to purchase electric vehicles.

$H_1$: There is a significant relationship between age and willingness to purchase electric vehicles.

Tabulation

| | Observed Frequency | | | |
|---|---|---|---|---|
| **Age** | **Maybe** | **No** | **Yes** | **Grand Total** |
| **18-25** | 14 | 8 | 35 | **57** |
| **25-40** | 6 | 9 | 21 | **36** |
| **40-50** | 6 | 2 | 32 | **40** |
| **50 and above** | 6 | 1 | 10 | **17** |
| **Grand Total** | **32** | **20** | **98** | **150** |
| | | | | |
| | **Expected Frequency** | | | |
| **Age** | **Maybe** | **No** | **Yes** | **Grand Total** |
| **18-25** | 12.16 | 7.6 | 37.24 | **57** |
| **25-40** | 7.68 | 4.8 | 23.52 | **36** |
| **40-50** | 8.533 | 5.333 | 26.133 | **40** |
| **50 and above** | 3.627 | 2.267 | 11.107 | **17** |
| **Grand Total** | **32** | **20** | **98** | **150** |

Table 22

| Calculation of Chi-square Value | | |
|---|---|---|
| **Observed Frequency** $(O_i)$ | **Expected Frequency** $(E_i)$ | $(O_i - E_i)^2/E_i$ |
| 35 | 37.24 | 0.134 |
| 32 | 26.133 | 1.317 |
| 21 | 23.52 | 0.27 |
| 14 | 12.16 | 0.278 |
| 10 | 11.107 | 0.110 |
| 6 | 8.533 | 0.752 |
| 6 | 7.68 | 0.367 |
| 8 | 7.6 | 0.021 |
| 2 | 5.333 | 2.083 |
| 16 | 10.693 | 2.633 |
| | $\chi$ 2 calc | 7.967 |
| | Degree of freedom | 4 |
| | $\chi$2 tab | 9.48 |

Table 23

**Note:** 2 degree of freedom is lost as there are 3 expected frequencies are less than 5.

**Result:** From the above calculations, we observe that $\chi$ 2 calc < $\chi$2 tab at 5% level of significance. Hence, we fail to reject Ho.

**Conclusion:** There is no effect of age on willingness to buy electric vehicles.

## 4. To find relationship between Age group and awareness towards carbon emission from fossil fuel.

**Hypothesis:**

$H_0$: There is no significant relationship between age and **awareness towards carbon emission from fossil fuel**.

$H_1$: There is a significant relationship between age and **awareness towards carbon emission from fossil fuel**.

Tabulation

| | Observed Frequency | | | | |
|---|---|---|---|---|---|
| | **Not Very important** | **Neutral** | **Important** | **Very important** | **Grand Total** |
| **18-25** | 7 | 6 | 20 | 24 | **57** |
| **25-40** | 7 | 14 | 6 | 9 | **36** |
| **40-50** | 6 | 10 | 11 | 13 | **40** |
| **50 and above** | 1 | 5 | 5 | 6 | **17** |
| **Grand Total** | **21** | **35** | **42** | **52** | **150** |
| | **Expected Frequency** | | | | |
| | **Not Very important** | **Neutral** | **Important** | **Very important** | **Grand Total** |
| **18-25** | 7.98 | 13.3 | 15.96 | 19.76 | **57** |
| **25-40** | 5.04 | 8.4 | 10.08 | 12.48 | **36** |
| **40-50** | 5.6 | 9.333 | 11.2 | 13.867 | **40** |
| **50 and above** | 2.38 | 3.967 | 4.76 | 5.893 | **17** |
| **Grand Total** | **21** | **35** | **42** | **52** | **150** |

Table 24

| Calculation of Chi-square Value | | |
|---|---|---|
| **Observed Frequency(Oi)** | **Expected Frequency(Ei)** | **(Oi-Ei)^2/Ei** |
| 24 | 19.76 | 0.909 |
| 20 | 15.96 | 1.022 |
| 13 | 13.867 | 0.054 |
| 6 | 13.3 | 4.006 |
| 9 | 12.48 | 0.970 |
| 11 | 11.2 | 0.003 |
| 6 | 10.08 | 1.651 |
| 10 | 9.333 | 0.047 |
| 14 | 8.4 | 3.733 |
| 7 | 7.98 | 0.120 |
| 6 | 5.893 | 0.002 |
| 6 | 5.6 | 0.028 |
| 7 | 5.04 | 0.762 |
| 11 | 11.107 | 0.001 |
| | **$\chi$ 2 calculated** | **13.313** |
| | **Degree of freedom** | **7** |
| | **$\chi$2 tabulated** | **14.067** |

Table 24

**Note:** 2 degree of freedom is lost as there are 3 expected frequencies are less than 5.

**Result:** From the above calculations, we observe that $\chi$ 2 calc < $\chi$2 tab at 5% level of significance. Hence, we fail to reject Ho.

**Conclusion:** There is no effect of age on awareness towards emission from traditional vehicles.

# 4.2 STATISTICAL ANALYSIS: Z-TEST FOR SIGNIFICANCE OF PROPORTIONS

## 5. To find if electric vehicles will eventually replace traditional internal combustion engine vehicles as the primary mode of transportation

$H_0$:The electric vehicles will not replace traditional internal combustion engine vehicles, i.e., P=0.5

vs

$H_1$: The electric vehicles will replace traditional internal combustion engine vehicles, i.e., P ≠ 0.5

| EVs will replace fossil-fuel vehicles? | Frequency |
|---|---|
| Yes | 82 |
| (Maybe + No) | 68 |
| | 150 |

Table 25

Here, n=150 and X=82.

Thus, p= X/n

p =(82/150)

p =0.5466

Hence, under the null hypothesis Ho, the test statistic z is given as :

$$Z = \frac{p - P}{\sqrt{(PQ)/n}}$$

$$Z = \frac{(0.5466 - 0.5)}{\sqrt{(0.5 * 0.5)/150}}$$

$$Z = 1.413$$

**Result:** From the above calculations, we observe that Z calculated < Z tabulated (Z=1.96 for two tailed test) at 5% level of significance. Hence, we fail to reject Ho.

**Conclusion:** Hence, we do not find enough evidence for rejecting the null hypothesis $Ho$. Thus, we fail to reject $Ho$. Hence, according to people's opinion it is difficult to replace traditional fossil fuel vehicles with EV's in short run.