



ELECTRIC VEHICLE

MARKET SEGMENTATION ANALYSIS OF ELECTRIC VEHICLES IN INDIA

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1. PROBLEM BREAKDOWN

1.1. FERMI ESTIMATION

Demand forecast of Electric Vehicles in India.

current no of EVs : 13,34,385 ~ 15,00,000

current no of non-EVs: 27,81,69,631 ~ 30,00,00,000

current % of EVs: 0.005%

To replace non-EVs with EVs, the ratio must be 1.

so, % increase in EVs in 2020 = 168% ~ 200%

Decrease in petrol/diesel cars = (previous market cap - current market cap) =(58% - 17%)
= 38% ~ 30%

overall counter per year of EVs = 230% ~ 250%

finding compound time (Assuming the manufacturing of EVs increases equally):

$$t = \ln(A/P) / (n(\ln(1+(r/n))))$$

(Here, we are using a compound interest formula, where t is time, P is principal, A is total number or amount after interest, r is interest rate and n is 1 .)

Using the formulae, we can deduce, time for EVs to be equal as non-EVs, in market,

so, $t = 4.229$ yrs ~ 5 years

so, by 2028 EVs should replace 80-90% of petrol and diesel cars in India.

Now, we know that EVs are a good market to invest in.

Which type of vehicle has higher market share in its segment?

We take top 2:

2 wheelers = 3.6%

3 wheelers = 47%

Hence, the demand and adoption of 3 wheelers is more by public in the EV segment.

Hence, the company should start by manufacturing 3 Wheelers.

1.2. OVERVIEW

Types of Electric Vehicle.

Robert Andreasen invented the first electric vehicle in 1839. Since that year scientists have tried to improve the original concept hoping that one day soon the electric vehicles may break the world's addiction to fossil fuels. This technology has a long way to go. The best batteries on the market are still too heavy and take too long to charge, the range is still too limited and the vehicles are too expensive for the average person although some of the world's best and brightest scientists are on the case as it looks at least several years before the average person can afford an electric car.

Analyzing the Electric Vehicle market in India using Segmentation analysis to come up with a feasible strategy to enter the market. Segmentation analysis is an important step before we embark on a marketing plan. It is important to learn how to analyze your audience and market. In effect, the carbon emission for EVs is not zero, but it is still less than that from petrol/diesel cars. Better performance: According to a US-based website, EV batteries convert 59-62% of energy into vehicle movement, while petrol-run vehicles only convert 17-21%, making **EVs more efficient**.

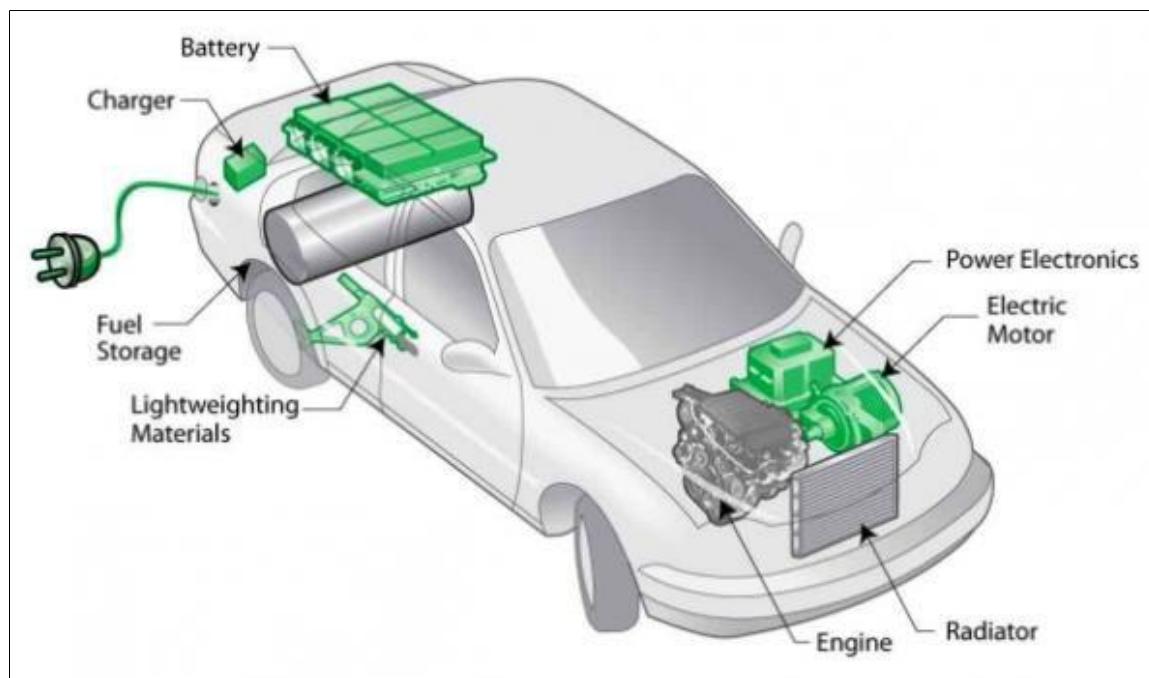
Advantages:

1. One of the benefits of electric cars is that they're easier on the environment. They have no exhaust system, which means they produce zero emission.
2. Electric vehicles run at about 1/3 the cost of gas-powered vehicles.
3. Maintenance of these vehicles is less frequent and less expensive and they have no oil changes.
4. Brakes don't wear out as fast because the engine slows the vehicle to produce electricity while driving.
5. Another benefit is that electric vehicles are quiet so quiet that legislators have considered requiring a noise making device be added to alert pedestrians of oncoming cars.

Disadvantages:

1. The mileage of old EVs are pretty short range, between 60 and 100 miles per charge, while newer EVs can travel 200 to 400 miles on a fully charged battery.
2. Charging an EV can take 15 to 20 hours to fully charge the battery in certain conditions.
3. Charging station availability is inconsistent. In areas where EVs are rare, Charging stations may be nearly non-existent.

What are the components involved in an electric vehicle?



What are the challenges in building an electric vehicle?

1. Shorter Driving Range and Degrading Batteries
2. Electric Vehicle Charging Infrastructure
3. Selection of Power Semiconductors
4. EV Reliability Is Key
5. Adapting to the Fluctuating Automotive Supply Chain

Market Overview:

The global electric vehicle market is segmented based on type, vehicle type, vehicle class, top speed, vehicle drive type and region. By type, it is divided into battery electric vehicle (BEV), plug in hybrid electric vehicle (PHEV) and fuel cell electric vehicle (FCEV). By vehicle type it is classified into 2 Wheelers, passenger cars and commercial vehicles. By vehicle class it is classified into mid-priced and luxury class. Based on top speed, it is segmented into less than 100 mph, 100 to 125 mph and more than 125 mph. By vehicle drive type, it is segmented into front wheel drive rear wheel drive and all-wheel drive. By region, the market is analysed across north, east, South, and western region of India.

2. DATA COLLECTION

2.1. FAME2 SCHEME DATASET

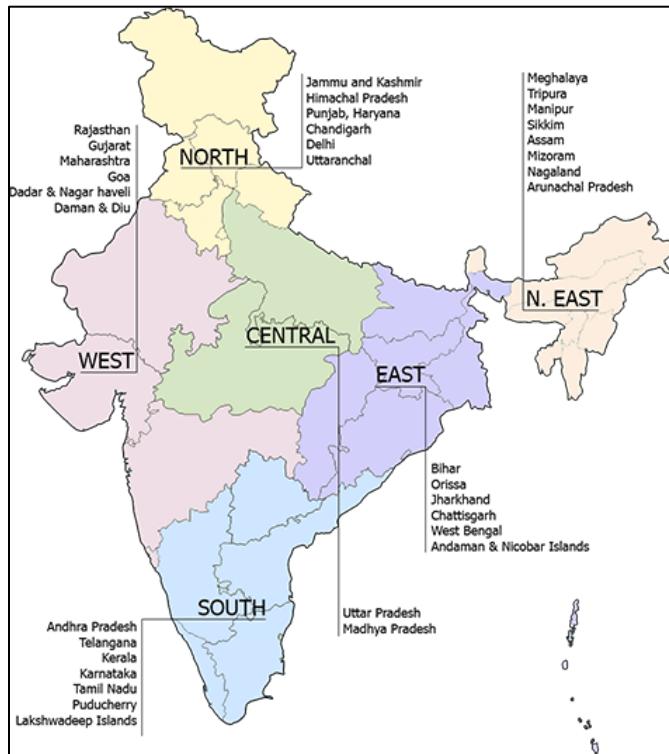
The Government of India released a scheme called FAME to increase the demand for EVs. Its phase 2 started in April 2019 for 3 years. This scheme mainly emphasized vehicles registered for commercial purposes such as e-3W, e-4W, and e-bus segments. However, privately owned registered e-2Ws are also covered under the scheme as a mass segment.



<https://fame2.heavyindustries.gov.in/dashboard.aspx>

This site consists of the data for the number of EVs sold in each state under this scheme. The data is extracted and compiled into a single dataset with the features such

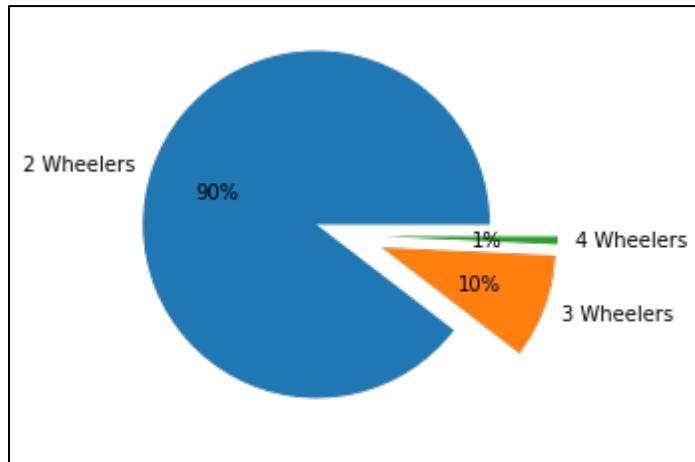
as State, Region, 2 Wheelers, 3 Wheelers, and 4 Wheelers. The states are separated into 5 regions as shown in the figure below.



Exploratory Data Analysis

Psychographic Segmentation:

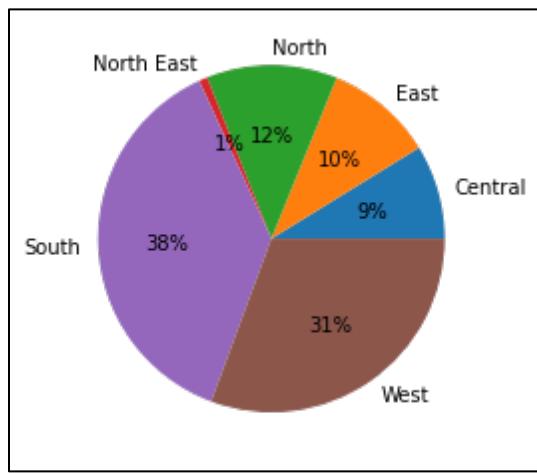
The following figure shows the number of EVs sold after the FAME2 scheme based on the type of vehicles.

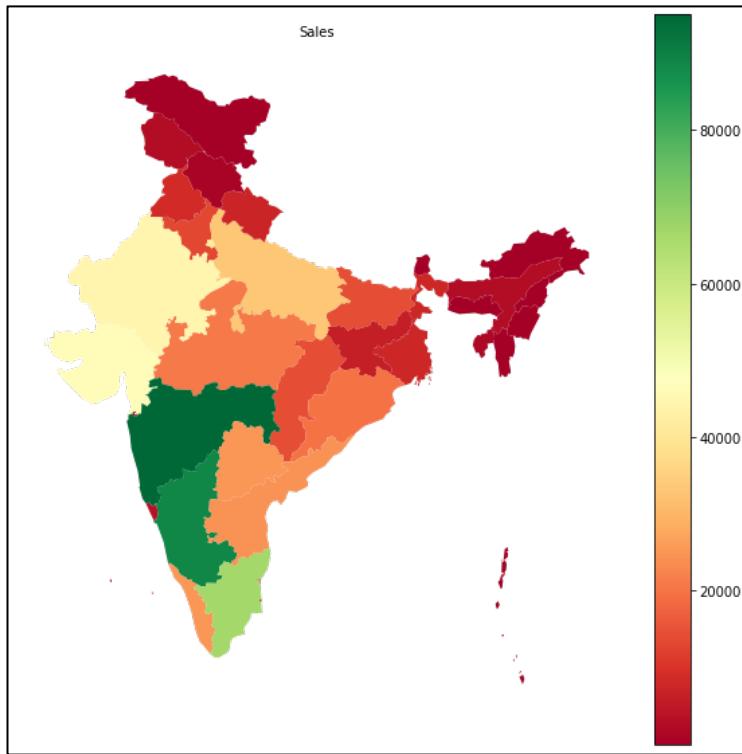


It can be observed that most of the vehicles sold are 2 wheelers followed by 3 wheelers

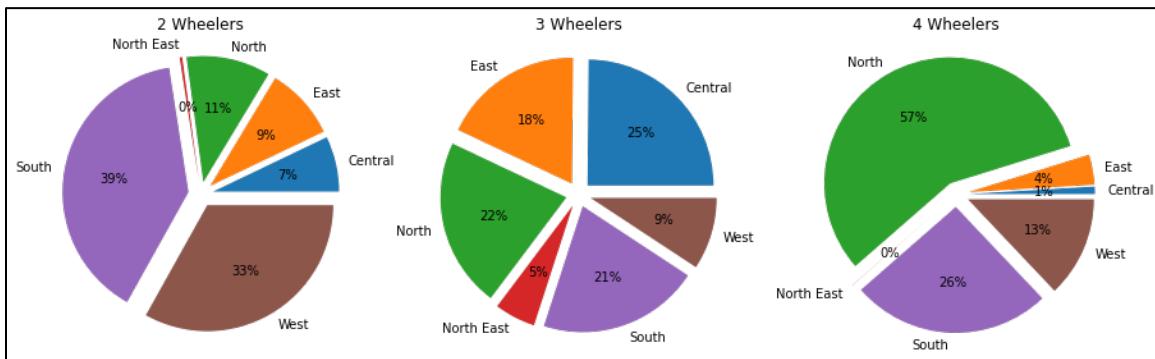
and very few 2 wheelers. This indicates that despite the government launching this scheme for commercial purposes people have taken the advantage of this scheme for privately owned vehicles.

Geographic Segmentation:

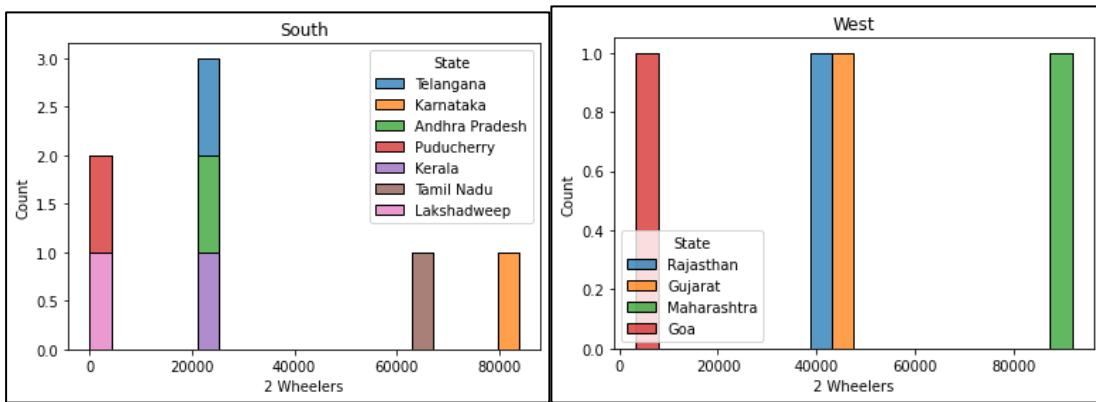




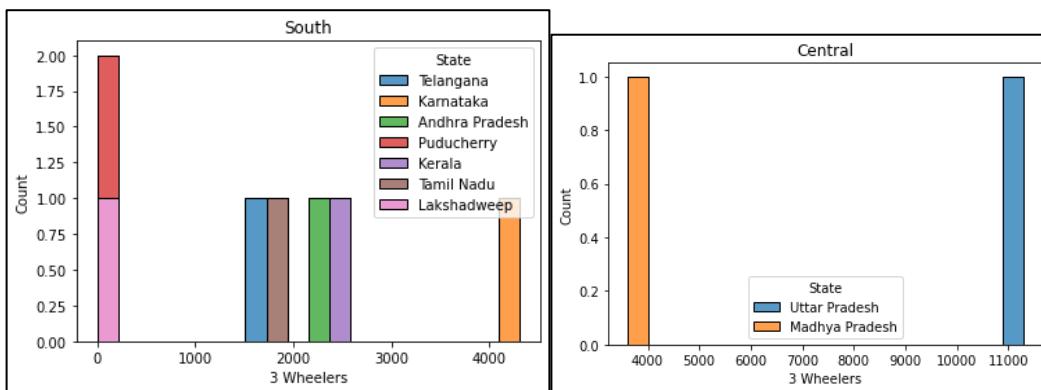
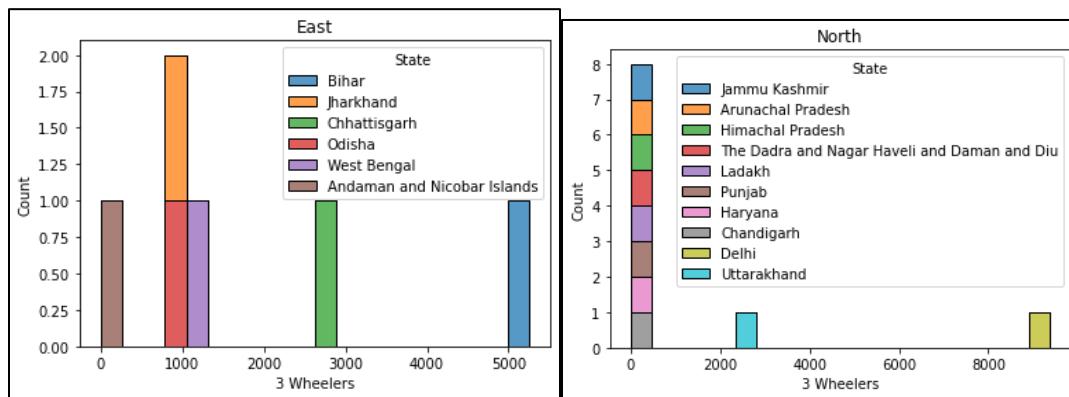
From the above figure, we can see that most of the EVs are sold in the southern and western parts of India, and the lowest sales are in the north and northeast.



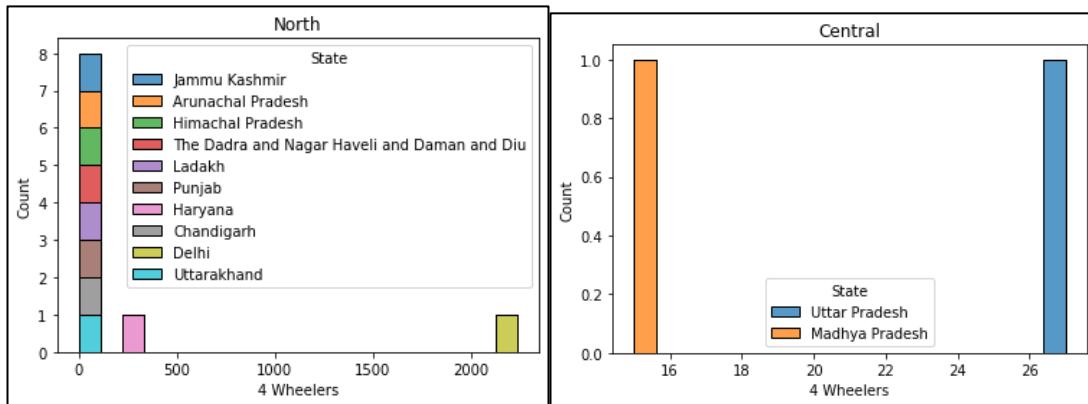
From the above chart, we can observe that most of the 2 wheelers are sold in the southern and western region. The sales of 3 wheelers are nearly the same in all regions and the sales of 4 wheelers are high in the northern region.



High Sales of 2 wheelers are in Karnataka and Tamil Nadu in the southern region and in Maharashtra in the western region.



High sales of 3 wheelers are in Bihar in the eastern region, in Delhi in the northern region, in Karnataka in the southern region and in Uttar Pradesh in central region.



High sales of 4 wheelers are observed only in Delhi and Haryana.

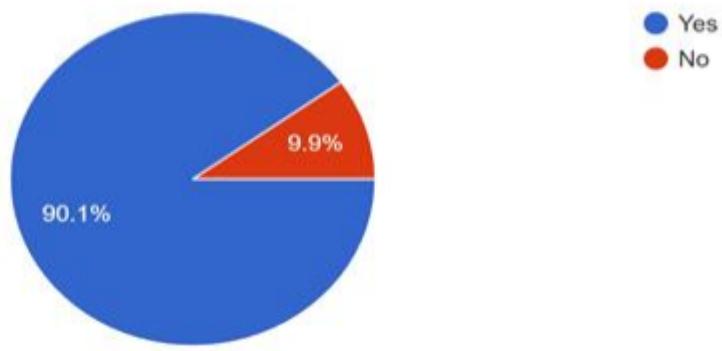
2.2. CONSUMER PERCEPTION OF EVS

From a survey report conducted on a sample population of 212 using an online questionnaire shows the customer perception of the electric vehicle. This sample population consists of 60.4% male and 39.6% female. 7.5% of respondents fall under age group of 18-23 yrs, 55.7% in 24-40 yrs, 27.8% in 41-55 yrs and 9% are 56 yrs & above.

Exploratory Data Analysis

Psychographic segmentation

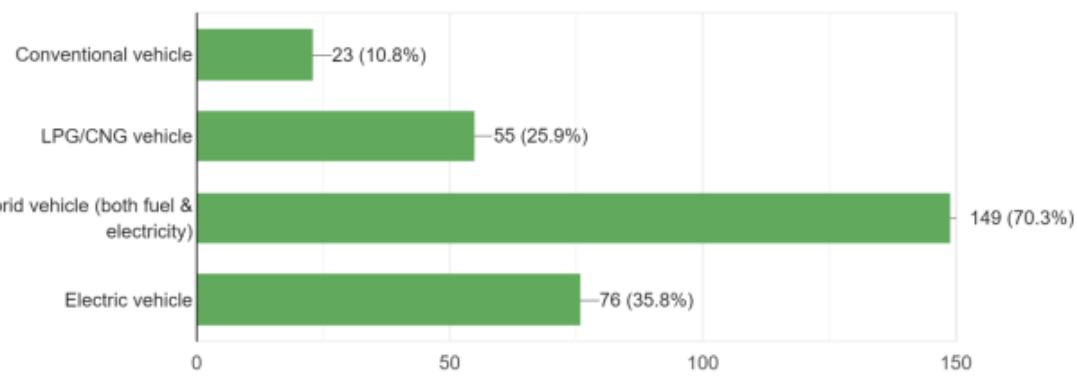
If wants to change/buy, would you prefer an eco-friendly vehicle?
212 responses



90% of people prefer eco-friendly vehicles because of increased awareness of climate change.

Which of the following would you prefer?

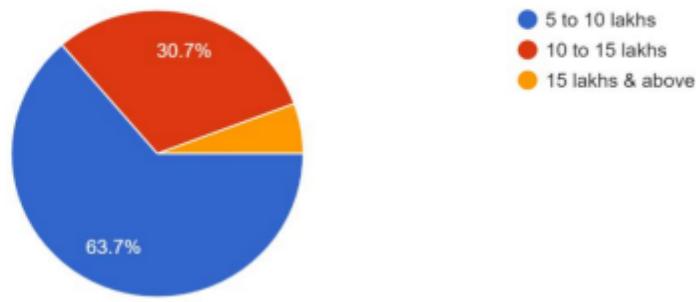
212 responses



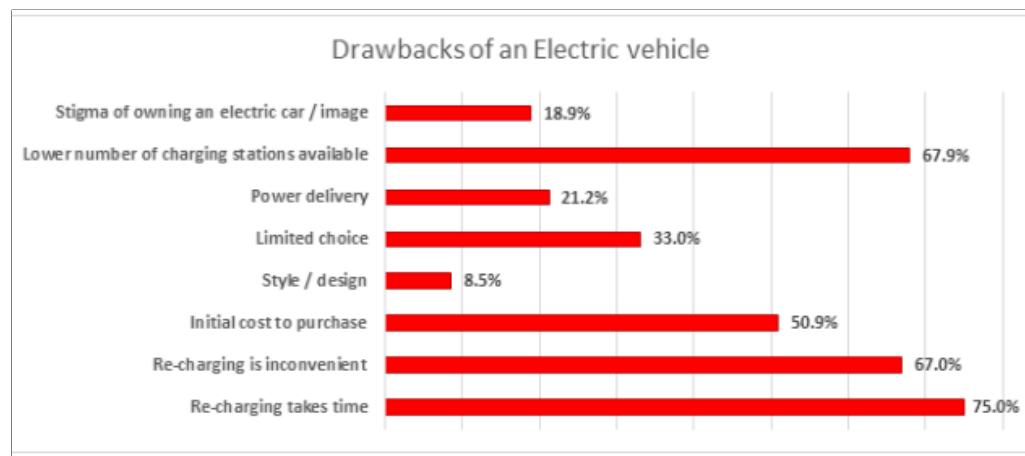
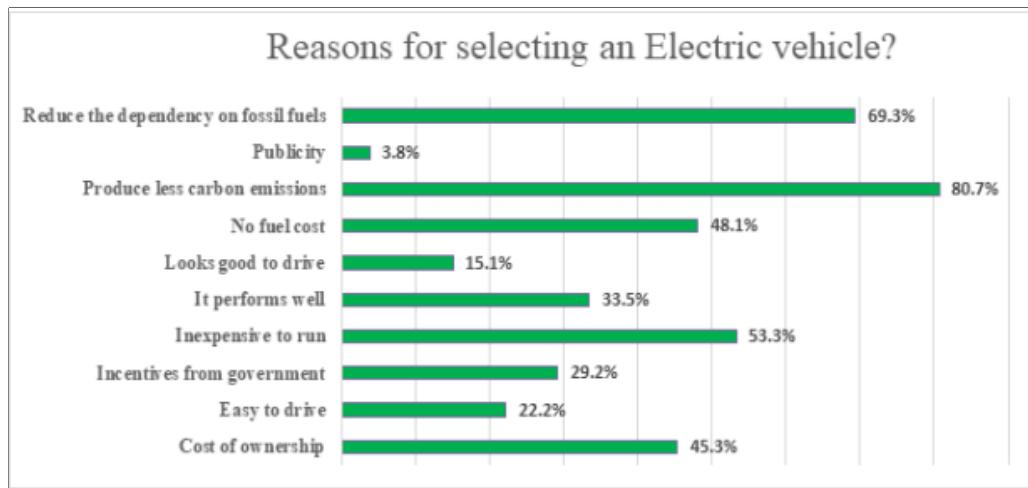
Most of them prefer to buy a hybrid instead of a completely electrically driven vehicle. This is probably because of the lack of infrastructure for charging EVs.

How much should be the cost of electric vehicles in the Indian market?

212 responses



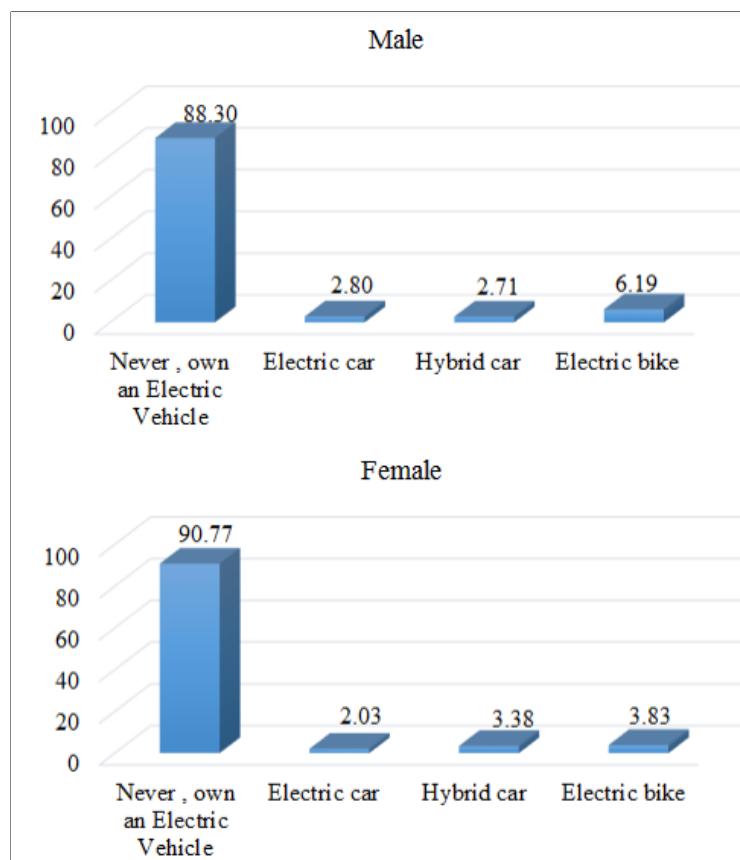
Most of them expect the cost of EVs to be in the range of 5 - 10 lakhs.



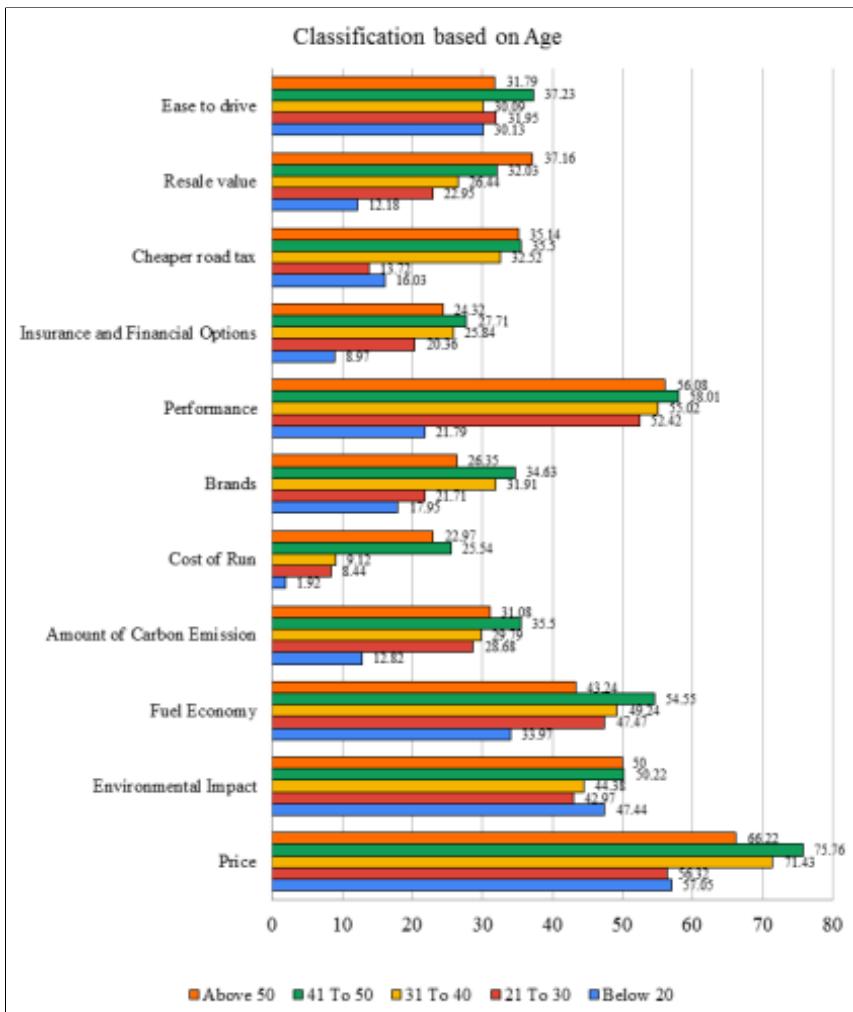
Most of them think that the reason to select EVs is to reduce dependency on fossil fuels and to reduce carbon emissions. The reason not to opt for EVs is because of the fewer charging stations and re-charging issues.

Demographic Segmentation:

Another survey conducted on 1700 individuals gives an insight into demographic aspect of the EV customer market. The analysis on the respondent types is classified based on gender, age, highest academic level, and occupation.



The above graph shows that most of the users didn't own an EV. Others owned an EV of each type.



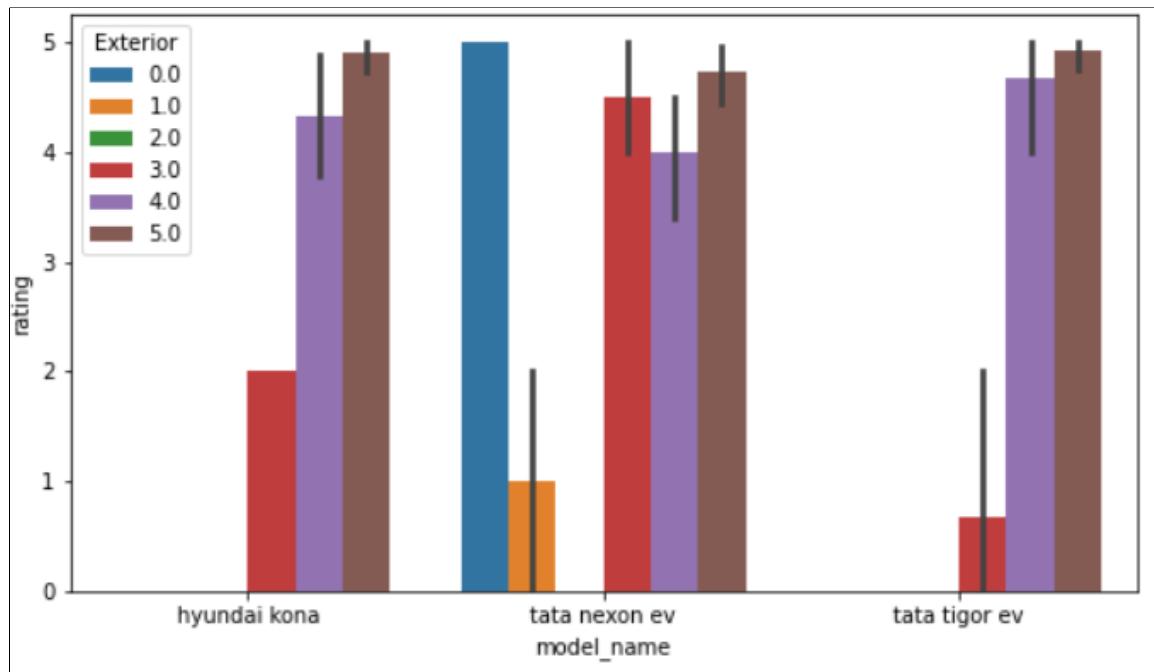
Looking at the factors that determine the purchase of EVs, it is found that the major factors are price and performance. People of all ages have the same response.

The above analysis indicates that there is not much of a demographic aspect when it comes to purchasing EVs. All prefer buying EV but the major concern is the price and charging facility.

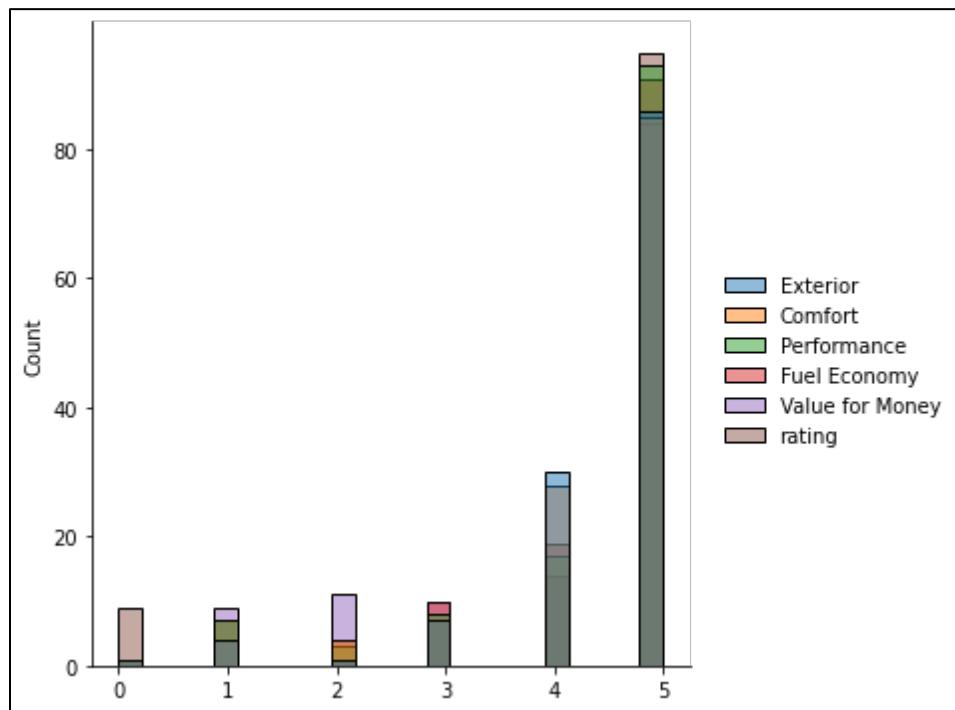
Behavioral Segmentation:

Usage of mobile applications:

A large customer base is increasingly using mobile applications for entertainment, Product delivery usage, Booking flights and much more. Due to this increasing usage of mobile applications, it is highly recommended that the electric vehicle start-ups to use this opportunity to present all the aspects of the vehicles such electric usage, location of the vehicle in case of theft, alerting if there are any malfunction, etc.



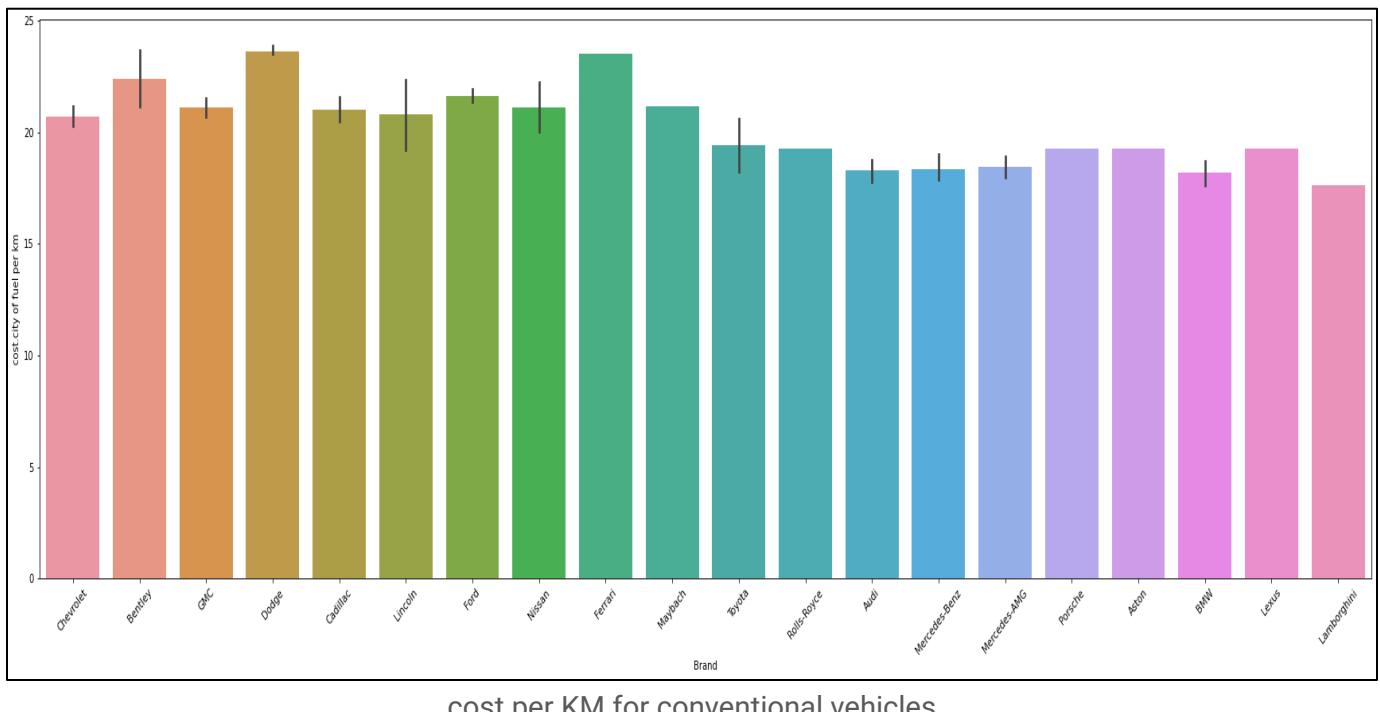
ratings based on brand's exterior type

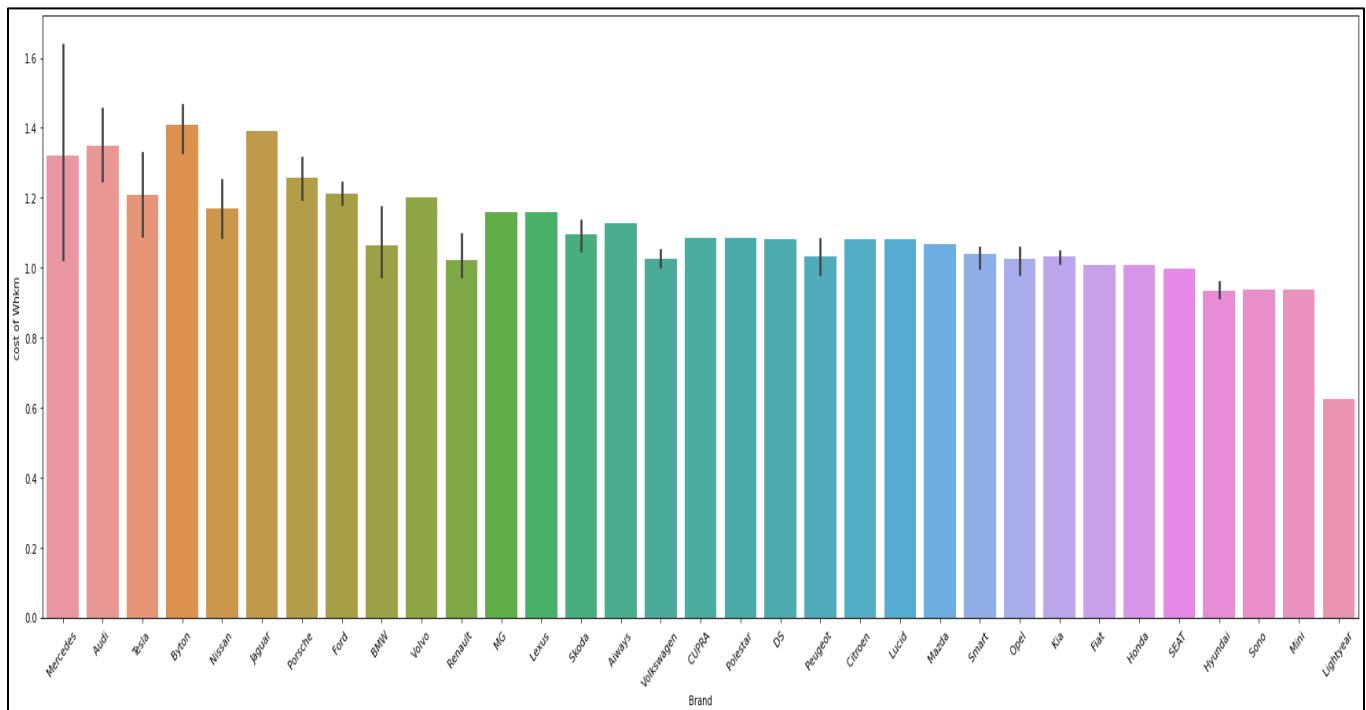


ratings based on various aspects

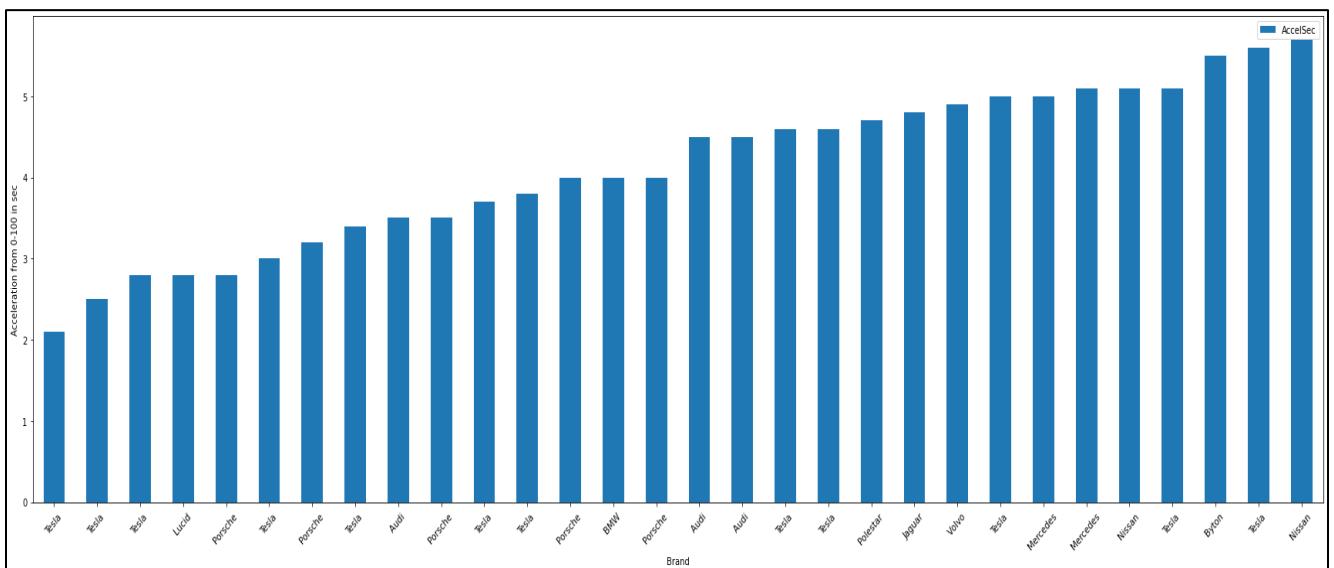
Vehicle Usage:

The usage experience of the vehicle is one of the major factor to be considered unless and until the consumer is not satisfied with the vehicle he/she will not use or recommend it to other users and by vehicle usage the mileage of the vehicle is considered by most of them consumers hence if an electric vehicle provides a better mileage than a non-electric vehicle then most of the consumers consider an electric vehicle over a non-electric vehicle.





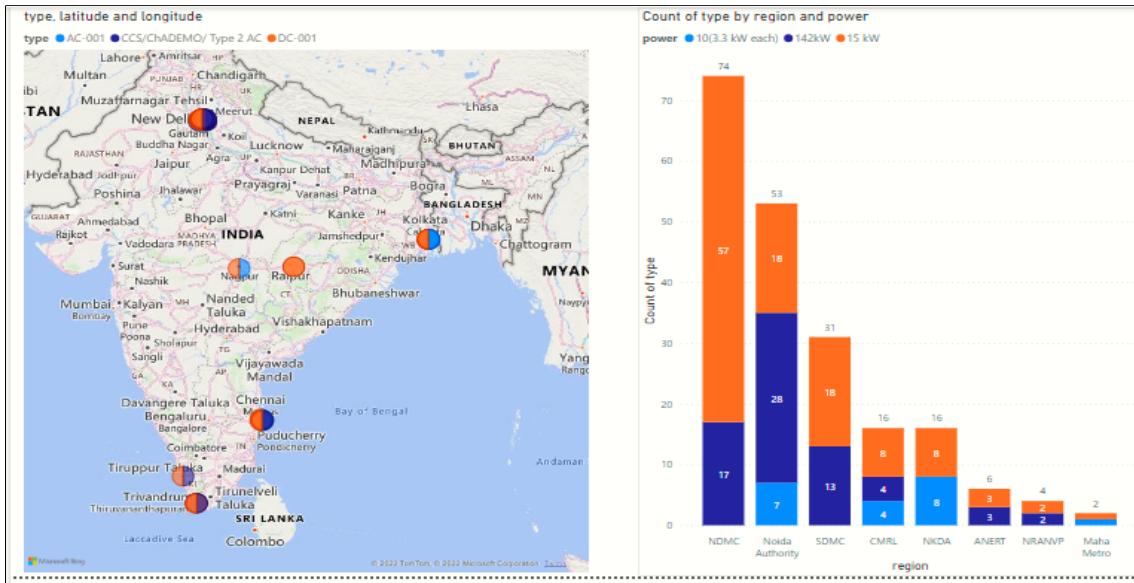
Cost per KM for Electric vehicles



Acceleration Pick up Electrician

2.3 Overall Charging stations in India

EDA of dataset of charging stations on the basis of location ,type of power and KW power



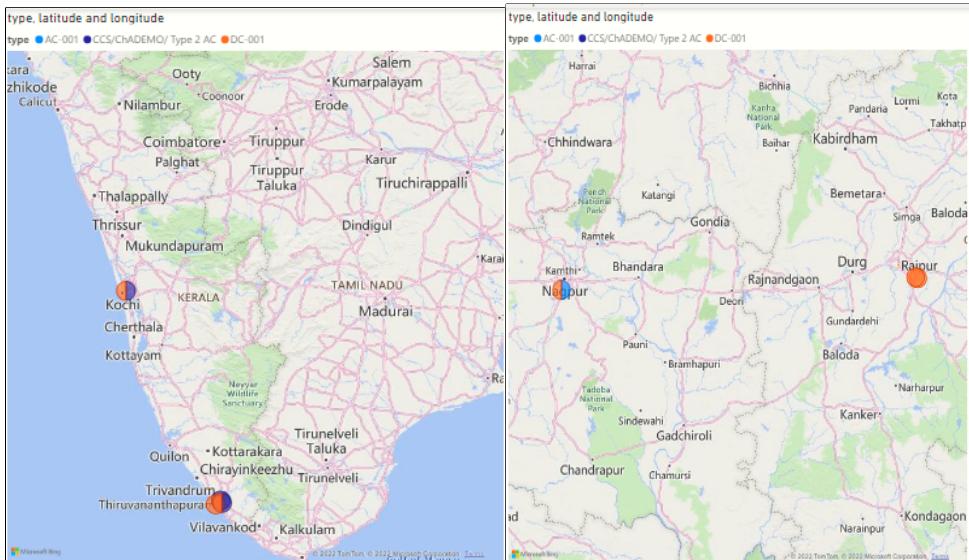
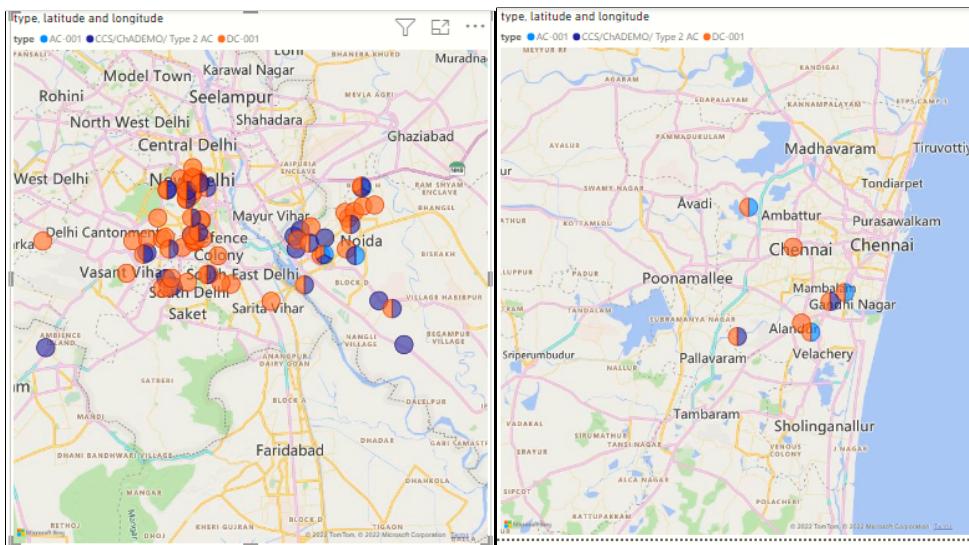
Charging is a major issue when it comes to Electric vehicles , currently only 1135 charging stations are available in India , which poses a doubt in consumers mind that if during operation any charging stations are not available.

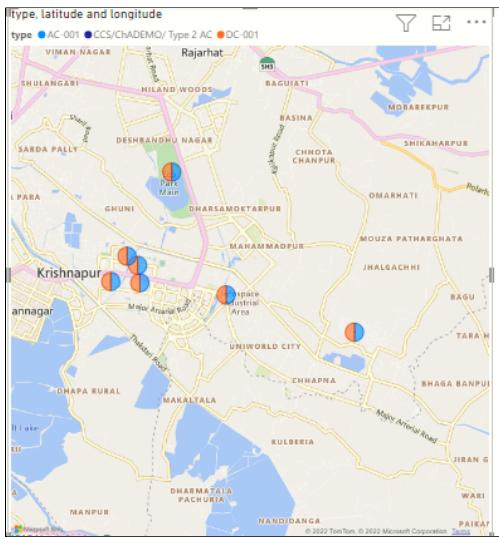
This could be an important segment for which attention is required.

Here we have found a dataset that includes all charging stations in India ,type of power available in each charging station and how much power it is supplying.

Some important insights from the EDA of respective dataset are :

- Chennai , Trivandrum , Delhi , West Bengal ,Nagpur , Raipur are the regions that consist of Charging station facilities.
- Most of the charging stations are concentrated in North-region ,specially in near Delhi and it consist of charging stations that can deliver power of 142KW and 15KW
- West India and North-east India merely have charging stations.



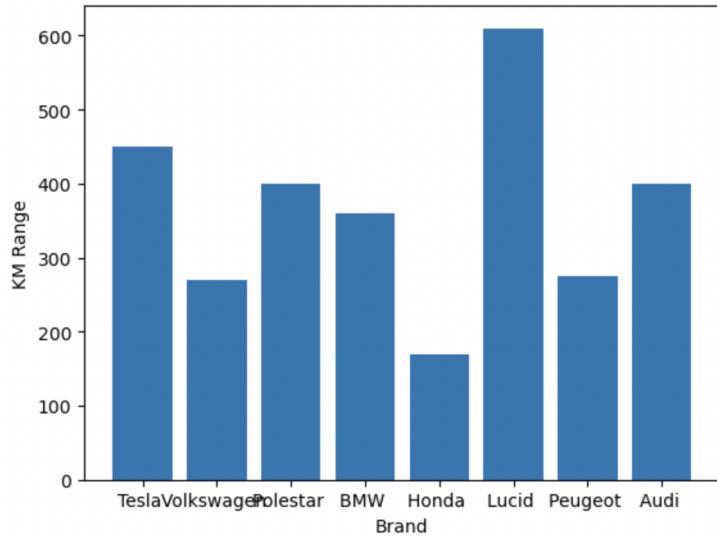


EDA OF ELECTRIC VEHICLE DATASET

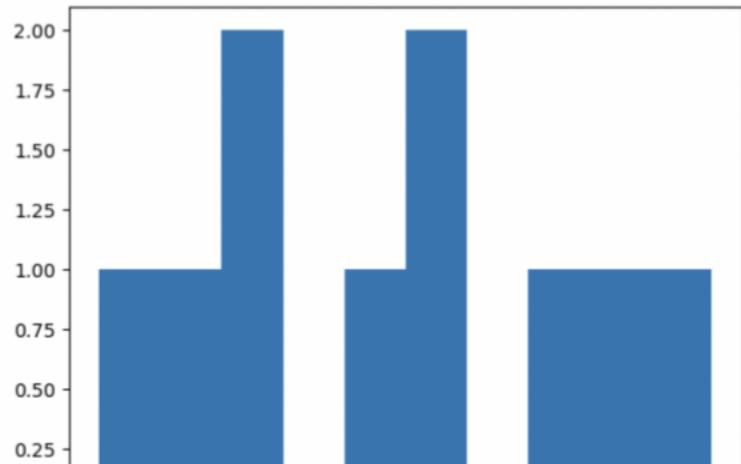
KM RANGE of diff diff Brands

```
In [18]: 1 plt.bar(df["Brand"][:10],df["Range_Km"][:10])
2 plt.xlabel("Brand")
3 plt.ylabel("KM Range")
```

```
Out[18]: Text(0, 0.5, 'KM Range')
```



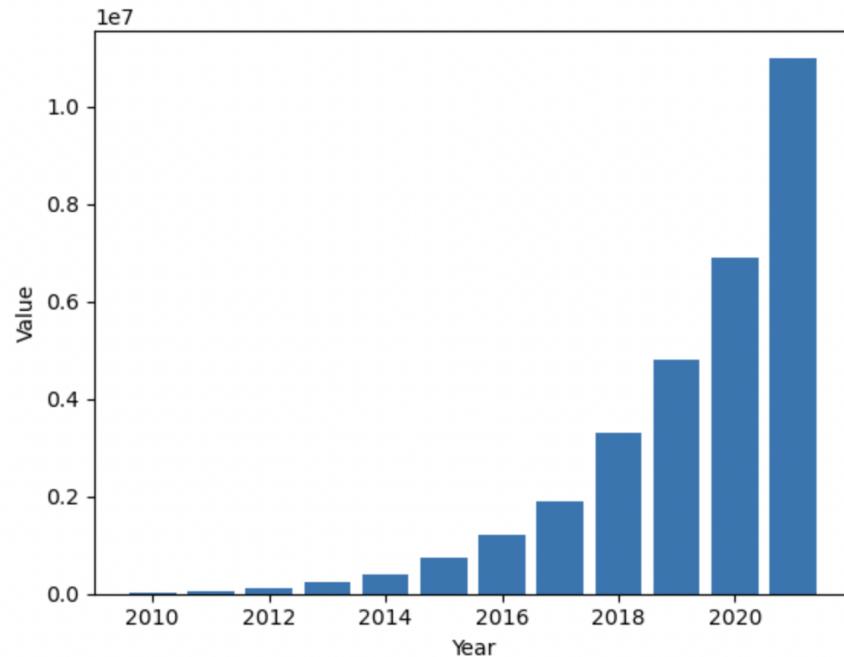
```
In [47]: 1 plt.hist(df["Brand"][10:20])  
Out[47]: (array([1., 1., 2., 0., 1., 2., 0., 1., 1., 1.]),  
 array([0., 0.7, 1.4, 2.1, 2.8, 3.5, 4.2, 4.9, 5.6, 6.3, 7.]),  
 <BarContainer object of 10 artists>)
```



Value of Car in every year

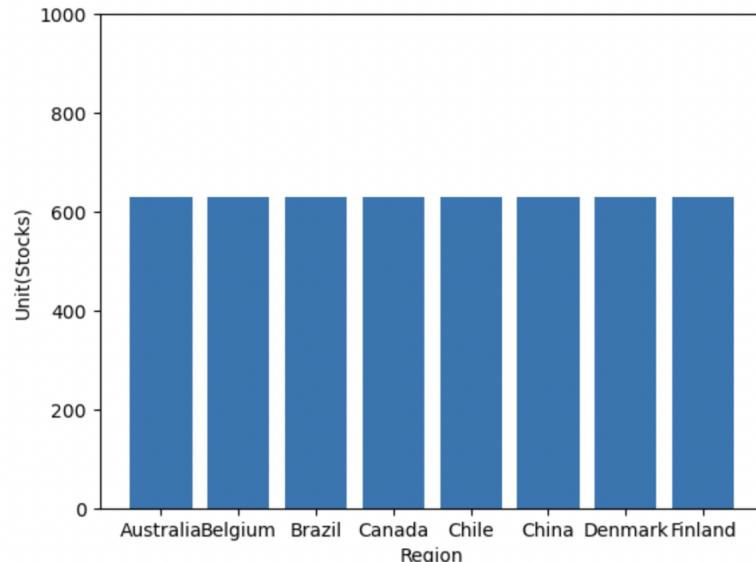
```
In [88]: 1 plt.bar(df1["year"],df1["value"])  
2 plt.xlabel('Year')  
3 plt.ylabel('Value')
```

```
Out[88]: Text(0, 0.5, 'Value')
```



```
In [112]: 1 plt.bar(df1["region"][:150],df1["unit"].value_counts())
2 plt.ylim(0,1000)
3 plt.xlabel('Region')
4 plt.ylabel('Unit(Stocks)')
```

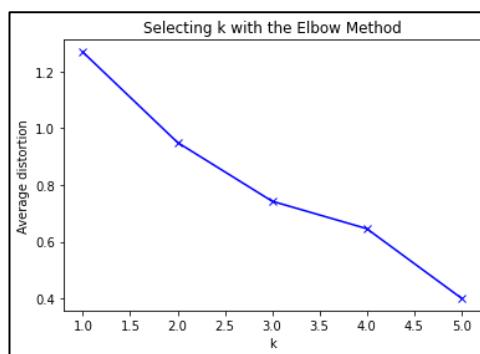
```
Out[112]: Text(0, 0.5, 'Unit(Stocks)')
```



3. SEGMENTATION

3.1. SEGMENTATION ON FAME2 DATASET

For segmentation K-Means clustering techniques is used. The elbow method is used to determine the optimal number of segments.

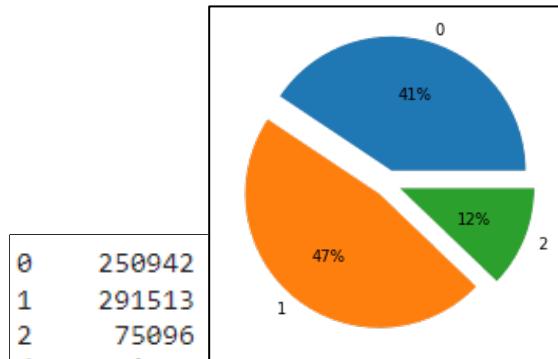


From the Elbow method, we can see that the ideal number of clusters is 2 or 3. Using K=3 the three segments are formed. The figure below shows the mean value of the vehicles.

	2 Wheelers	3 Wheelers	4 Wheelers
Group			
0	80270.333333	2914.333333	462.666667
1	8392.483871	984.548387	26.580645
2	26083.500000	10330.500000	1133.000000

The figure below shows the total number of vehicles in each segment,

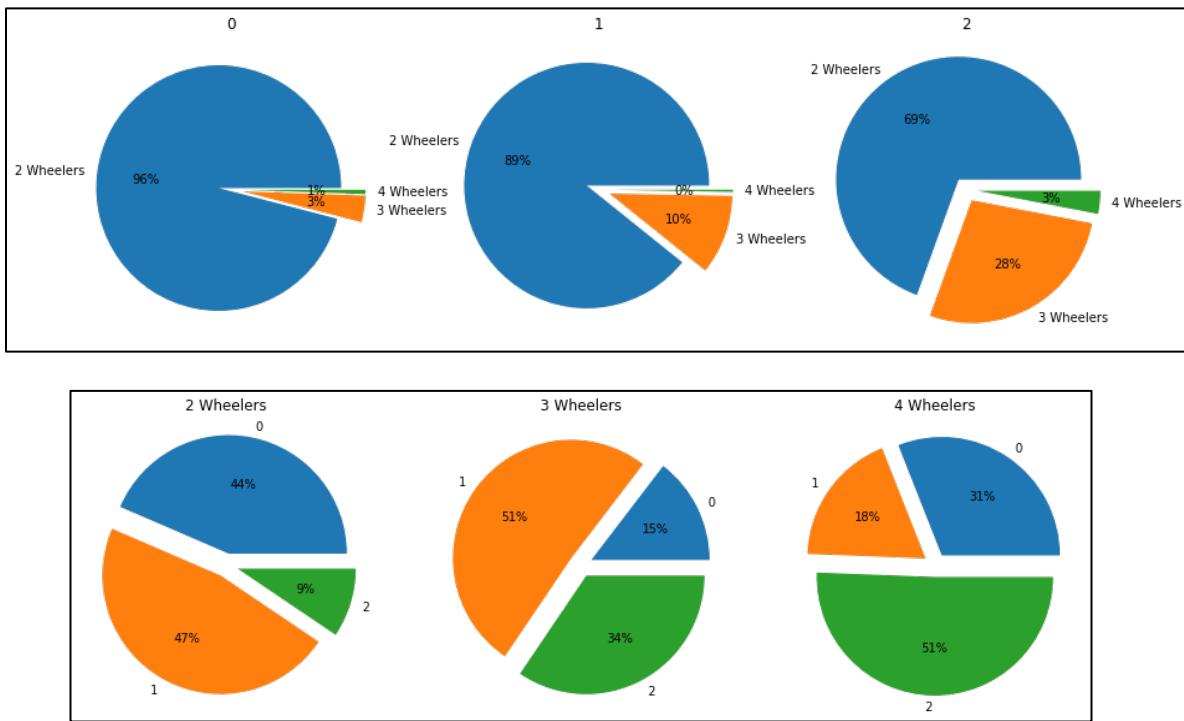
Group	2 Wheelers	3 Wheelers	4 Wheelers
0	0	240811	8743
1	1	260167	30521
2	2	52167	20661



4. PROFILING AND DESCRIBING SEGMENTS

4.1. SEGMENTATION ON FAME2 DATASET

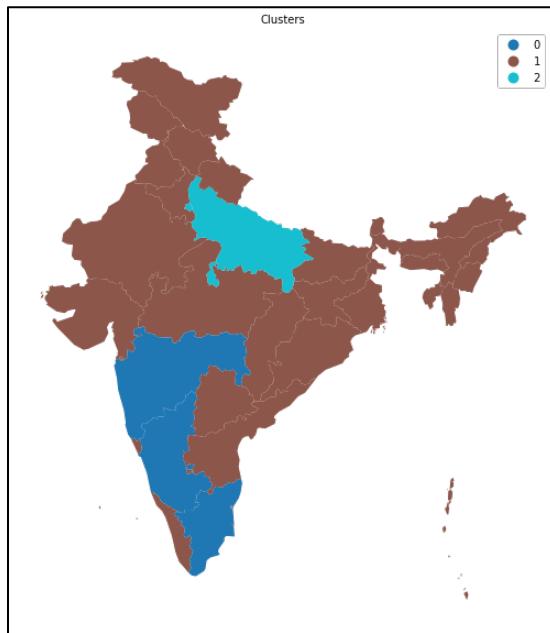
The figure below shows the percentage of each vehicle type within each segment,



The 1st segment corresponds to regions where there are high sales of 2 wheelers.

The 2nd segment corresponds to regions with average sales of all types of EVs.

The 3rd segment corresponds to regions with high sales of 3 & 4 wheelers.

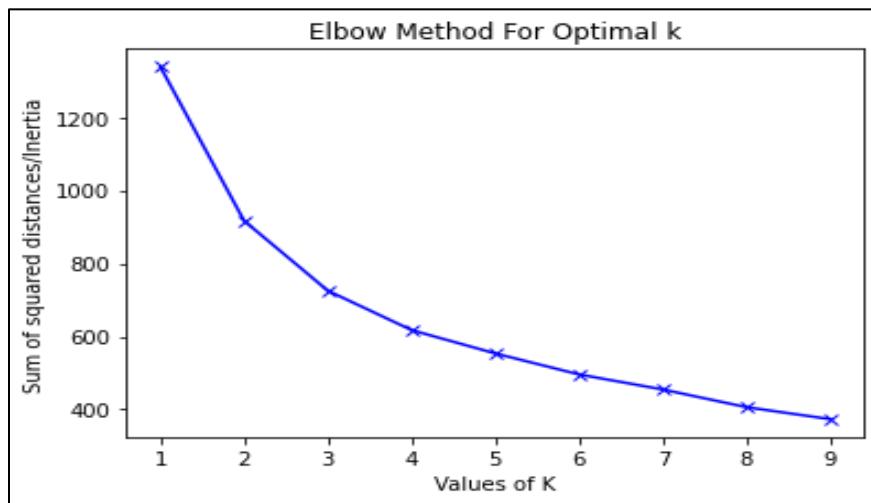


Looking at the choropleth map of India we can see that the 1st segment comprises mainly of the states from the western and southern parts of India where the sales of 2

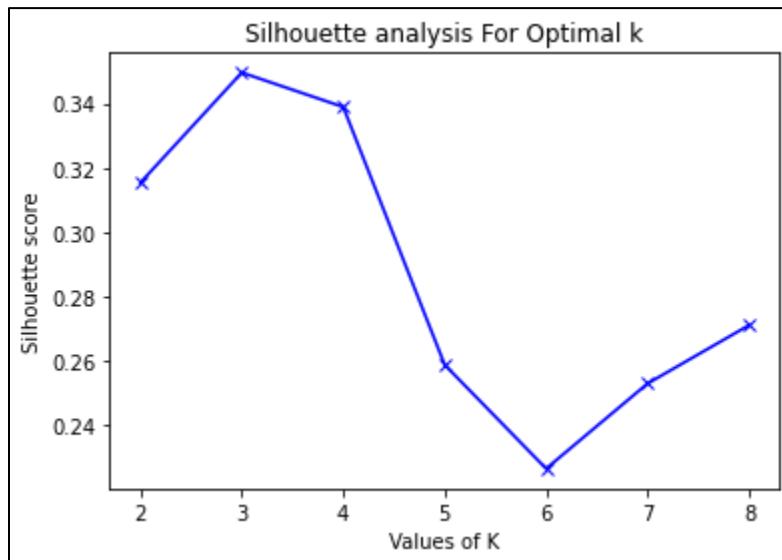
wheelers are high, the 3rd segment comprises the states from the central region where the sales of 3 & 4 wheelers are high and the rest of the states fall under the 2nd segment with average sales.

4.2. SEGMENTATION ON ELECTRIC VEHICLES DATASET :

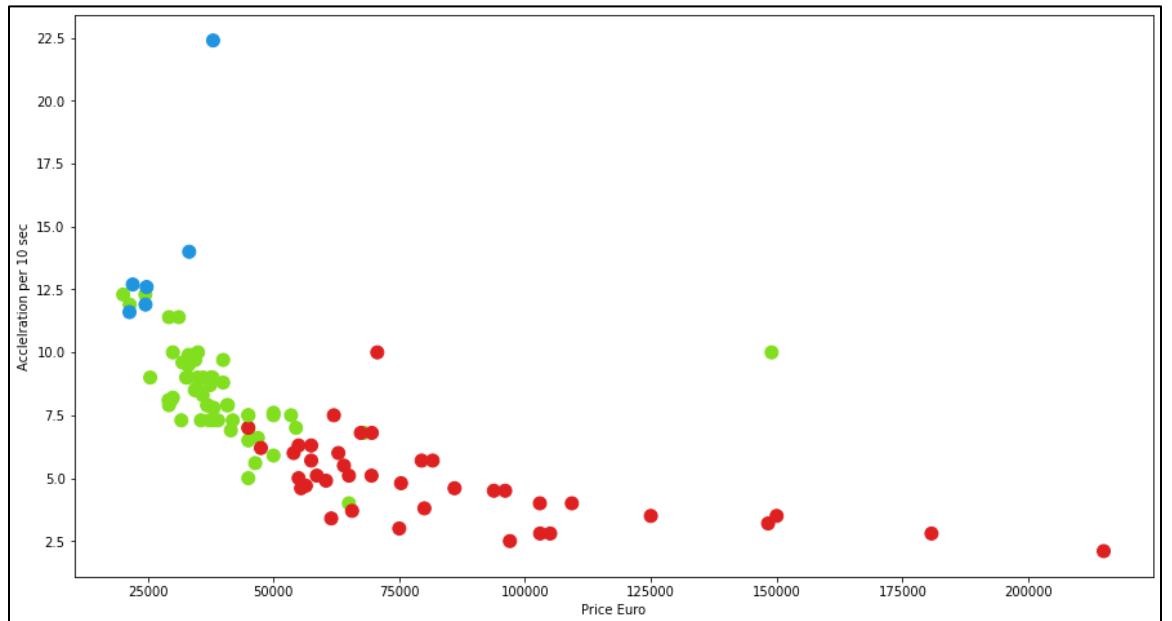
applying K-Means clustering (Elbow Method) for finding out the various segments based on price.



Finding out the number of appropriate clusters using Silhouette score.



The segmentation obtained based on pickup speed for the price of Electric cars



5. SELECTION OF TARGET SEGMENT

From the above analysis we can select the 3rd segment as the target segment where there are high sales of 3 & 4 wheelers. This segment consists of the central and some northern region of India which includes the 2 states Delhi and Uttar Pradesh.

In these regions there is high demand of commercial electric vehicles, particularly 3 wheelers which are used for transportation purposes rather than 4 wheelers which are used as passenger vehicles. So the startup can focus on commercial 3 wheeler EV market and come up with a strategy to produce or sell more of 3 wheeler EV.

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[Cars-Conventional engine and EVs](#) | [Kaggle](#)

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