MARKET SEGMENTATION
ELECTRIC VEHICLE START UP

By

Sarvesh Harikant

Avinash Aryan

Laiba Noor

Sankha Subhra Mukherjee

Overview

India's automobile sector is one of the largest in the world, accounting for 7.1 percent of the country's GDP. As a person's salary rises, his or her first priority is to purchase a car. Nowadays, owning a car is more of a need than a luxury. Currently, 100 percent Foreign Direct Investment (FDI) is permitted in this sector, which means that foreign investors do not need prior authorization from the Indian government. During the period April-January 2017, private car sales increased by 9.17 percent, commercial vehicle sales increased by 3.03 percent, and two-wheeler sales increased by 8.29 percent.

During the fiscal year 2016-17, a total of 37,91,540 passenger vehicles, 8,10,286 commercial vehicles, 7,83,149 three-wheelers, and 1,99,29,485 two-wheelers were produced. According to the Confederation of Indian Industry, the Indian automobile sector is the world's largest three-wheeler market, second largest two-wheeler market, tenth largest passenger car market, fourth largest tractor market, fifth largest commercial vehicle market, and fifth largest bus and truck segment. From April 2000 to March 2017, the vehicle industry received a total of Rs. 92,218.42 crore, or 5.02 percent of overall FDI inflows in India.

Electric vehicles (EVs) are playing an important role in addressing the difficulties of air pollution and greenhouse gas (GHG) emissions in India. India has five of the top ten most polluted cities in the world.

In the winter of 2020, India's capital, New Delhi, implemented an Odd-Even selection programme based on licence plate number to reduce personal car traffic, specifically to prevent contamination of air quality due to the presence of smog (The Economic Times, 2019). The transportation sector is a substantial contributor to global GHG emissions. The transportation sector accounts for over 15% of worldwide GHG emissions and more than 20% of energy-related CO2 emissions (Our World in Data, 2020).

EVs have recently emerged as a feasible answer to clean and sustainable mobility, with the goal of boosting the city's economy, lowering pollution levels, and creating jobs in the transportation industry.

EV sales increased by 15% in 2019 compared to 2018, led by EV sales in Europe — Germany, France, the United Kingdom, and Spain (93%) — followed by China (17%) and other nations (22%). (Deloitte, 2020). The global number of electric vehicles increased by more than three million to 10.9 million in 2020, an increase of more than three million from the previous year. China continues to be the undisputed leader, with over five million EVs in its fleet, followed by the United States with 1.77 million (Automotive World Report, 2020).

Market Overview

The Indian Electric Vehicle Market was valued at USD 5 billion in 2020 and is predicted to reach USD 47 billion by 2026, growing at a CAGR of more than 44% during the forecast period (2021-2026).

The Indian Electric Vehicle Market has been impacted by the COVID-19 epidemic, which has resulted in supply chain delays and the shutdown of production units across the country due to continual lockdowns and travel restrictions. However, the electric vehicle (EV) sector in India is still in its infancy. Because of many government efforts and programmes, it is predicted to grow at a considerably quicker rate during the forecast period.

Meanwhile, the difference in India's road transport mobility demand characteristics compar ed to other developed nations may be appreciated by the fact that two-wheelers account for over 79 percent of total vehicle demand in India (NITI Aayog Report, 2 020), as seen in **Fig. 1.** Utilities from RE infrastructure corporations and government agencie s are bullish on the EV future and are working on the ground to develop a preference for EVs in the foreseeable future as demand increases.

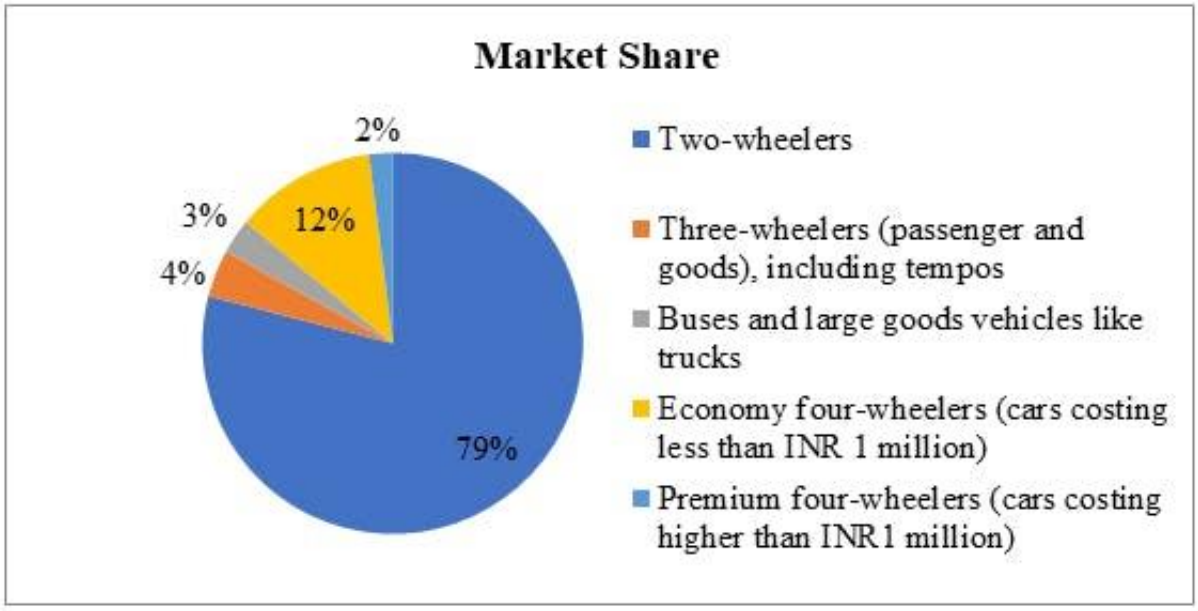


Fig 1. Market share utilities from RE infrastructure

E-commerce companies, such as Amazon, are initiating projects to use e-Mobility for last-mile delivery in order to reduce their carbon impact. India is experimenting with e-Mobility for public transportation, and the country has already deployed electric intercity buses in several major cities. Furthermore, state governments are actively involved in the implementation of policies encouraging the use of EVs. Kerala, for example, plans to put one million electric vehicles on the road by 2022 and 6,000 e-buses in public transportation by 2025.

Telangana plans to attain EV sales objectives of 80 percent 2- and 3-wheelers (motorcycles, scooters, auto-rickshaws), 70 percent commercial automobiles (ride-hailing businesses like Ola and Uber), 40 percent buses, 30 percent private cars, and 15 percent electrification of all vehicles by 2025. Following the launch of the FAME India plan, which aims to transition toward e-mobility in the light of expanding international policy commitments and environmental difficulties, the EV market in India has gained substantial traction. Furthermore, India has the greatest untapped market in the world, particularly in the electric two-wheeler segment.

India's Transition to EVs

Road transportation and fossil fuels have been inextricably linked in the past, with EVs only s ucceeding in a few niche areas.

According to recent studies, the world outside of Europe, China, and the United States is lag ging behind in terms of EV market exploration for a variety of reasons, including a lack of go vernment commitment, insufficient/unsuitable charging infrastructure, cultural differences regarding mobility models, and so on (Deloitte, 2020).

Electric minibuses are being introduced by state governments for intracity travellers. However, the industry was troubled by economic uncertainties, the difficulty of transitioning to BS-VI standards, the COVID-19 epidemic, statewide lockdown, supply-chain bottlenecks, and workforce migration, all of which hurt global car sales. Figure 2 depicts the important investment considerations related to the seamless adoption of EV technology, government laws, CapEx and OpEx models (NITI Aayog, 2021).

Charging Stations

Throughout India, high-level rapid charging stations are being constructed along major highways. In terms of charging station security, governments may consider installing charging stations beneath hotspots. Because flyovers are erected at the intersections of national and state highways, these stations will reduce right of way (RoW) difficulties. As a result of the increased customer access, overall startup costs will be greatly lowered. The Bihar government has set a goal of 400 charging stations along strategic routes and tourist attractions in the state. The emphasis is on regions where a consumer spends an average of one hour during transit for food and rest.

In order to address its unique mobility demand, India has built its own EV market, in line with global trends. Last year, India's embryonic EV market accounted for barely 5000 of the country's total 2.4 million car sales (The Hindu, 2021). Due to a lack of local component and battery manufacture, insufficient charging infrastructure, and the high cost of EVs, there have been few takers in the price-conscious market (**see Table 1 below**) (AutoTech Review, 2020). As a result, rather than relying on an EV, EV owners regard it as an optional car for a planned trip.

Along major highways across India, high-level quick charging stations are being built. Governments may explore placing charging stations beneath hotspots to improve charging station security. Because flyovers are built at the intersections of national and state highways, these stations will help with right of way (RoW) issues. Overall setup expenses will be significantly reduced as a result of enhanced consumer access. The state of Bihar's government has set a goal of 400 charging stations along vital roads and tourism destinations. The focus is on areas where consumers spend an average of one hour in transit for meals and rest.

Sl.	Types		Electric Vehicle		IC Engine Vehicle		
1.	Variants		Mahindrae2o Plus	Tata Nexon EV (XZ)	Ritz Petrol Vehicle	Tata Nexon XZA (Petrol)	Tata Nexon XZA (Diesel)
2.	Vehicle Costs		INR 5.46 lakhs	INR 16.40 lakhs	INR 4.3 lakhs	INR 11.00 lakhs	INR 12.80 lakhs
3.	Running Cost						
	a).	Capacity	10.08 kWh	30.20 kWh	43 L	44 L	44 L
	b).	Cost of Fuel	INR 7.22/Unit	INR 7.22/Unit	INR 91.35	INR 91.35	INR 84.35
	c).	Total Cost	INR 72.78	INR 218	INR 3928	INR 4020	INR 3712
	d).	Range	110 km	312 km	800 km	748 km	946 km
	e).	Cost/km	INR 1.51	INR 1.44	INR 4.91	INR 5.37	INR 3.93
4.	Maintenance Cost		Substantial		Nominal		
	a).	Battery Replacement Cost	INR 1.5-3 lakhs	-	INR 20000	INR 29020	INR 42660
	b).	Battery Life	3-5 Years	8 Years or 160000 km	6 Years	6 Years	6 Years

Fig. AutoTech Review 2020

Phase-I (2017-2019 Action Plan): The initial action plan focuses on influencing the government's position, company growth, economic prospects, and the initial setup.

Phase-II (Action Plan for 2020-2024): Focuses on seizing commercial opportunities as they arise, assembling and implementing solutions through a broader geography package, and developing initial setup. With continual technological breakthroughs, coalition among strategic parties will be critical in meeting these aims.

Phase III (Action Plan for 2025-2032): Gathering all economically possible choices to meet national goals.

In accordance with this action plan, the Government of India (GoI) launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME-India) Scheme to promote the progressive adoption of reliable, economical, and effective electric and hybrid vehicles (GoI, 2019). The scheme's first phase was approved for a two-year period beginning April 1, 2015. The programme has been expanded from time to time, with the most recent extension allowing for a period of up to March 31, 2019. In February 2019, the GoI authorised the FAME-II plan, with a fund demand of INR 10,000 crores (US$1.3 billion) for the fiscal years 2020 to 2022. (The Economic Times, 2019).

METHODOLOGY

The methodology used in this report (Fig. 1) began with a thorough review of the facts and figures influencing car buying behaviour and trends in India. Then, a questionnaire survey was prepared to learn about the present buying preferences and decisions in India. The questionnaire was created in Google Forms and sent to prospective responders via multiple channels such as social media (WhatsApp, Facebook distribution of hardcopies). The responses were examined, and the outcomes are discussed in this paper.

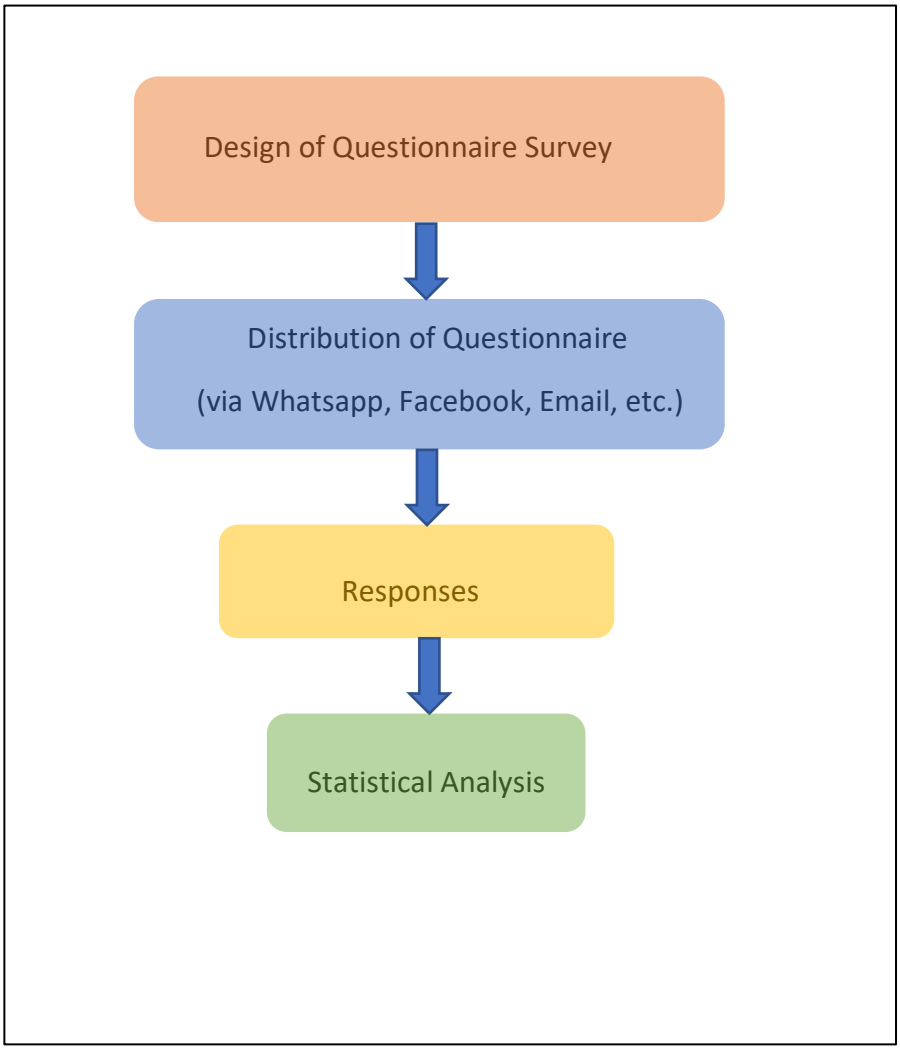


Fig 3. Methodological Diagram

Results

Majority of the respondents (73 %) in the survey were aged between 18-25, followed by 24% being aged between 26 – 35 (as shown in the Figure)

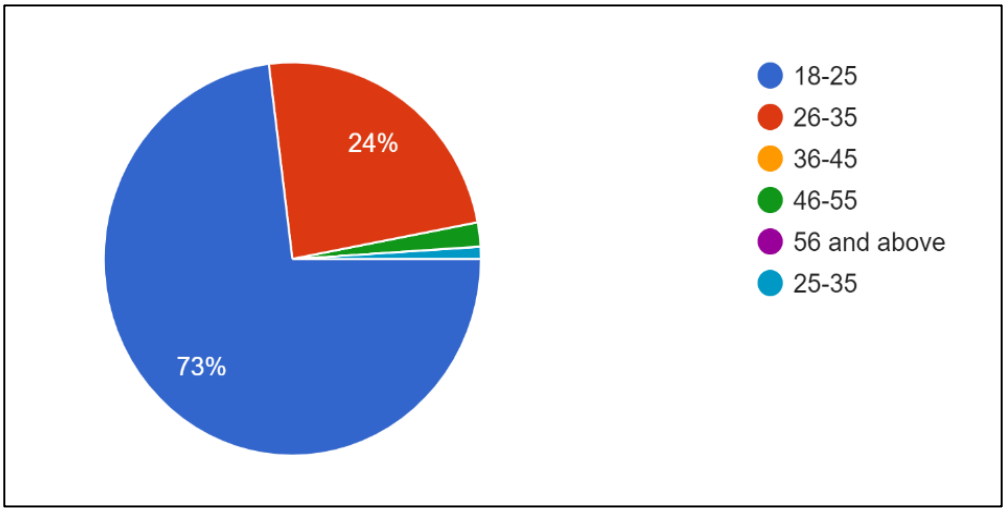


Fig 4. Age Group

The chart below illustrates that the majority of the respondents were working professionals which is around 71% of the total, followed by students which is 24%.

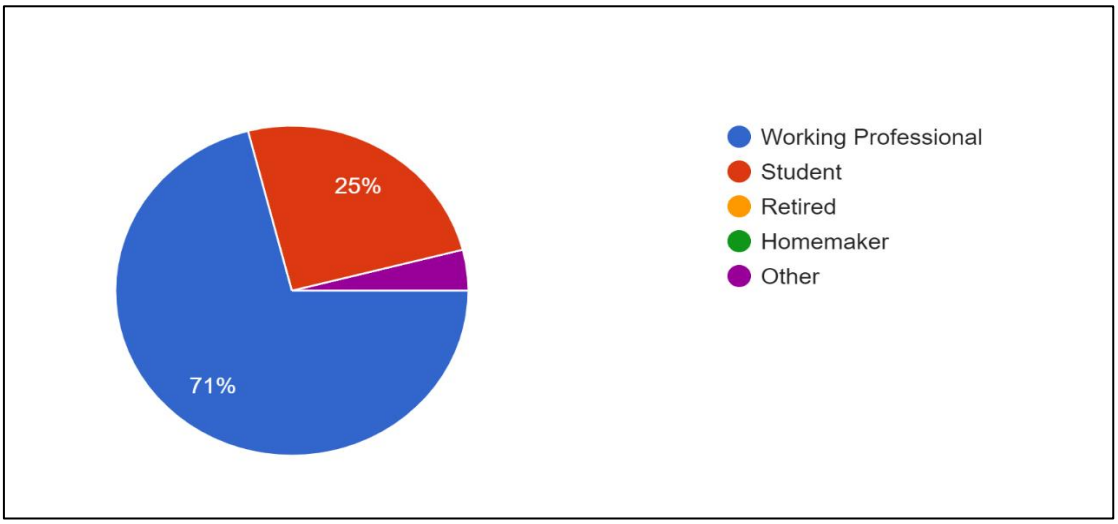


Fig 5. Occupation

Figure 6 illustrates the income group of respondent's income. Most of the respondants falls under the income group of Rs. 100,000 – 500,000 which is 41% of the total, followed by the annual income of between Rs. 500,000-1,000,000.

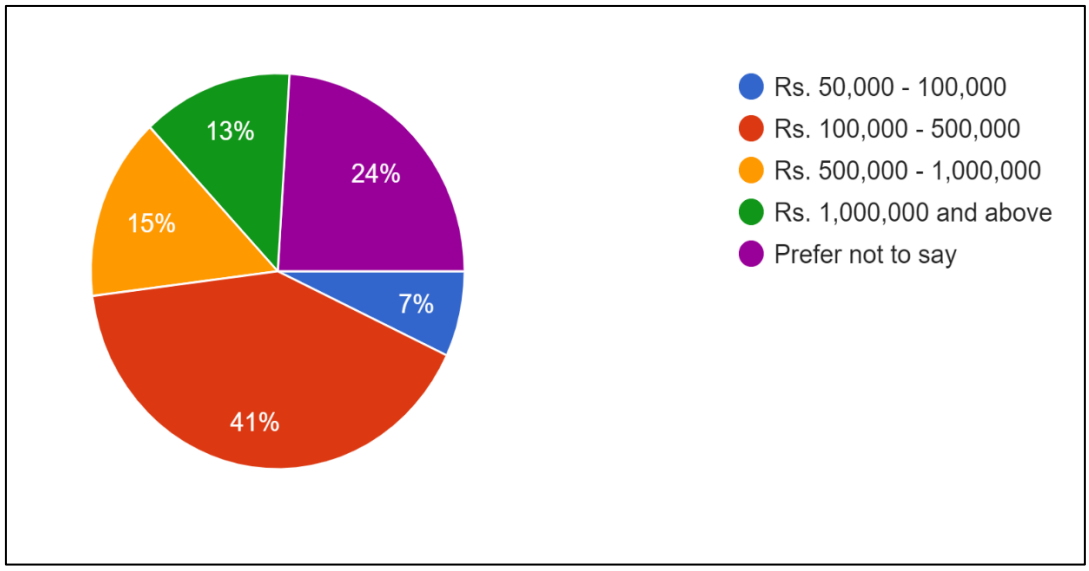


Fig 6. Annual Income

Owning an Electric Car

Around 99% of the people in the survey do not own an Electric vehicle, which means that only 1% of the people own an electric car. As shown in the figure below, people are not much interested in electric vehicle.

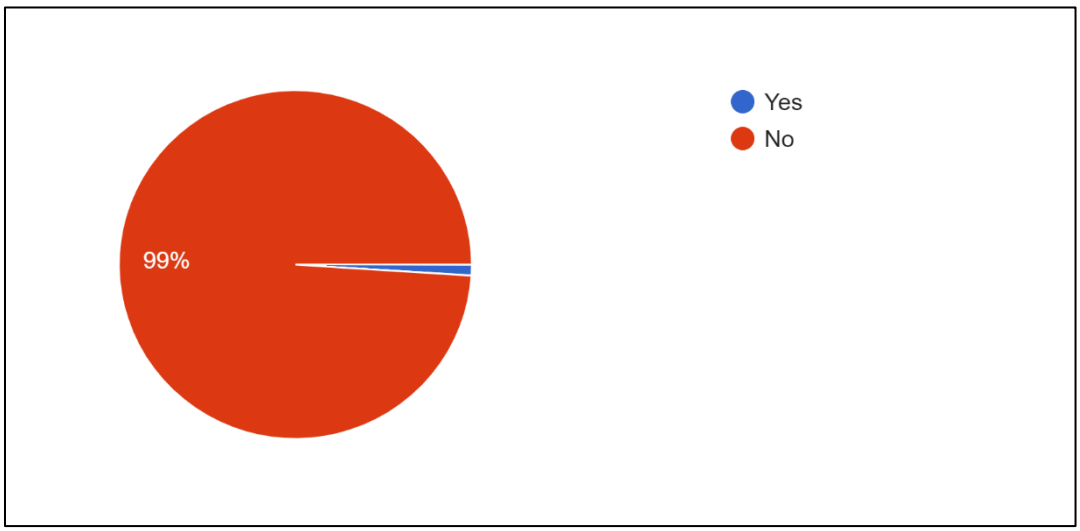


Fig 7. Owning an Electric Vehicle

As the chart below illustrates that 74% of the respondents have not even driven an electric car. As well as only 17% of the total respondents have only driven an all electric car.

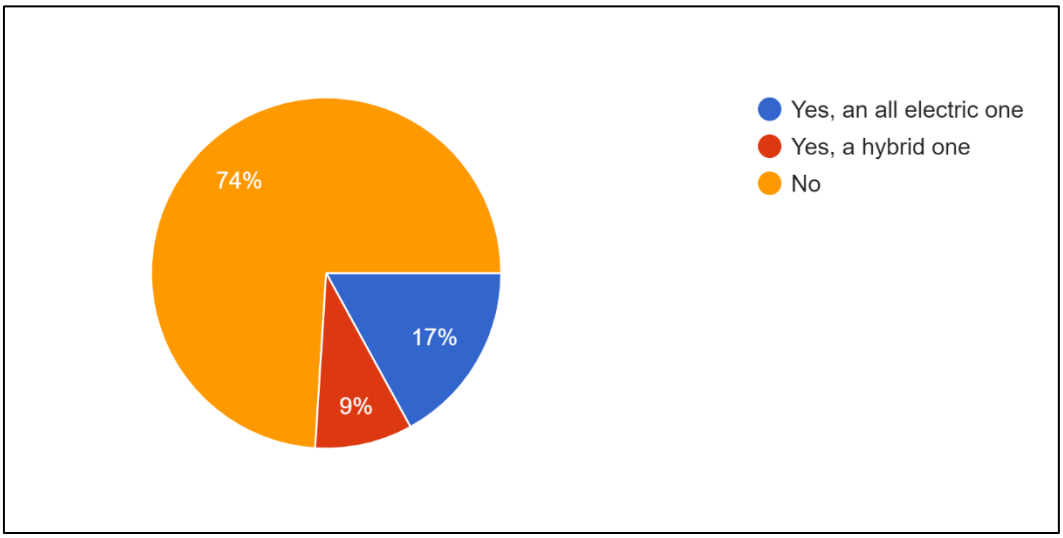


Fig 8. Driven an Electric Car

As shown in figure below, 59% of the people considered themselves as they are always environmental consicous, followed by 39% of the people who considered themselves as environment consicous but not always.

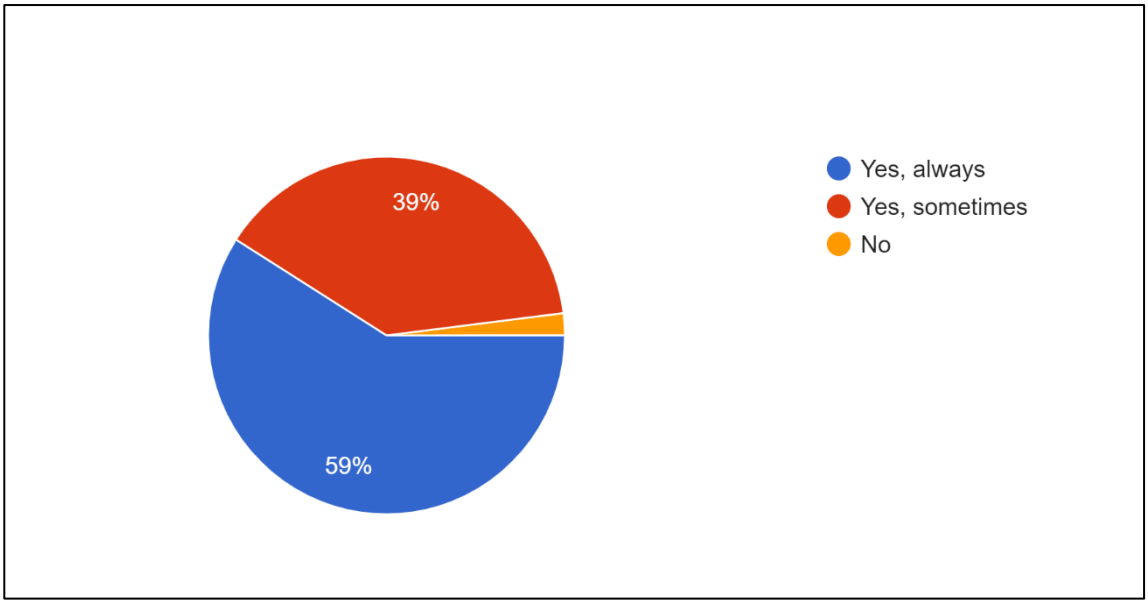


Fig 9. Environmental consicous

Among the factors that encourages the respondents to buy an electric vehicle were Price, Positive environmental effect, References, New trends, Test drives, Beneficial financial or insurance, Cheaper in operation, Low noise level. In which respondents 83% of the respondents choosed Positive environmental effect. The next factor that encouged the

respondents to buy an electric car was Low noise level which encouraged around 59% of the people, which shows environmental consicous encourages people to buy an electric vehicle.

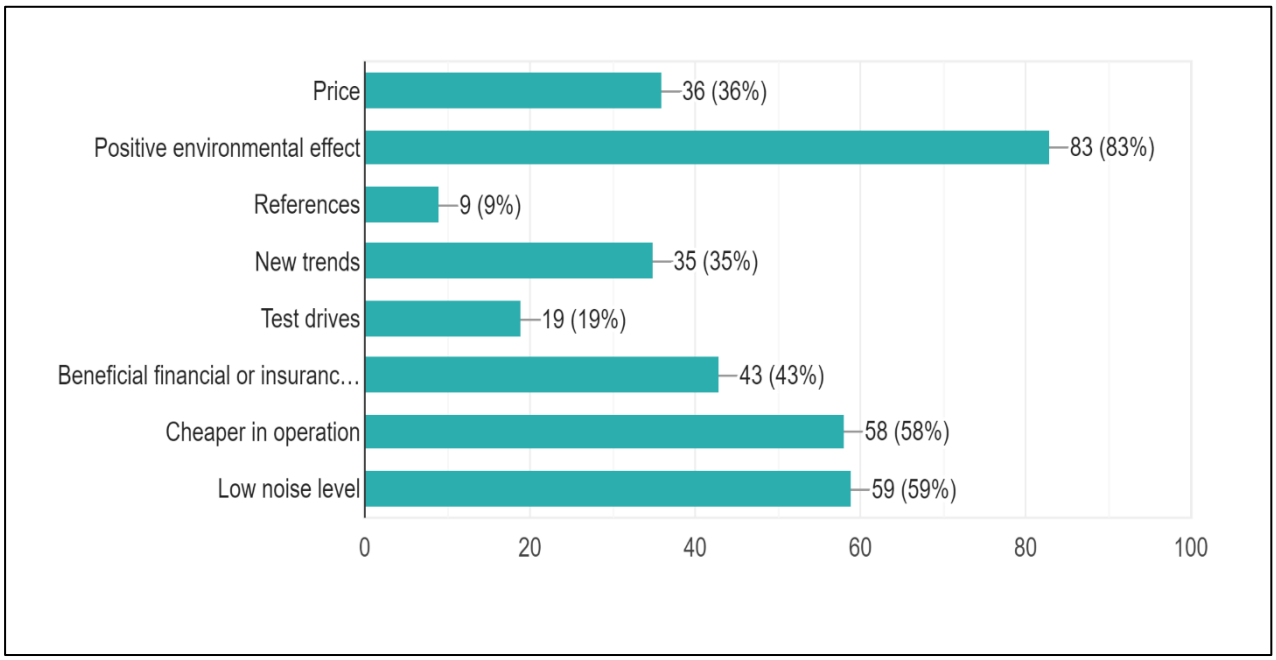


Fig 10. Factors encouraging to purchase an Electric vehicle

As for the factors that discourages the people to consider buying an electric car includes Limited range, long recharging time, Price, Lack of consumer choice, Lack of trust to new technologies, Unwillingness to go for a different type of car. In this 73% choose long recharging time as one of most discouraging factors, the other factor which discouraged the respondents was the high price they have to pay to own an electric vehicle, followed by limited range.

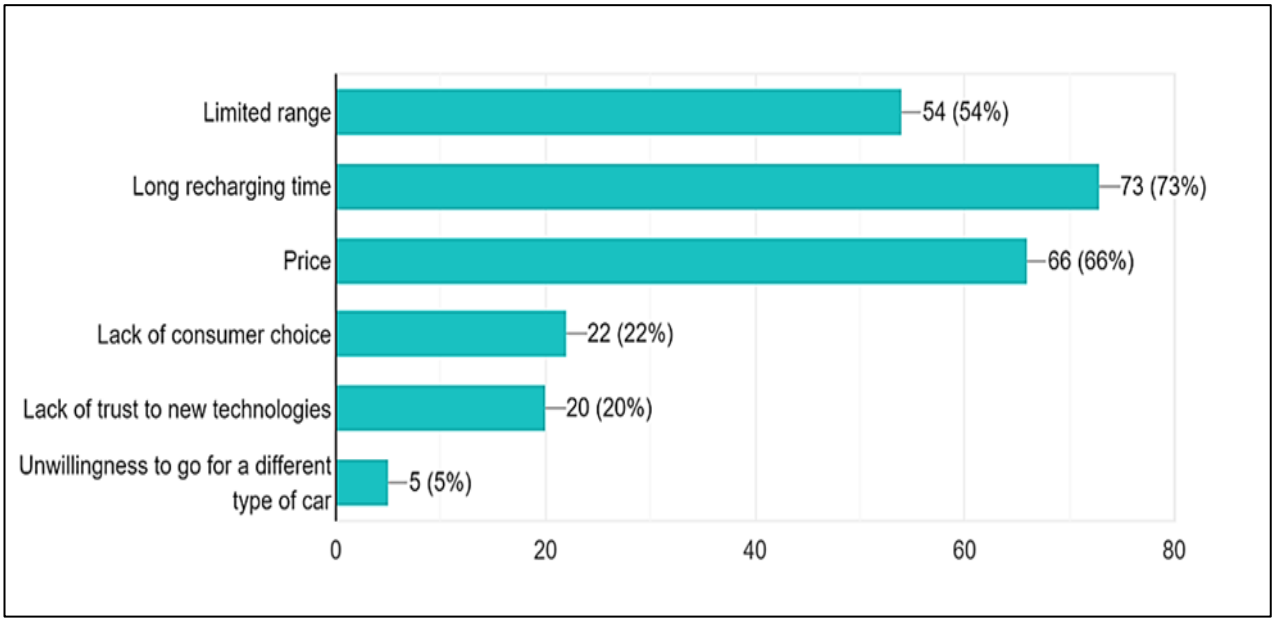


Fig 11. Factors discouraging to buy an electric vehicle

Some of the other responses includes the following results which are as follows:

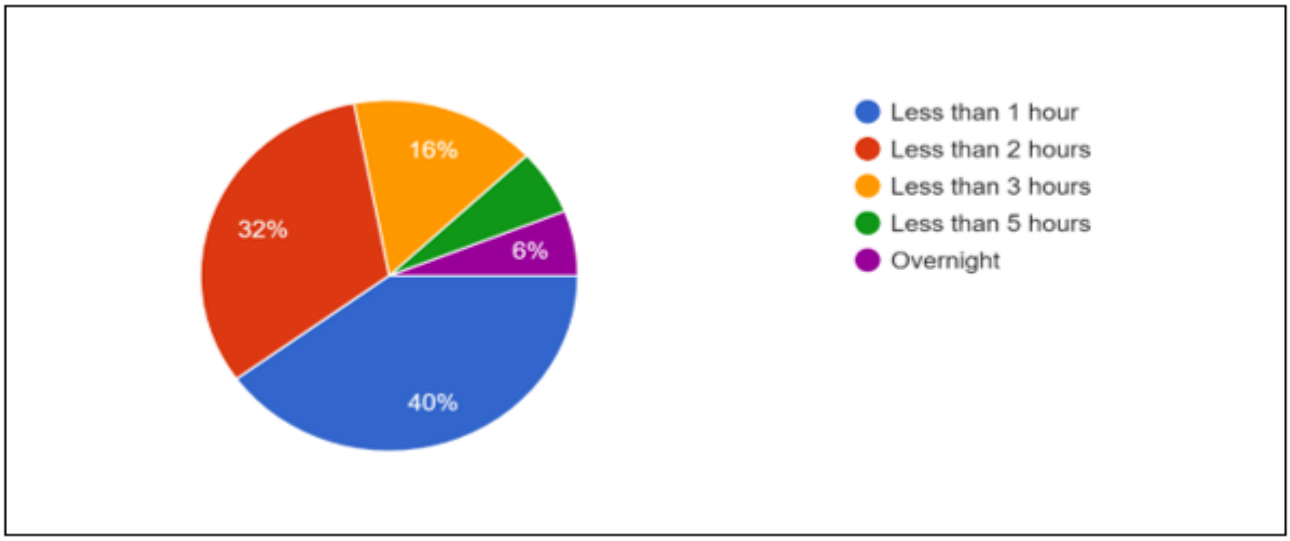
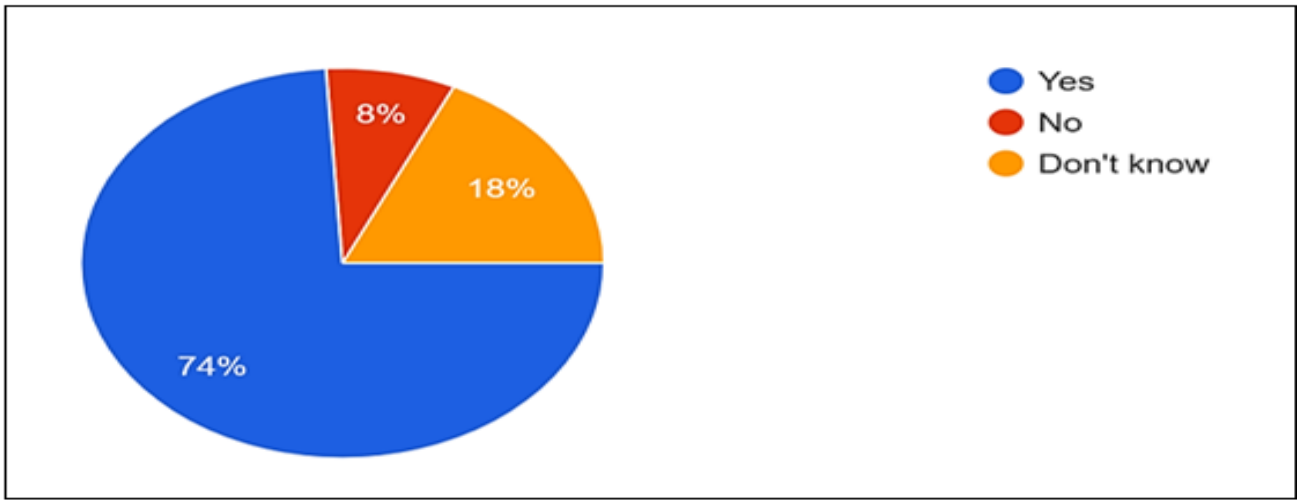


Fig 12. Time in which Battery should get fully charged



13.Economical electric Cars

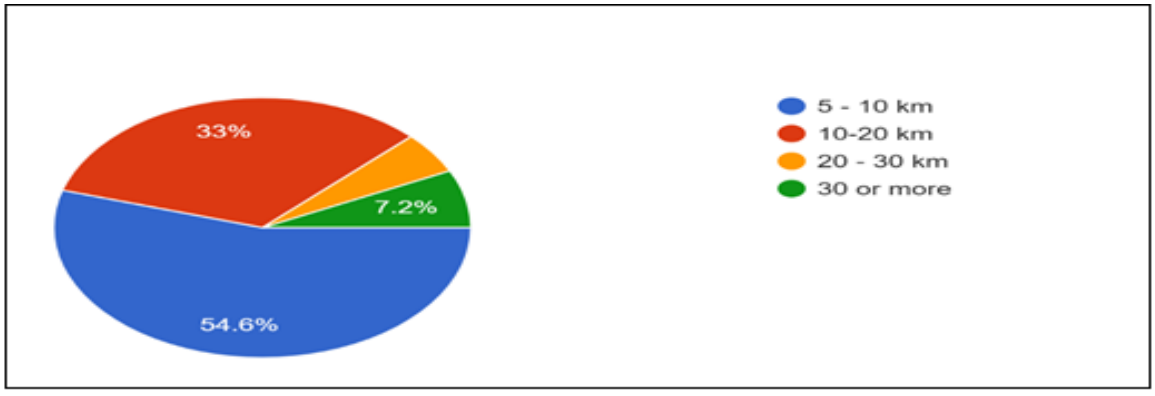


Fig.14. Distance at which the charging stations should be placed

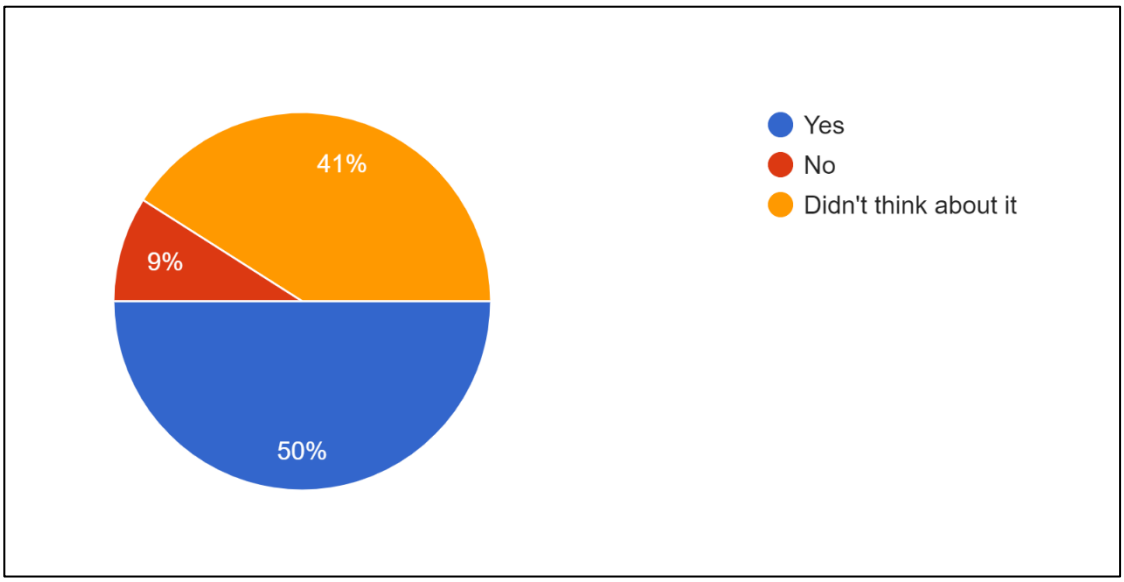


Fig 15. Convert your car to all electric car

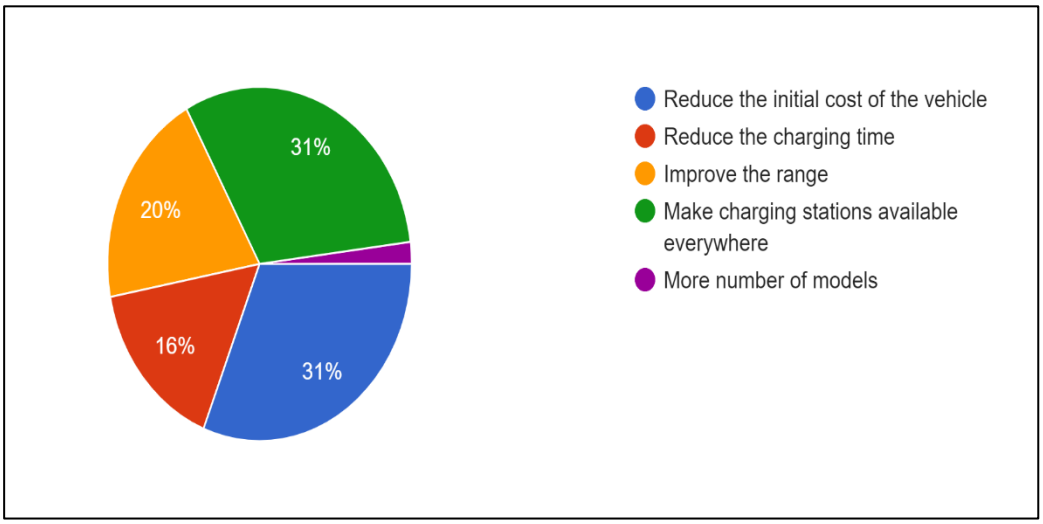


Fig 16. Improvements to be made

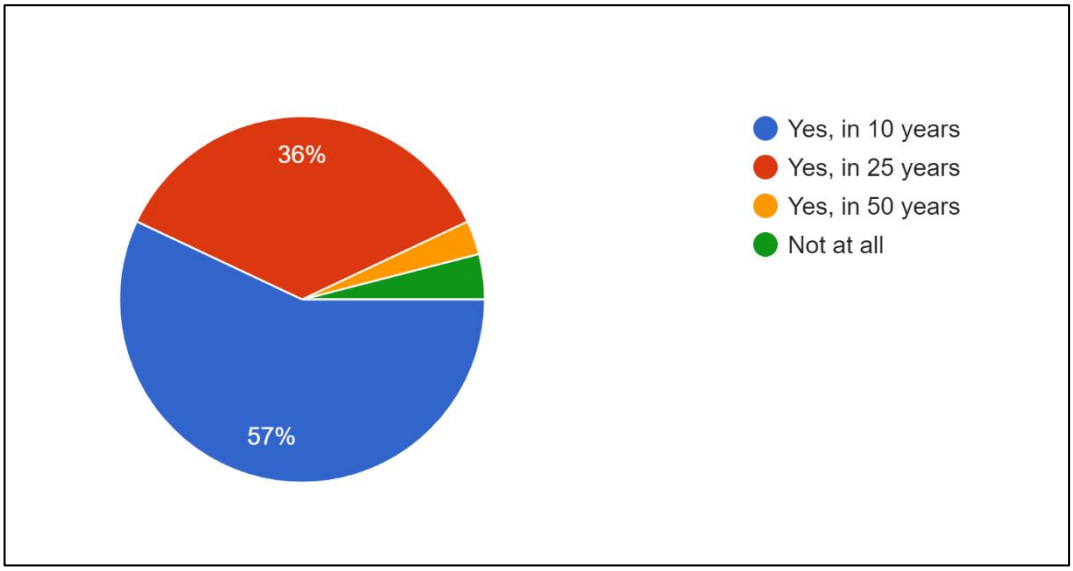


Fig 17. Electric cars surpass gasoline cars in near future

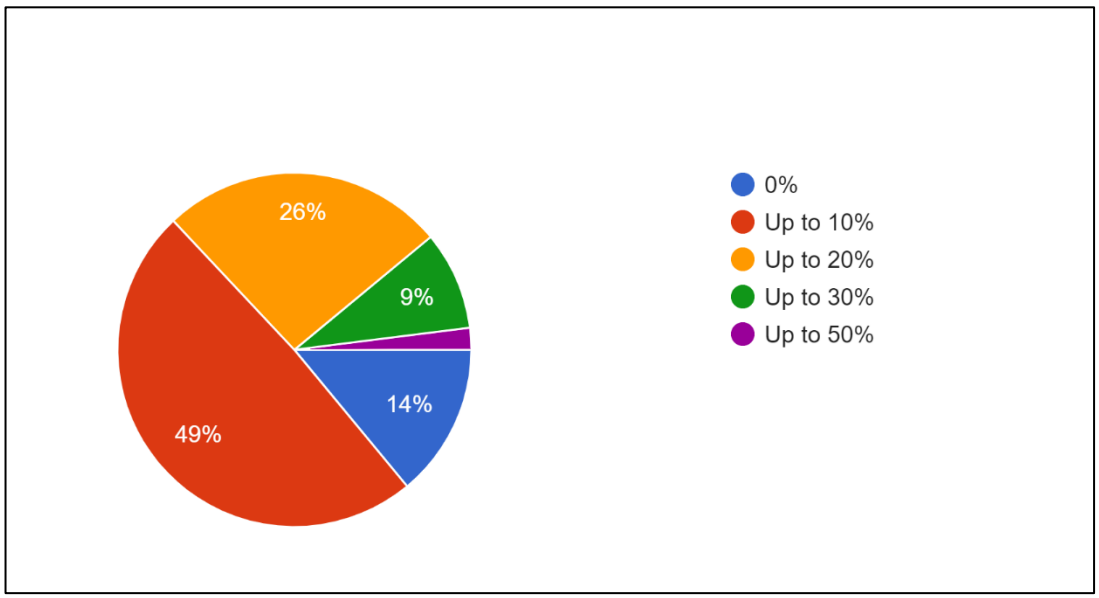


Fig 18. Percentage more pay for a new electric car with same performance

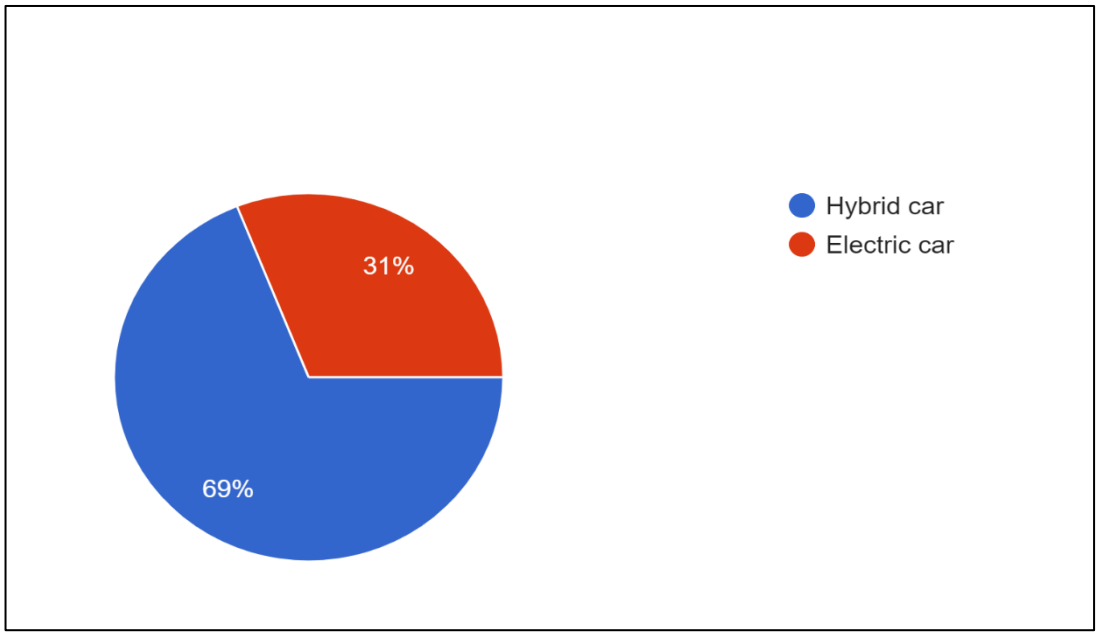


Fig 19. Prefer a hybrid car (use both electricity and fuel) or electric car

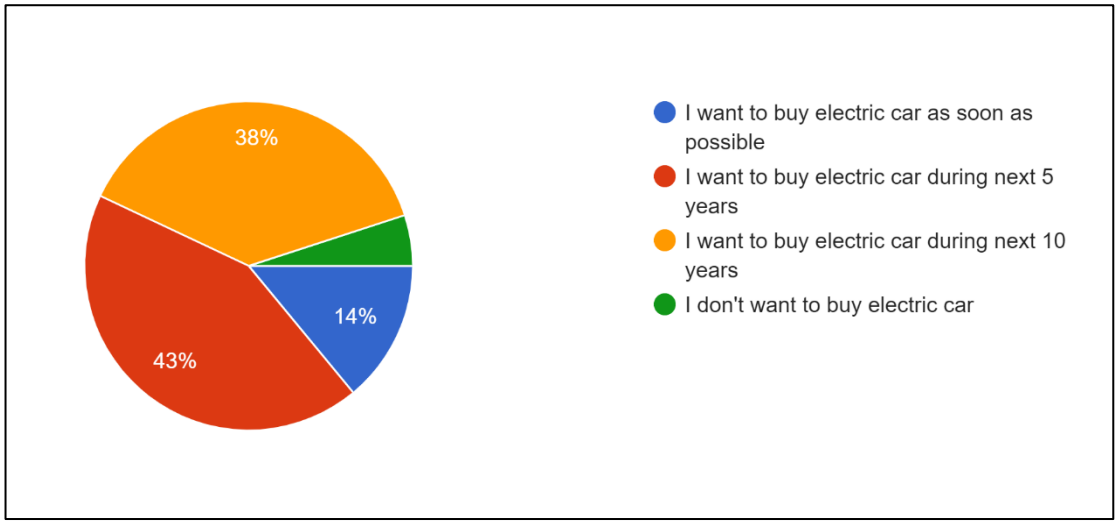
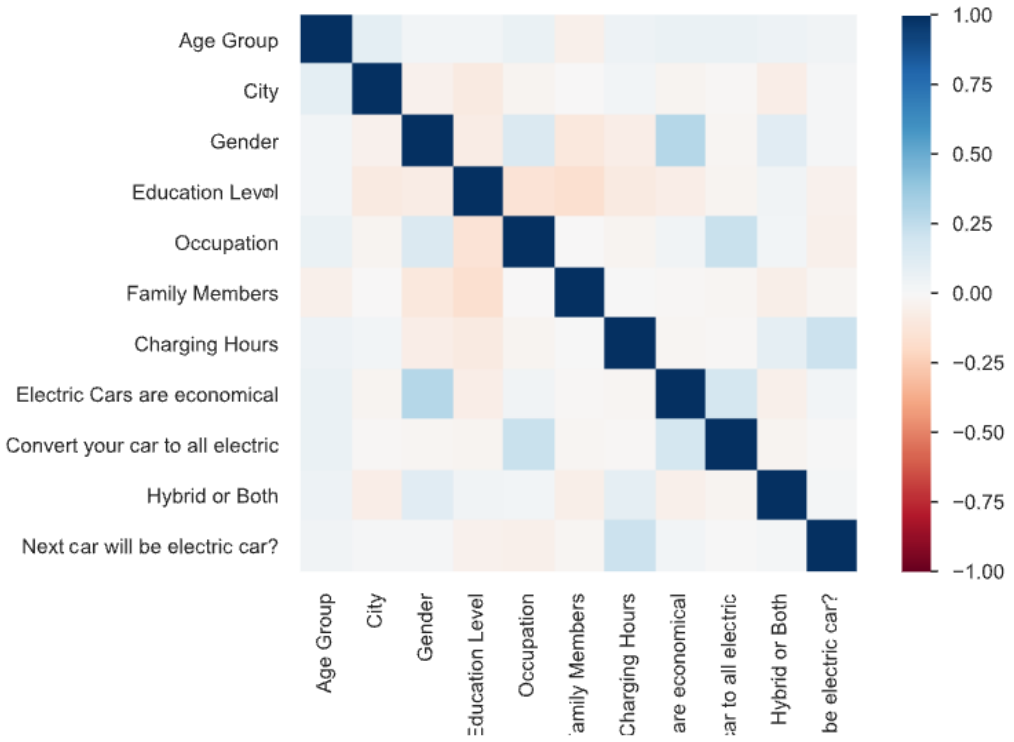


Fig 20. Next car to be electric car

Correlation



Analysis and Approaches used for Segmentation

Clustering

Clustering is one of the most common exploratory data analysis techniques used to get an intuition about the structure of the data. It can be defined as the task of identifying subgroups in the data such that data points in the same subgroup (cluster) are very similar while data points in different clusters are very different. In other words, we try to find homogeneous subgroups within the data such that data points in each cluster are as similar as possible according to a similarity measure such as euclidean-based distance or correlation-based distance. The decision of which similarity measure to use is application-specific. Clustering analysis can be done on the basis of features where we try to find subgroups of samples basedon features or on the basis of samples where we try to find subgroups of features based on samples.

K-Nearest Neighbour(KNN) Algorithm

- K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning technique.
- K-NN algorithm assumes the similarity between the new case/data and available casesand put the new case into the category that is most similar to the available categories.
- K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into awell suite category by using K- NN algorithm.
- K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problems.
- K-NN is a non-parametric algorithm, which means it does not make any assumption onunderlying data.
- It is also called a lazy learner algorithm because it does not learn from the training set immediately instead it stores the dataset and at the time of classification, it performs anaction on the dataset.
- KNN algorithm at the training phase just stores the dataset and when it gets new data, then it classifies that data into a category that is much similar to the new data.

How do I choose K?

In real-life problems where we have many points the question arises is how to select the valueof K?

Choosing the right value of K is called parameter tuning and it's necessary for better results. By choosing the value of K we square root the total number of data points available in the dataset.

a. K = sqrt (total number of data points).

b. Odd value of K is always selected to avoid confusion between 2 classes.

When is KNN?

a. We have properly labeled data. For example, if we are predicting someone is having diabetesor not the final label can be 1 or 0.

It cannot be NaN or -1.

b. Data is noise-free. For the diabetes data set we cannot have a Glucose level as 0 or 10000.It's practically impossible.

c. Small dataset.

How does KNN work?

We usually use Euclidean distance to calculate the nearest neighbor. If we have two points (x,y) and (a, b).

The formula for Euclidean distance (d) will be $d = sqrt((x-a)^2+(y-b)^2)$.

We try to get the smallest Euclidean distance and based on the number of smaller distances weperform our calculation.

Implementation

Data Sources

We conducted a survey from the major cities in India and gathered some datasets which arerelated to the case.

Packages/ Tools used:

1. Pandas: To read or load the datasets.

```
]: df = pd.read_csv('data.csv')
```

	Age Group	City	Gender	Education Level	Occupation	Family Members	Annual Income	Charging Hours	Electric Cars are economical	Charging stations	Convert your car to all electric	Hybrid or Both	Next car will be electric car?
0	29	Kolkata	Male	Postgraduate	Working Professional	5	150000	1	Yes	15	Yes	Hybrid car	5
1	29	Mumbai	Male	Graduate	Working Professional	4	1000000	1	Yes	8	Yes	Electric car	5
2	25	Mumbai	Male	Graduate	Working Professional	4	5000	5	Yes	15	Didn't think about it	Hybrid car	5

Data Pre-processing

Tools used :

1. SkLearn :We have used LabelEncoder() to encode our values.

```
from sklearn.preprocessing import LabelEncoder
label_encoder = LabelEncoder()
```

```
df['City']= label_encoder.fit_transform(df['City'])
df['Gender']= label_encoder.fit_transform(df['Gender'])
df['Education Level']= label_encoder.fit_transform(df['Education Level'])
df['Occupation']= label_encoder.fit_transform(df['Occupation'])
df[' Electric Cars are economical']= label_encoder.fit_transform(df[' Electric Cars are economical'])
df['Convert your car to all electric']= label_encoder.fit_transform(df['Convert your car to all electric'])
df['Hybrid or Both']= label_encoder.fit_transform(df['Hybrid or Both'])
```

```
df.head()
```

	Age Group	City	Gender	Education Level	Occupation	Family Members	Annual Income	Charging Hours	Electric Cars are economical	Charging stations	Convert your car to all electric	Hybrid or Both	Next car will be electric car?
0	29	14	2	3	2	5	1500000	1	2	15	2	1	5
1	29	0	2	1	2	4	1000000	1	2	8	2	0	5
2	25	19	2	1	2	4	50000	5	2	15	0	1	5
3	25	3	2	1	2	4	7500000	1	0	8	0	1	5
4	21	19	2	3	1	4	50000	12	0	15	0	1	5

Segmentation

Tools used:

1. Matplotlib(): To plot the graph.

Handling the non- correlated values

```
from statsmodels.stats.outliers_influence import variance_inflation_factor
```

```
X = df.drop(['City'],axis=1)
y = df['City']
```

```
def calc_vif(X):

    # Calculating VIF
    vif = pd.DataFrame()
    vif["variables"] = X.columns
    vif["VIF"] = [variance_inflation_factor(X.values, i) for i in range(X.shape[1])]

    return(vif)
```

```
X = df.iloc[:,:-1]
calc_vif(X)
```

	variables	VIF
0	Age Group	10.108819
1	City	2.977481
2	Gender	19.847772
3	Education Level	3.671436
4	Occupation	12.617601
5	Family Members	14.972987
6	Annual Income	2.176048
7	Charging Hours	2.839026
8	Electric Cars are economical	5.975061
9	Charging stations	5.423142
10	Convert your car to all electric	2.592471
11	Hybrid or Both	3.264585

Here, In this table we can say that family members and the occupation are not as correlated asthe other variables so we drop those variables. And also we can see that gender is less correlatedbut as we need it for the segmentation so we keep it.

```
X = X.drop(['Family Members', 'Occupation'], axis=1)
```

```
X.head()
```

	Age Group	City	Gender	Education Level	Annual Income	Charging Hours	Electric Cars are economical	Charging stations	Convert your car to all electric	Hybrid or Both
0	29	14	2	3	1500000	1	2	15	2	1
1	29	0	2	1	1000000	1	2	8	2	0
2	25	19	2	1	50000	5	2	15	0	1
3	25	3	2	1	7500000	1	0	8	0	1
4	21	19	2	3	50000	12	0	15	0	1

Here we split the dataset for testing and training, using sklearn.

```
from sklearn.model_selection import train_test_split

X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2, random_state=42)
```

Here we are scaling the values using StandardScaler()

```
from sklearn.preprocessing import StandardScaler
```

```
scaler = StandardScaler()
```

```
X_train = scaler.fit_transform(X_train)
```

```
X_test = scaler.transform(X_test)
```

Here, we use KNN algorithm to find the nearest neighbours, we train the model and classify the dataset. And we predict the model.

```
from sklearn.neighbors import KNeighborsClassifier
classifier = KNeighborsClassifier(n_neighbors=5)
```

```
classifier.fit(X_train, y_train)
```

```
KNeighborsClassifier()
```

```
y_pred = classifier.predict(X_test)
```

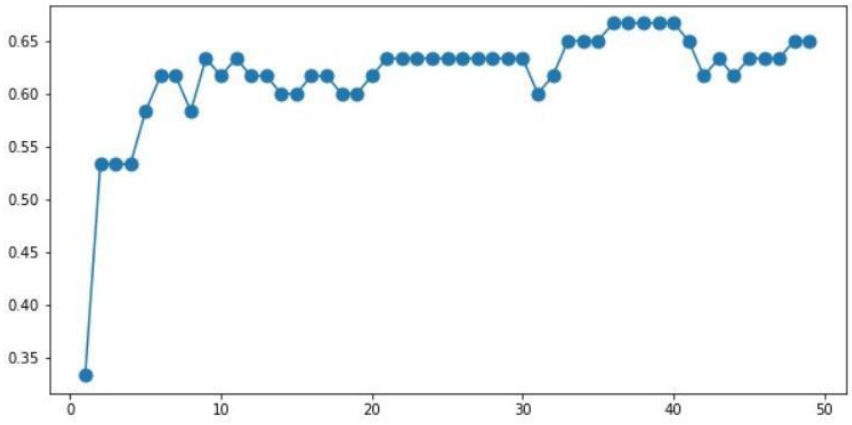
```
error_rate = []

for i in range(1,50):
    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train, y_train)
    pred = knn.predict(X_test)
    error_rate.append(np.mean(pred != y_test))

plt.figure(figsize=(15,10))
plt.plot(range(1,50),error_rate, marker='o', markersize=9)
```

The graph below tells how accurate the model is.

```
[<matplotlib.lines.Line2D at 0x2aef8f6dd00>]
```



Target segment

So from the analysis we can see that the customer mainly focus on the battery life of the vehicle and how easily they can access the charging stations. And people with a high amount of incometends to buy the vehicles.

Marketing Mix

Setting prices for our products is both an art and a science. Most importantly, you must know and understand your cost of production. From there you can adjust based on product characteristics, a specific pricing strategy, customer price sensitivity, customer values, and other factors. Price contributes to the perception of your product, that is, when consumers

see a product price it sends signals to them about quality, match with the market outlet, expectations for assistance, etc. Keeping accurate and complete records accounting for all steps – production, packaging, storage, promotion, transportation/distribution, and sales – will assistyou in setting a price and making adjustments as necessary.

4Ps of Marketing

The 4Ps helps companies to review and define key issues that affect the marketing of its products and services and is often now referred to as the 7Ps framework for the digital marketing mix. Marketing as a whole relies on all seven Ps. It is essential to consider them as a whole, and not in isolation. Customers must experience a coherent view of your company and your product, and that can only come from viewing the customer experience from end-to-end across all seven Ps.

Importance of Marketing

Mix It helps understand what our product or service can offer to our customers and helps plana successful product offering. Helps with planning, developing and executing effective marketing strategies. Help determine whether your product or service is suitable for your customers.

I) Product: Since the company is selling electric vehicles so it should depend on the factors that the customers are fond off.

II) Price:- The price should be a reasonable one and affordable for the customers.

III) Place:- Through the analysis we have seen that urban cities like Bangalore and Mumbai are the best suitable for the Electric Vehicle Start up.

IV) Promotion: Promotion can be based on the analysis. More offers and promotions can be given to the segments that are more valuable to the company.

Codes

https://github.com/Avikuz/Market-Segmentation-for-E.V-Startup-project

References

Dataset used for geographic analysis

- https://www.drivespark.com/four-wheelers/2019/state-wise-car-sales-india-report-for- fy2019-details-028980.html