Electric Vehicle Market Segmentation

By

Himangan Sarma

Saurav H Das

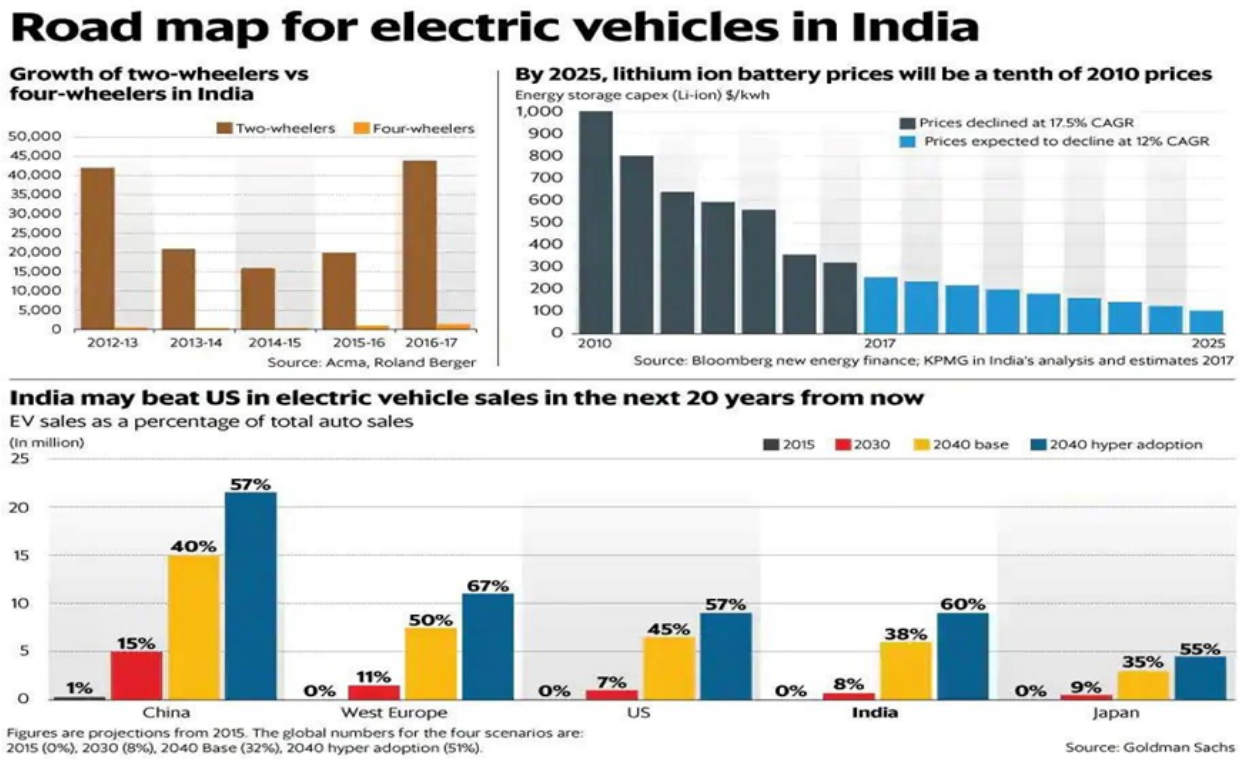
Sreeja Annavarapu

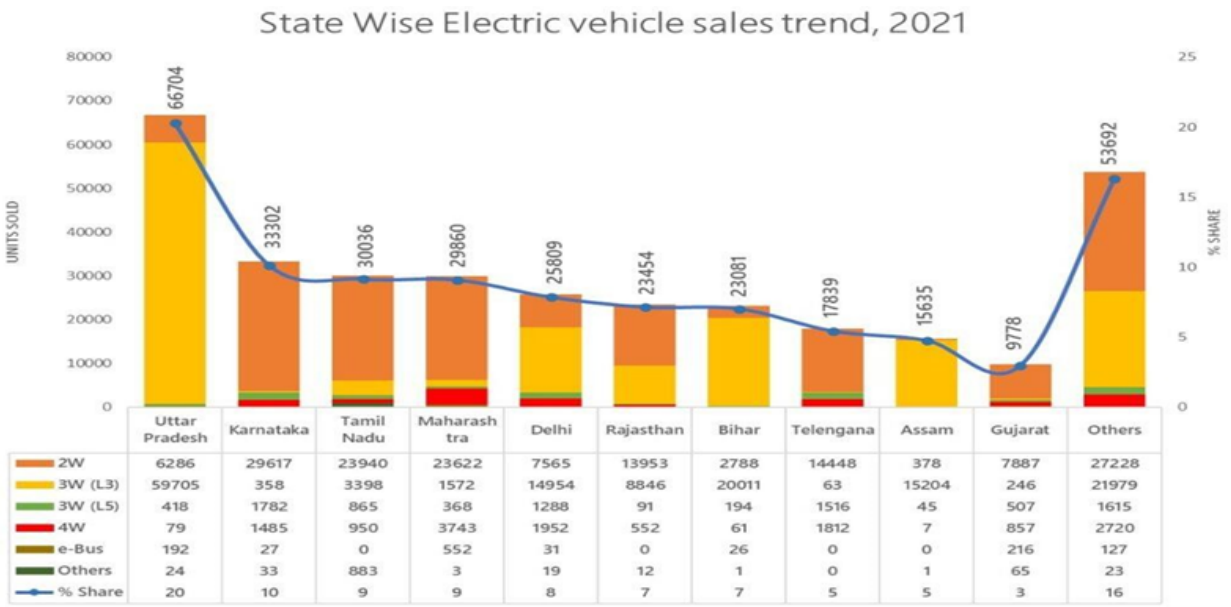
07.2022

Introduction:

Since the heyday of electric vehicles, especially since the oil shocks of the 1970s, people have shown renewed interest in them. There are three main reasons for this. Air pollution, the fact that oil is a finite resource, and the demand to reduce CO2 emissions. The first
reason has become a social problem in response to increasing pollution levels from road traffic and factories around the world. At that time, the Muskie Act was passed
in America. This required lowering CO, HC and NOx emission levels in vehicles. Otherwise they could not be sold or imported. The second, triggered by societal demand for alternative energy sources, fueled the oil crisis. Given the current state of oil supply
and demand, the sense of urgency has eased somewhat. Given that oil is a finite resource and will eventually run out, the search for sustainable alternative energy is perhaps the most important issue facing the world in the long term. Finally, the third reason is a new problem that will undoubtedly become even more pressing in the future. Electric vehicles produce no tailpipe emissions, and they are 10-30 % more energy efficient than conventional vehicles.
Although electric vehicles themselves produce zero emissions, power plants producing the power to charge the vehicles may produce pollution depending on the major source of power used. In this context, electric vehicles should be very promising due to the wide range
of power supply options. However, there are at least two main obstacles. One is to find the best battery technology and the other is to get the market to accept the
new automotive technology.
Problem Breakdown:
India's automobile industry is the fourth largest industry in the world as of 2021 statistics. In 2022, India became the fourth largest country in the world in the automobile industry. As of 2020, India is the world's fifth largest automobile market, with sales of surpassing Germany.
Today, India's automobile industry is worth more than US $ 100 billion, with accounting for 8% of the country's total exports and 2.3% of India's GDP. As a team working under an EV startup that is still determining the vehicle / customer area to develop the EV, our team uses segmentation analysis to analyze, identify and target the Indian EV market.
Market overview:
Automakers and policy makers are raising awareness and action related to electric vehicles (EVs). EV technologies such as the full battery electric and plug-in hybrid electric models are attractive options for achieving environmental, social and
health goals. The EV is not only 2-4 times more efficient than the traditional internal combustion engine model, but also reduces its reliance on petroleum-based fuels, and is a greenhouse gas when powered by low carbon energy emissions can be significantly reduced. In addition, the zero-emission EV is well suited to solve the problem
of air pollution. In addition, electric vehicles are driving advances inbattery technology. This is an important issue of industrial competitiveness in the transition to clean energy. The cost of batteries and electric vehicles is low. The charging infrastructure expanding. This advance will facilitate electrification of transport modes such as motorcycles tricycles, light commercial vehicles (LDVs) (cars and vans), taxis, shared vehicles, buses, and large vehicles with short-distance requirements. Manufacturers are continuing to expand the number of EV models available to customers. Effective policies still needed to address upfront investment costs, promote EV charging infrastructure and ensure a smooth integration of charging

demand in power systems. With foundations being laid for widespread adoption of EVs in several large economies, there are strong prospects that the 2020s will be the decade in which electric mobility significantly expands.

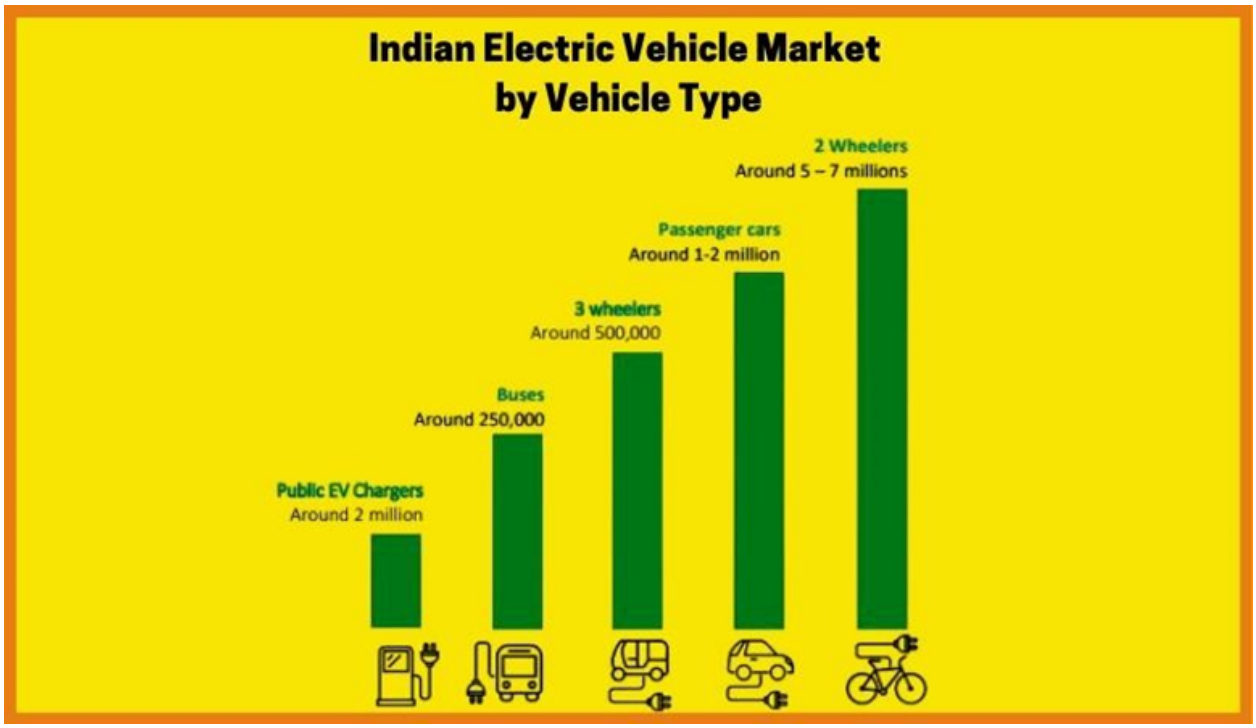




Market Segmentation:

The global electric vehicle market is segmented on the basis of type, vehicle type, vehicle class, top speed, vehicle drive type, and region. By vehicle type, it is classified into two- wheelers, passenger cars, and commercial vehicles. By type, they are classified into four types:

- Battery Electric Vehicle (BEV): Fully powered by electricity. These are more efficient compared to hybrid and plug-in hybrids.
- Hybrid Electric Vehicle (HEV): The vehicle uses both the internal combustion (usually petrol) engine and the battery-powered motor powertrain. The petrol engine is used both to drive and charge when the battery is empty. These vehicles are not as efficient as fully electric or plug-in hybrid vehicles.
- Plug-in Hybrid Electric Vehicle (PHEV): Uses both an internal combustion engine and a battery charged from an external socket (they have a plug). This means the vehicle's battery can be charged with electricity rather than the engine. PHEVs are more efficient than HEVs but less efficient than BEVs.
- Fuel Cell Electric Vehicle (FCEV): Electric energy is produced from chemical energy. For example, a hydrogen FCEV.



The situation analysis is required prior to setting up a marketing strategic plan. India is now targeting deployment of 6-7 million of electric vehicles by 2020 under the Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) scheme, which is likely to drive the growth of electric vehicle market in India. However, Indian electric vehicle market is in its nascent stage when compares with the other matured markets such as U.S, China and Europe among others, where India accounting to be a negligible participant having a share of 0.1%.

Current Trend in the Electric Vehicles Market:

The global electric vehicle (EV) market is developing at a rapid pace. According to EV volumes, overall electric vehicle reached a global share of 8.3% (including battery electric vehicles [BEVs] and Plug- in hybrid electric vehicles [PHEVs]) in 2021 from 4.2% in 2020 with 6.75 million vehicles on the road. This is an increase of 108% as of 2020. EVs are

gaining attention across the globe as they help reduce emissions and depletion of natural resources. The Indian EV market is also evolving fast as close to 0.32 million vehicles were sold in 2021, up 168% YoY. Ongoing electric vehicle adoption in India is based on the Paris agreement to reduce carbon emissions, to improve the air quality in urban areas and reduce oil imports.

Government of India is trying to implement different policies or scheme to promote green energy. As we know that due to pollution there is need of green energy which can reduce problems that has arisen due this pollution. Government is giving scheme through which people can take electric vehicle in low cost. Government of India has launched National Electric Mobility Mission 2020 through which they are providing incentives to reduce cost of electric vehicle and increase sale of it in India. Niti Ayog of India plans about the policies which are implemented for electric mobility by government. And also, Niti Ayog is trying their best to improve condition of sale of electric vehicles in India.

Target Market:

This process involves the identifying of variations in customer needs and the determining of how these needs can be fulfilled. Customers may differ in many ways; wants, purchasing power, geographical location, attitudes, personality, knowledge, benefits sought, and/or habits. Hence, by identifying specific groups within a market, a market campaign for a product or service can be more fine- tuned to fit specific segments. Besides usual socio- demographic variables psycho-graphic and behavioral variables were included to identify specific market segments.

Behavioural Segmentation:

The target market can be divided into various segments based on factors like Customer Age, Number of family members/dependents, salary etc.

- Age: Younger consumers purchase less expensive vehicles and prefer the latest technology.
- Number of Dependents: Greater number of dependents makes the consumer buy a vehicle with more seats and so they prefer SUVs.
- Salary: If you overlap the normalized salary plots with price plot in provided codes, you would observe the median of salary violin plot matches that of the price of the vehicle indicating a very direct relationship.

Psychographic Segmentation:

1. Make of vehicles: Preferred EV model of customers varies based on the age and income of customers, but data shows that most people prefer SUVs because of its advantages like safety, fuel efficiency, advanced features, affordability and after-sales services.
2. Price of vehicle: Affordability of customers increases with their age and experience. Middle-aged customers and families with more than one earning members can afford costly EVs whereas young customers or families with single earning members prefer affordable vehicles.

3. Make of vehicles they tend to purchase (based on number of dependents): Customers with more family members tend to purchase EVs that have more seats and enough cargo space, whereas individual customers focus on performance and features.
4. Make of vehicles they tend to purchase (based on personal loan): Customers who want to buy vehicles with the help of personal loan will choose the vehicle model based on their monthly income. Customers with less annual income prefer EVs that cost less monthly payment(EMI) and are willing to pay more than the actual price by the end of loan repayment. whereas Customers with more annual income prefer EVs that come with less interest rate on the overall vehicle cost.

Demographic segmentation:

It's an accessible form of market segmentation, as it requires fewer data points to implement than psychographic or behavioural segmentation, whilst offering more selective nuance
than geographic segmentation. There are plenty of ways to segment markets using demographics.
The most commonly used demographic segmentation factors are:

- Age
- Gender
- Ethnicity
- Income
- Level of education
- Religion
- Occupation
- Family structure

Geographic Segmentation:

Geographic segmentation is a marketing strategy used to target products or services at people who live in, or shop at, a particular location. It works on the principle that people in that location have similar needs, wants, and cultural considerations. By understanding what people in that area require, brands can target more relevant marketing messages and suitable products to customers who are then aware and more likely to buy.

Target Customer base of EV Start-ups:

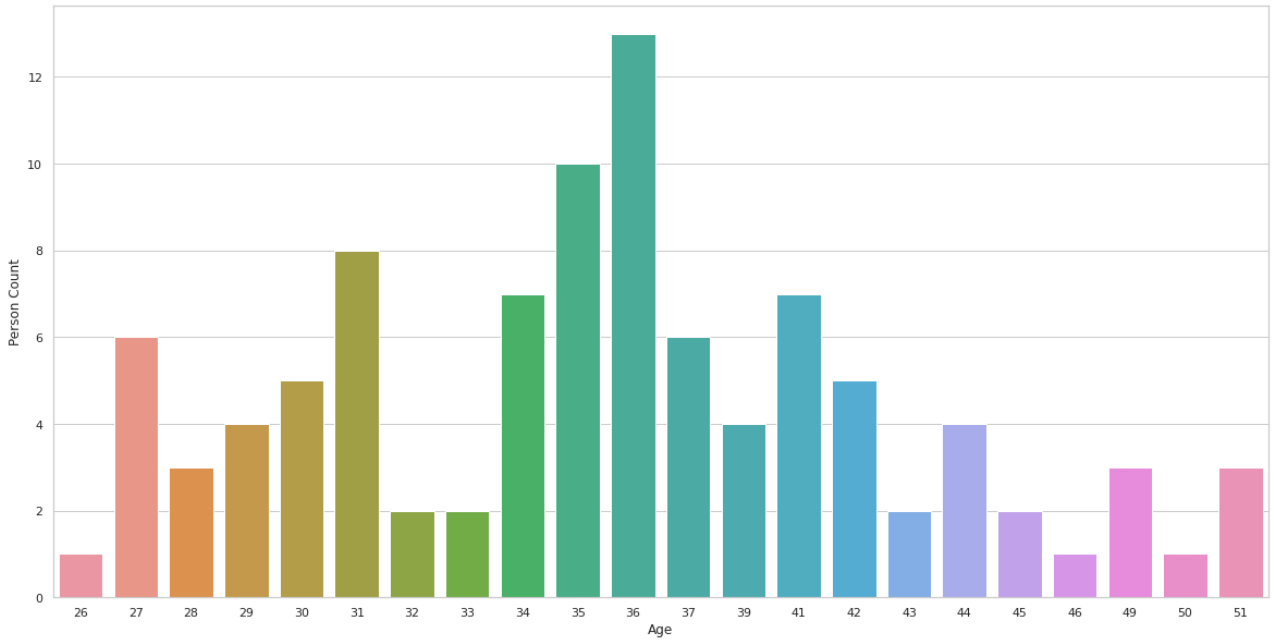
A recent study by Deloitte concludes that 49% of Indian car customers prefer to switch from ICE cars to hybrid / fully electric cars. However, given
the different income levels across the country, only consumers with per capita income above Rs 7 are the most effective target groups for Indian EV manufacturers. Therefore, our
target customer base is people aged 26-51 years living in urban areas of India with per capita income above LPA7. Of India's 1.38 billion people, 31 million fit our target customer profile, which is our target customer base.

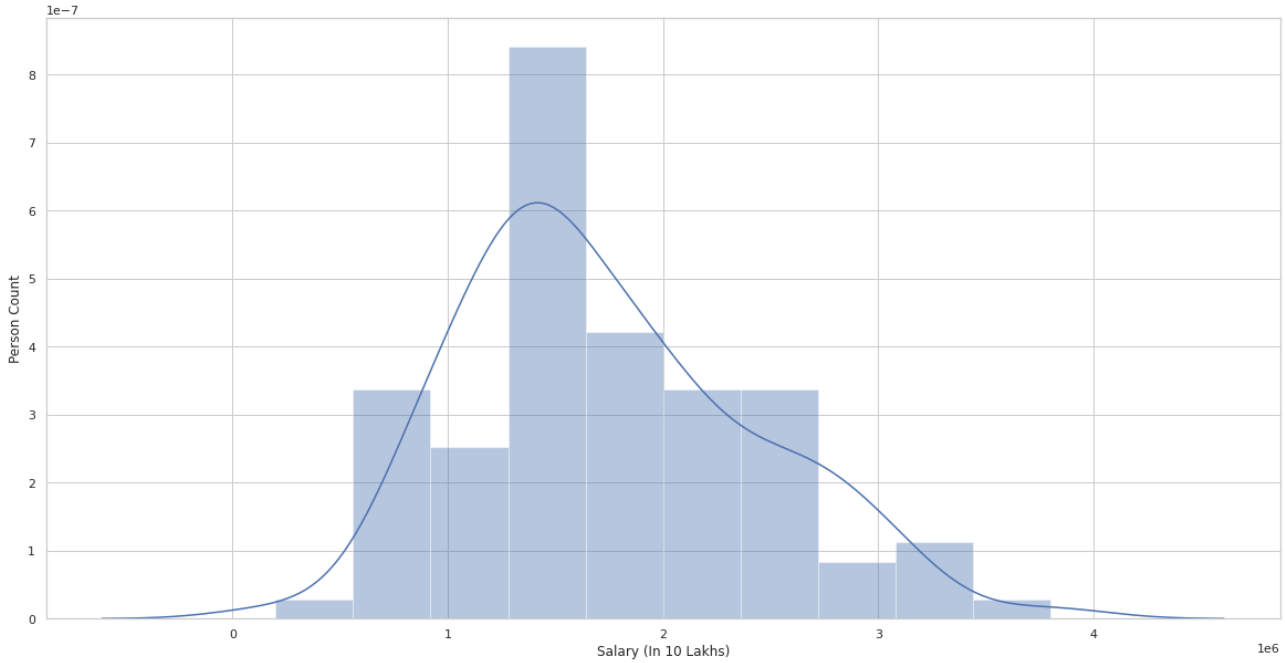
ANALYSIS

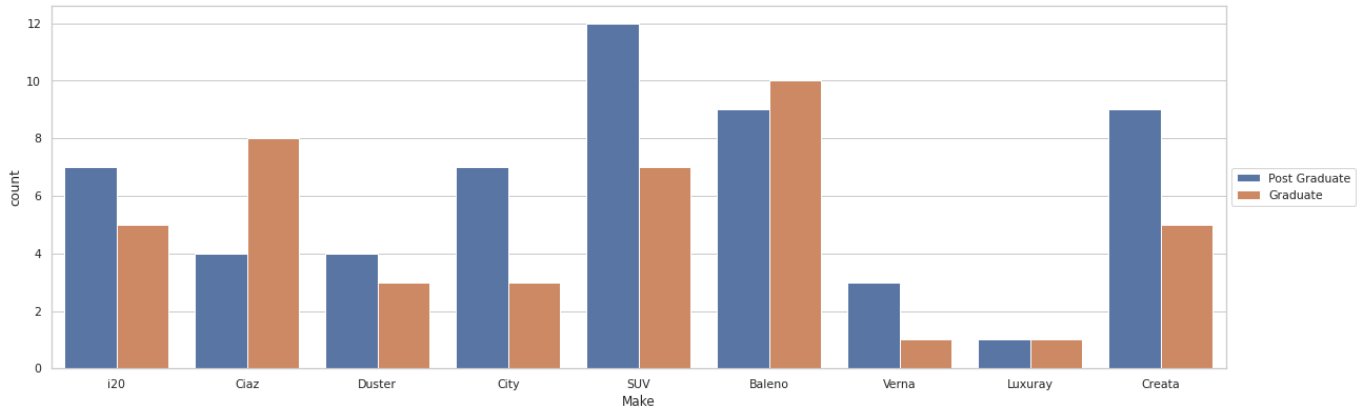
Initially we acquired a dataset from online sources having various information and behaviour of customers buying cars like marital status, salary, education, loan among others. We made a detailed study

of the ages which are more prone to buy cars and provide a good customer base for the product.In addition, we tried to understand the weightage of people engaged in business and people employed in salaried jobs in buying vehicles.

Going a bit deep into the analysis, we plotted a bar chart showing the percentage of people buying vehicles in a particular price range and also plotted a chart to show the number of vehicles being purchased by people in a particular salary range. Similarly, to make our model even more accurate we made an analysis of the relation between age or education of a person with the probability of buying the vehicle.







Correlation Matrix: using seaborn library we produce a heatmap of correlation to visualize how the variables are related with each other. This can give us certain correlations that we can leverage during market segmentation.

SEGMENTATION :

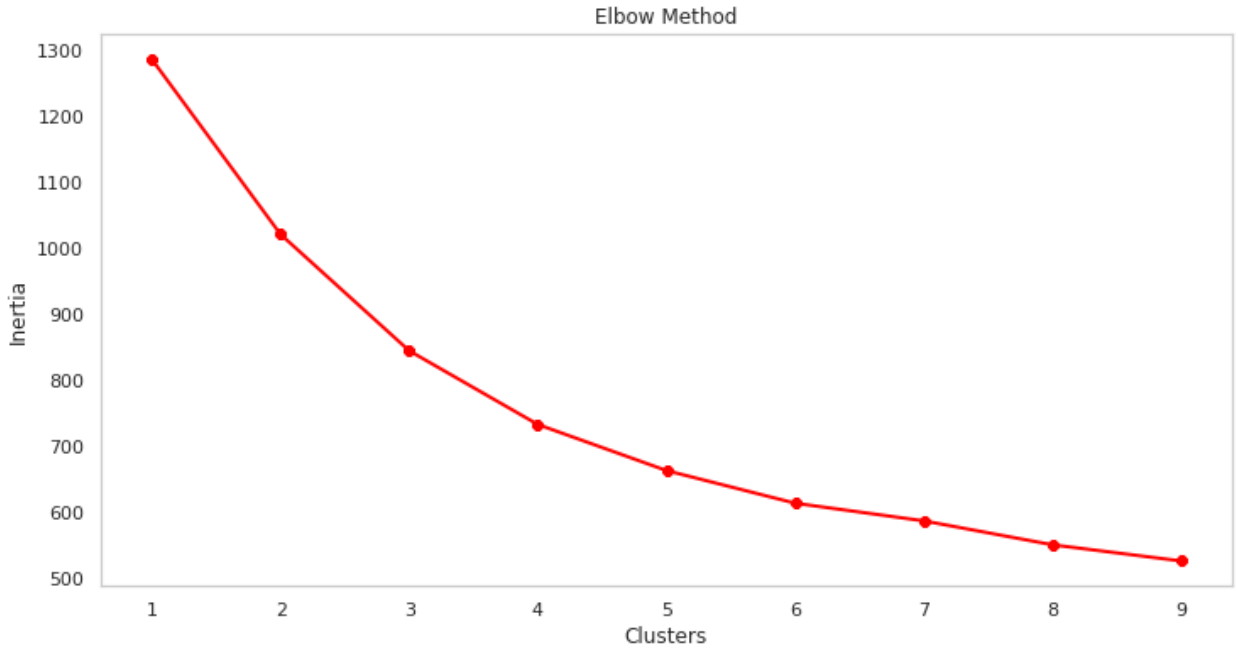
Using Scikit Learn library, we segment the dataset and get a list of **4 segments** having the variables like Profession, marital status, education, personal loan, house loan, salary, price of the vehicle etc. In this list, we get a correlation between all the variables. Then we produce a heatmap and standardize the numericals values to increase the efficiency of the model.

CLUSTERING :

K-means clustering is a type of unsupervised learning, which is used when you have unlabeled data (i.e., data without defined categories or groups). The goal of this algorithm is to find groups in the data, with the number of groups represented by the variable K. The algorithm works iteratively to assign each data point to one of K groups based on the features that are provided. Data points are clustered based on feature similarity. The results of the K-means clustering algorithm are:

The centroids of the K clusters, which can be used to label new data. Labels for the training data (each data point is assigned to a single cluster) . The 'means' in the K-means refers to averaging of the data; that is, finding the centroid.

As we are not given any information regarding the number of segments to produce we will be using elbow method to determine the number of clusters. Inertia is the squared distance of each sample in a cluster to its cluster center and sums them up. Initially we are trying to find the optimal K value using the Elbow Method wherein we will be finding the Within Cluster Sum of Square (WCSS) and try to find the point where it rapidly decreases which makes the graph look like an "elbow" there. The K value corresponding to that point is the optimal K value. We can clearly see that this elbow is forming at Clusters=4



So we can say the ideal number of clusters would be 4.

The customers in a segment have similar features and that information may be leveraged to create targeted promotion campaigns or design new offers schemes for different target segments.We study the records in each segments to find out their common features.

Segment 1:

1) The features of this segment are that the people in this segment are married but their spouses aren't working in salaried jobs.
2) The average price of car bought in this segment is just around 10L.
3) The average salary of all the people is around 19L.
4) They have higher number of dependants compared to average so that explains the less average price of the car bought.

Segment 2 :

1) The people in this segment are married.
2) They have working wives.
3) The people have high salaries (above 20L).
4) The people in this segment buy costly cars(around 17 L).
5) Many have post graduate degrees.
6) The people in this segment generally have more than 2 dependants.

Segment 3:

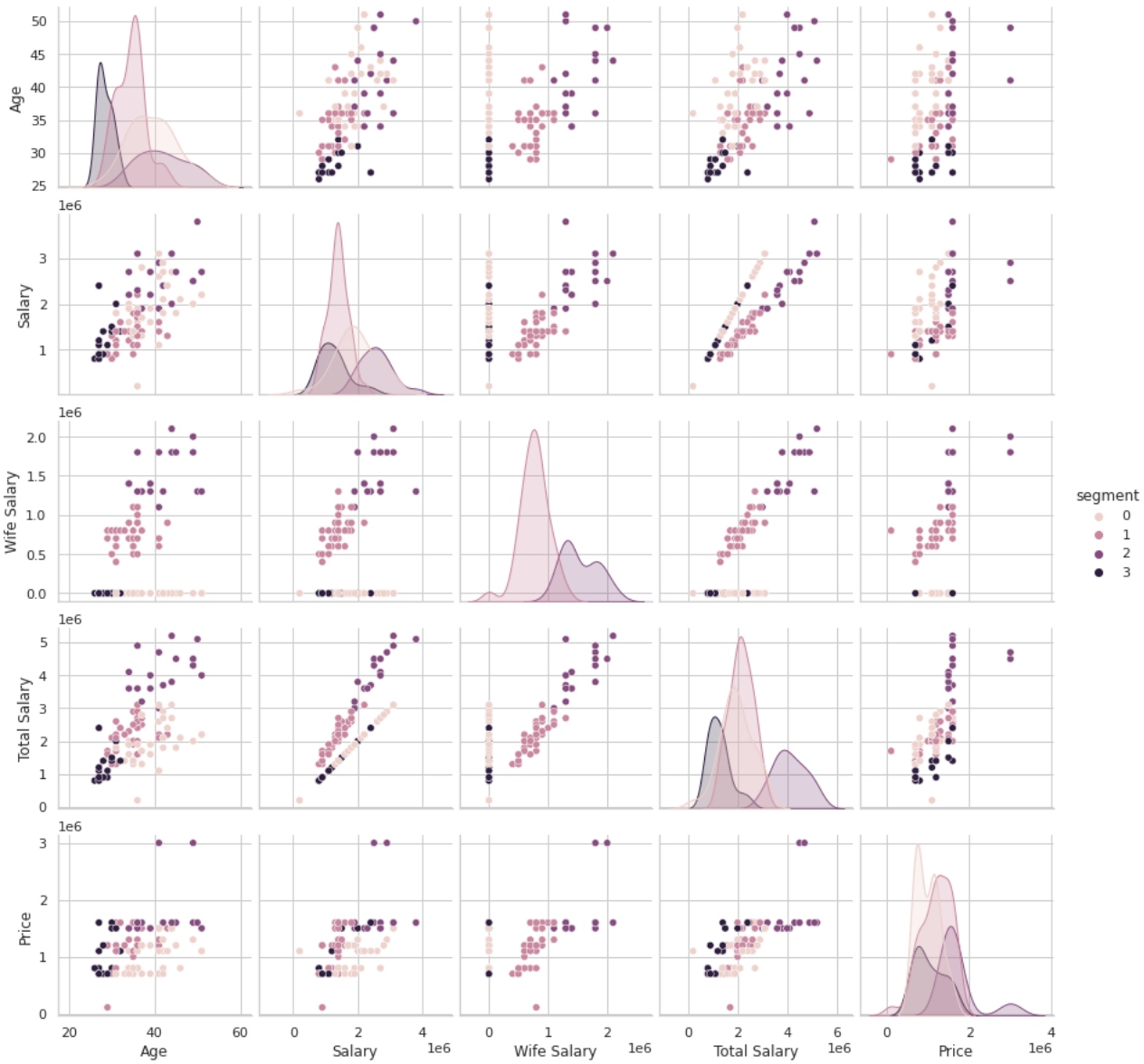
1) They people in this segment are generally single.
2) Their income is generally lower as compared to others (average of 12.5L).
3) But the average price of cars bought is quite high (10L).
4) A larger proportion of them are businessmen.
5) Low or no dependants.

Segment 4:

1) The people in this segment are married.
2) They have working wives.
3) Their salaries aren't very high (Total salary of around 20L-25L).
4) Price of car bought is higher than average around 12L.

PAIRPLOTS

We produce variable pairplots using seaborn to look at how the elements from different clusters are distributed in scatter plots for the different independent variables. This will show us that the clustering process was succesfull


Age
Salary
Wife Salary
Total Salary
Price
1e6
segment
0
1
2
3

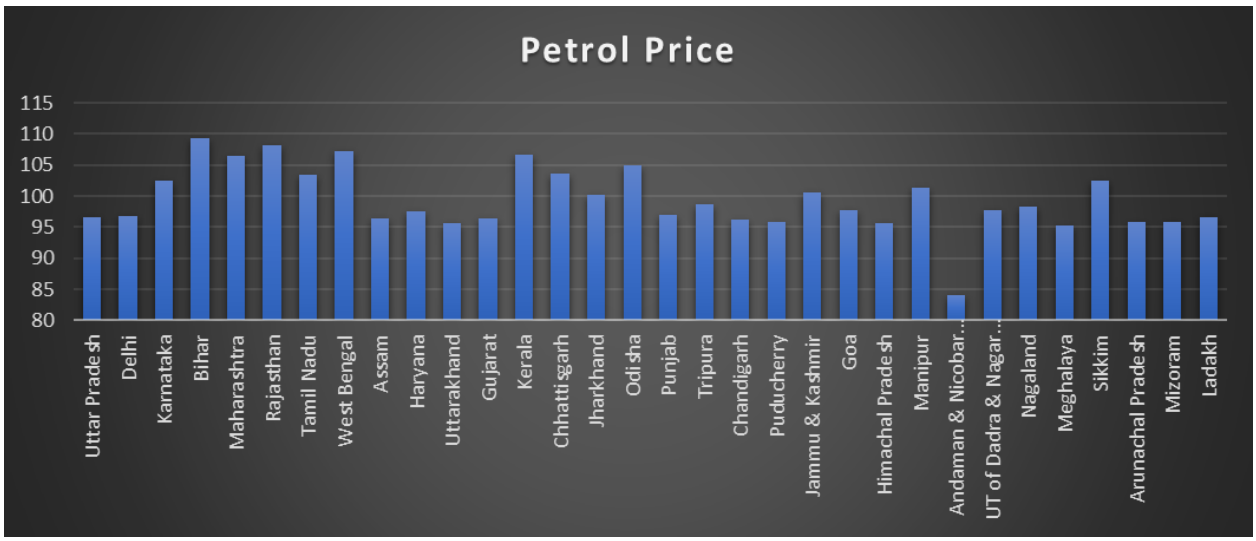
CONCLUSION : Since we know that the price of EVs is quite higher than normal vehicles, and it would require people to spend more than they spend on average vehicles, the best segments to target for selling the EVs would be **Segment 2 and Segment 4**.

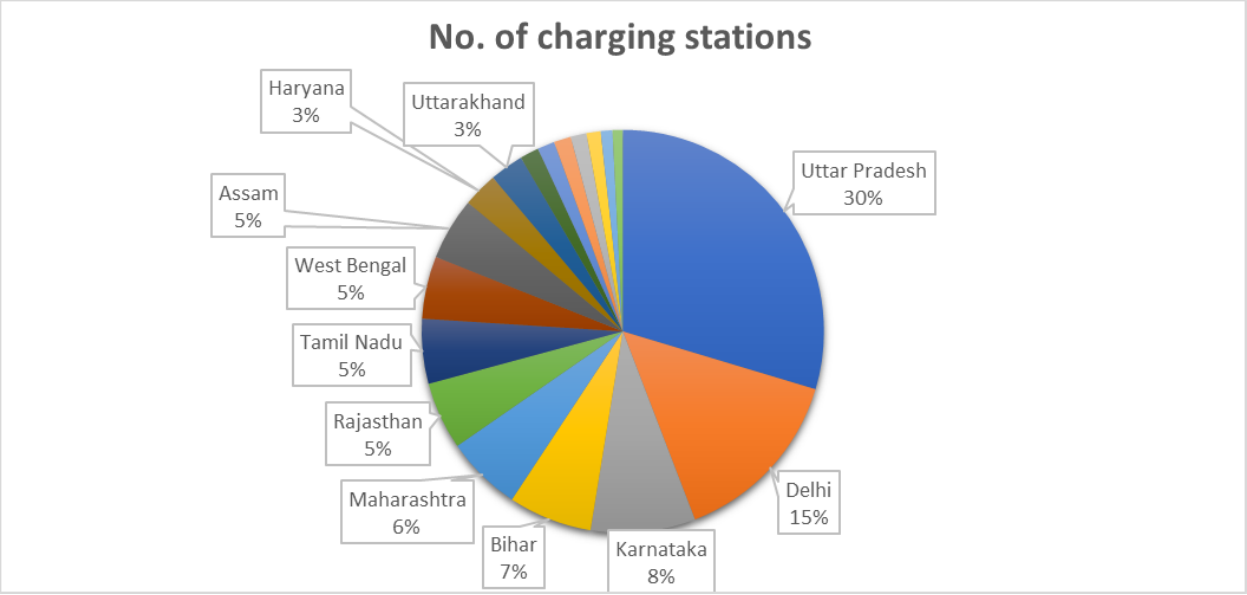
Segmentation according to geography :

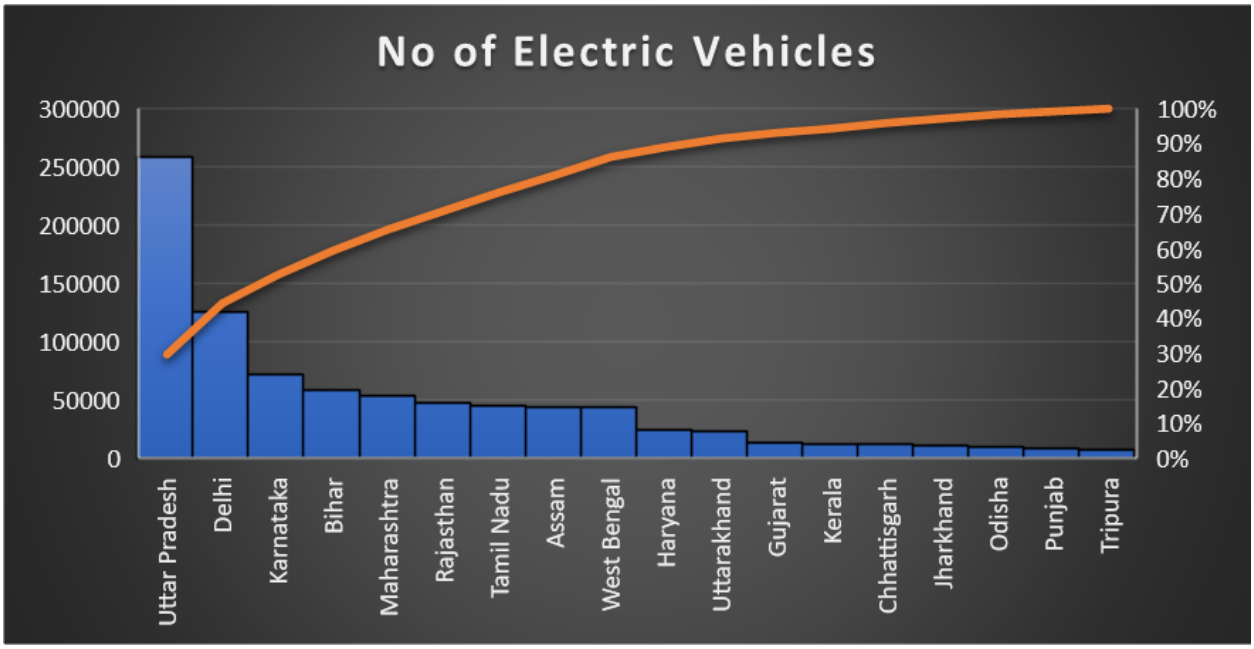
We took a dataset having variables like state-number of charging stations,number of charging stations sanctioned, total vehicles, total EVs,petrol price etc.

Analysis

We look at a few trends to understand our dataset better. Using MS Excel itself, we come up with a few visualizations for this purpose

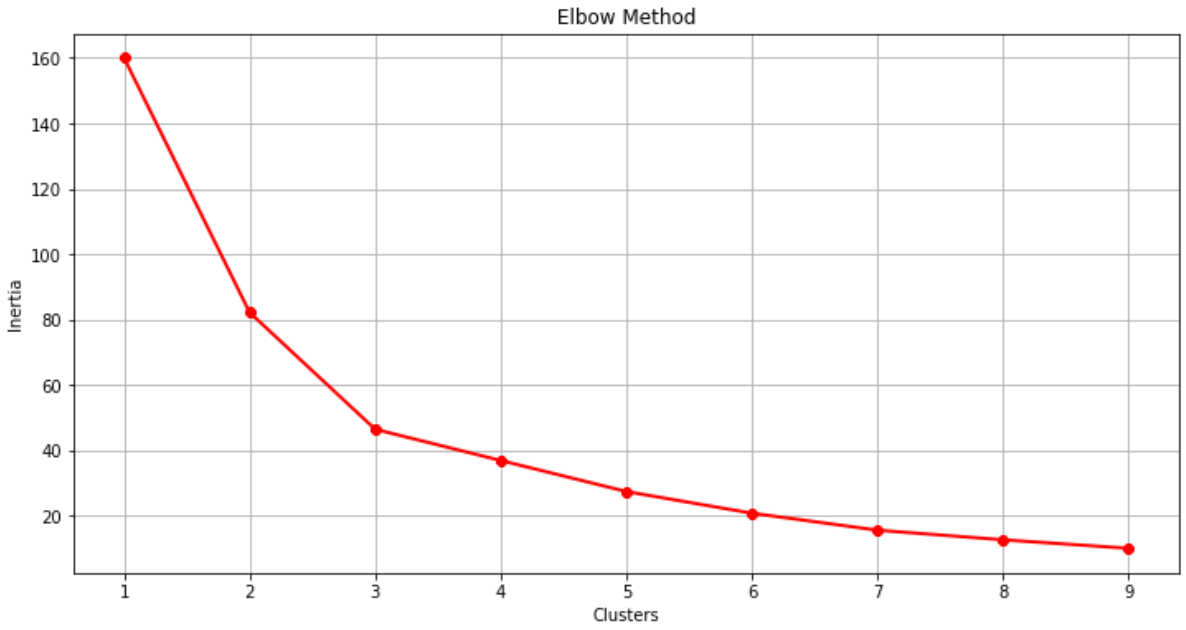






Segmentation

We will break down these states into clusters/segments in other target the specific states/regions that have better prospects of a growing EV market. Just like the demographic clustering process, we will use K-means here as well to come up with the clusters



Initially we tried to find the optimal K value using the Elbow Method wherein we will be finding the Within Cluster Sum of Square (WCSS) and try to find the point where it rapidly decreases which makes the graph look like an "elbow" there. The K value corresponding to that point is the optimal K value.

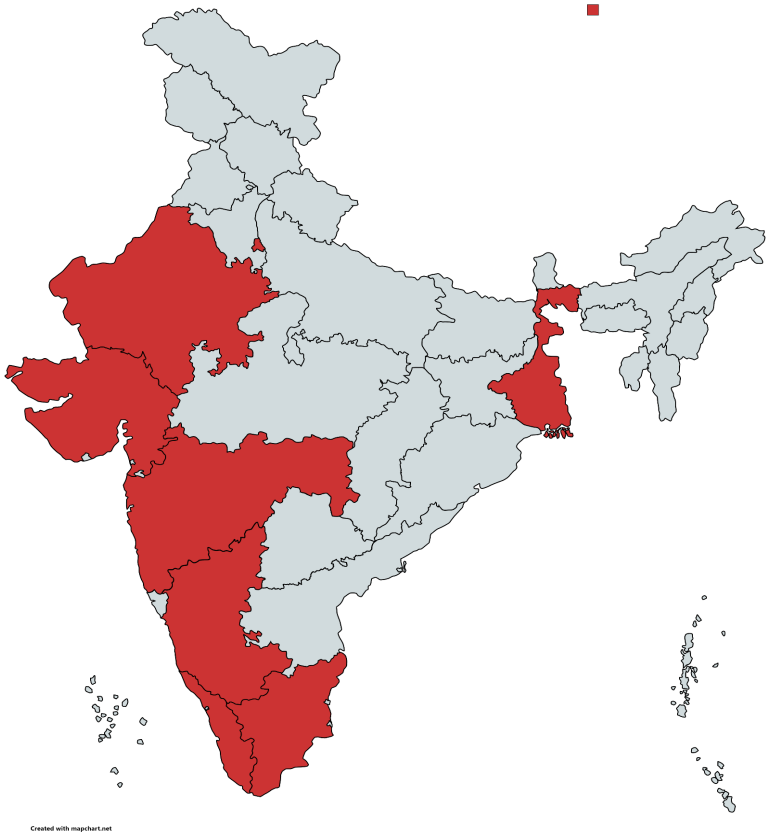
We can clearly see that this elbow is forming at Clusters=3

But if we observe the segment distribution we will find that only one state has been segmented in a cluster which is probable due to some hyperparameter tuning problem. So the states were mainly divided into 2 segments These are explained as follows:

Segment 1 :

1) There is a well established network of Electric Vehicles as well as charging stations.
2) Also the government aims at increasing the scope of this network which is visible from the large number of charging stations being sanctioned.
3) This could be equated to the fact that the prices of petrol in most of these states is higher than 100 which is the national average.

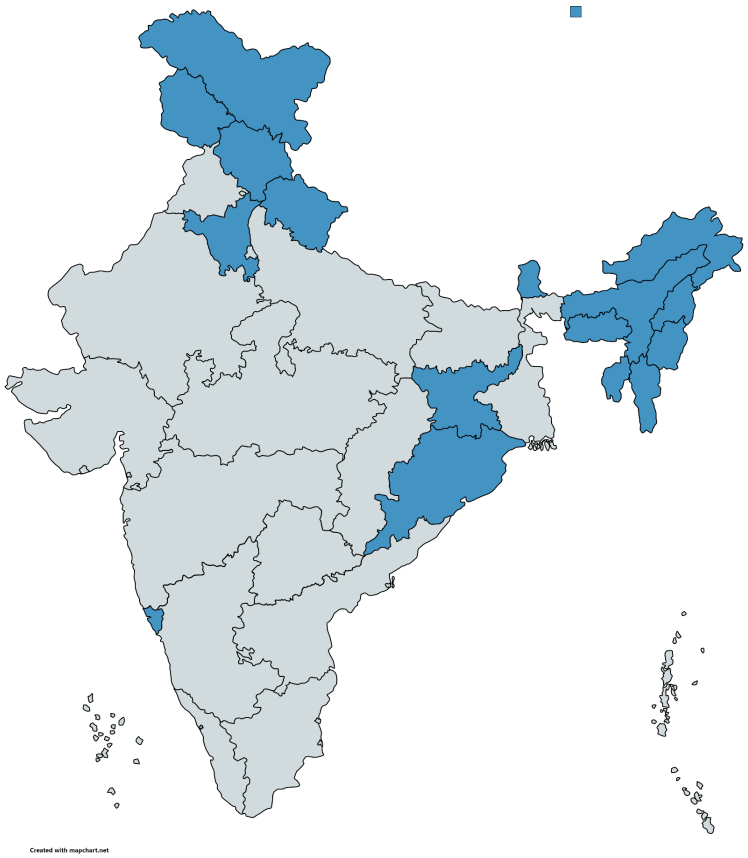
The main places in this segment are the developed areas like Delhi,Maharashtra,Karnataka etc.



Segment 2:

1) These are states with fewer charging stations and electric vehicles.
2) Also, the number of sanctioned stations indicates a lesser priority of the government as well the people to promote Electric Vehicles.
3) The lower prices of petrol in these stations is one of the reasons for them.
4) Also most of them are less developed states with lower per capita income which explains the willingness to not switch to more expensive Electric Vehicles.

This segment mainly consists of comparatively less developed states like Assam,Goa, Arunachal Pradesh etc.



CONCLUSION : We can clearly see that segment 1 consists of the states to target for the sale of our product, ie EVs.

FINAL VERDICT : So, for the successful launch and sale of EVs in the country, we have derived the segments(factors) to concentrate on. These segments will ensure that the product reaches to the correct market audience and thereby increasing the chances of sale and overall profit of the futuristic and innovative EVs. According to geography, people from the **states in Segment 1** should be marketed since they have a strong network of charging stations too. According to the overall segmentation , the price of EVs should be around **20 Lakhs** which from analysis is supposed to be suitable for many people to purchase.