Market Segmentation Analysis of Electric Vehicles Market in India

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Overview:

Although more than 90% of all vehicles currently rely on oil as their essential energy source, there is growing interest in developing electrical energy hotspots for vehicles. This change changed the profile of the electric vehicle (EV), which uses an electric motor instead of a traditional gasoline engine that consumes fuel and gas. The electric vehicle will then be considered as a possible replacement for the regular HE vehicle within a reasonable period of time. Given the huge problem of increasing global air pollution, the overall adoption of electric vehicles could help achieve practical improvement goals. In a country like India, where transport space is expanding rapidly and dependence on petroleum products is rapidly increasing, the introduction of electric vehicles represents a significant opportunity to reduce emissions and reduce dependence on imported oil.

Currently, electric vehicles make up a small portion of the Indian market, which is dominated by fossil fuel-based transportation. This dependence contributes to environmental degradation through greenhouse gas emissions, exacerbating global warming. The widening gap between India's domestic oil production and consumption highlights the need to find sustainable and clean alternatives for the transportation system, with electric vehicles emerging as one of the most promising options.

The current state of India's road transport sector is characterized by high energy utilization, unequal vehicle-to-passenger ratios, significant per capita energy consumption, and high emissions of ozone-depleting substances. Despite having a high per capita vehicle ownership of, India ranks third in overall CO2 emissions and is relying heavily on electricity to achieve zero-emission transport. This highlights the urgent need to focus on automotive innovation.

Furthermore, rapid urbanization and expansion of urban areas have led to an increase in private car ownership. Electric vehicles, including hybrid electric vehicles (HEV) and plug-in hybrid electric vehicles (PHEV), bring several benefits to Indian roads:

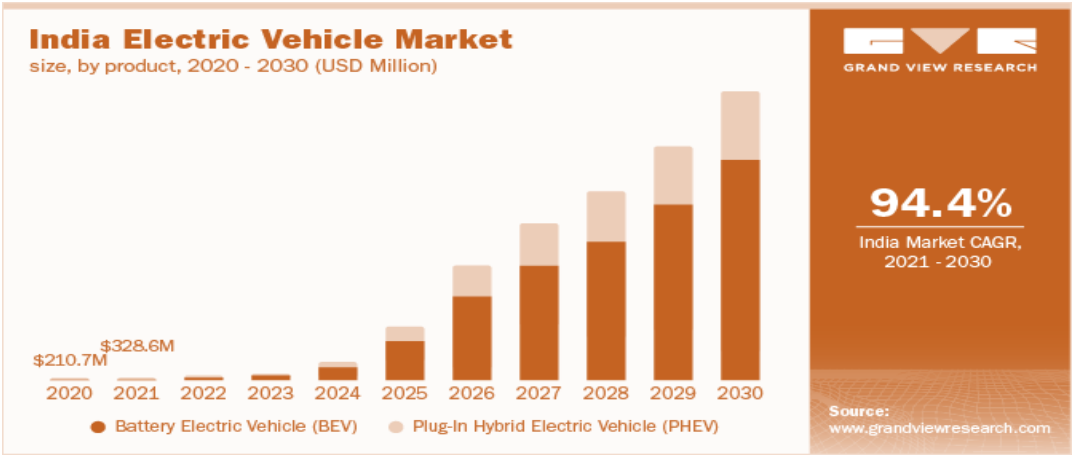
1. 1.Hybrid and electric powertrains are more efficient at low speeds. The conditions encountered are compared to internal combustion engines.
2. HEVs and EVs can recover a significant portion of the energy lost during braking

through regenerative braking systems.

3. Unlike conventional vehicles, HEVs and electric vehicles do not consume fuel when idling.
4. This often happens in India due to traffic congestion.
5. 4.India's low average mileage makes electric vehicles more viable and eliminates concerns about limited range on a single charge.
6. 5.Urban driving behaviour in India is characterized by frequent stops and starts in traffic jams, making it suitable for the efficiency of electric vehicles.
7. In summary, the transition to electric vehicles represents a viable solution to address India's growing transportation challenges and provide cleaner and sustainable mobility options for the future.

Market Overview:

The Indian electric vehicle market is segmented on the basis of vehicle type and power source. Vehicle types include travel vehicles, commercial vehicles, two-wheelers and three-wheelers, and energy source types include battery electric vehicles, module electric vehicles, and crossover electric vehicles. While we primarily focus on the Indian electric vehicle market by vehicle type, the report first discusses the impact of Force Sources openness.

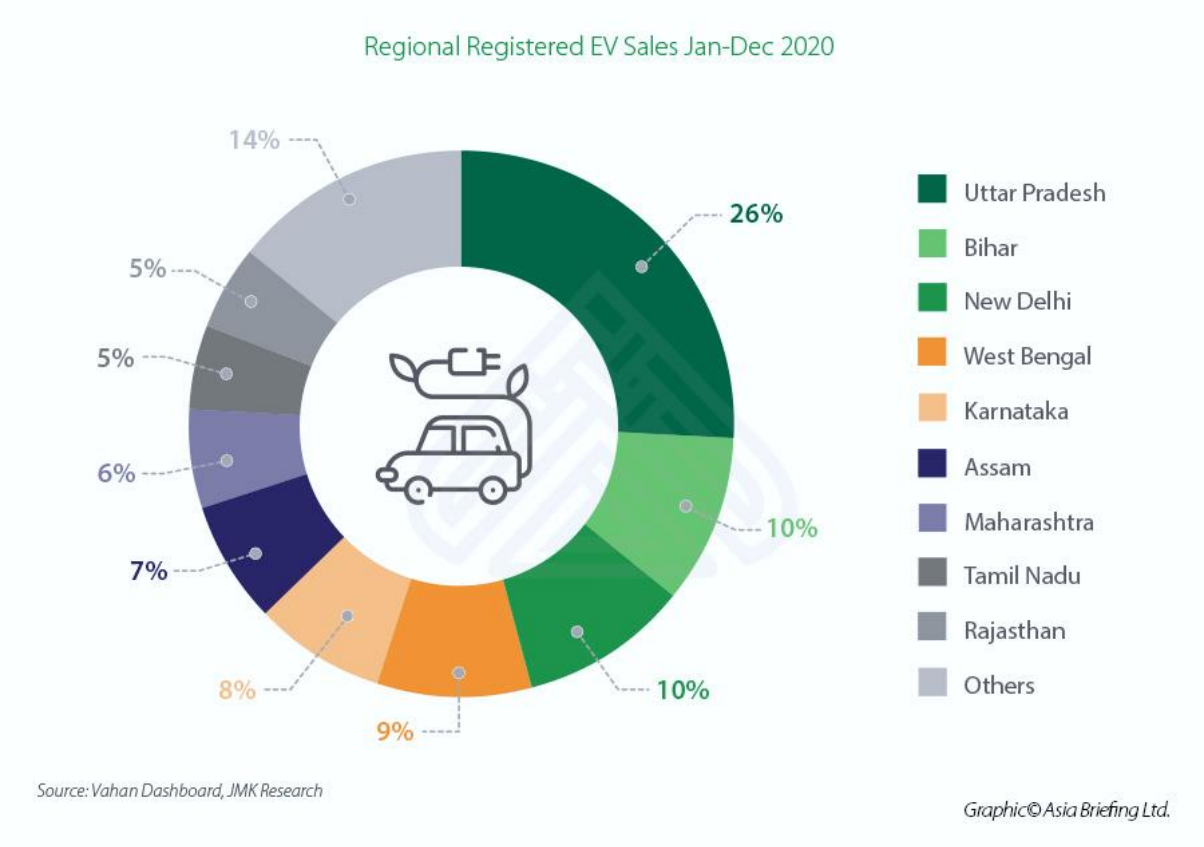


The electric vehicle market in India in 2020 is estimated to be 5 billion units during the period (2021- 2026). Despite the challenges caused by the coronavirus pandemic, including production network disruptions and production stoppages due to nationwide lockdown and travel restrictions, India's electric vehicle (EV) market remains in its infancy. Despite the accelerated update coming soon, is expected to circulate through various government initiatives and policies.

In particular, e-commerce giants such as Amazon are pioneering the use of electric mobility for last-mile deliveries with the aim of reducing CO2 emissions. India is also researching e-mobility for public transport, with electric intercity buses already in use in major cities. The state government is also actively promoting the adoption of EV through the implementation of guidelines. Example: –

- Kerala aims to have 1 million electric vehicles on its roads by 2022 and 6,000 electric buses in public transport by 2025.
- Telangana has set ambitious electric vehicle sales targets for 2025, 80D44 in

two-wheelers and three-wheelers, 70% in commercial vehicles, 40% in buses, 30% in private vehicles and electrification of the entire fleet.The goal is to achieve a 15% penetration rate.



India's EV market is all set to go big following the implementation of the Conspiracy (India Popular) aimed at faster uptake and assembly of (hybrid and) electric vehicles in India. This is in line with his goals of global responsibility and of course. Furthermore, the share of electric bicycles in India represents a huge undiscovered market with 100% untapped FDI in the region and the development of the market will be enhanced through the programmed courses during the estimated period of It is expected that.

Fermi Estimation:

The Fermi estimation process involves using variables and equations to predict specific outcomes based on rough estimates and assumptions. Therefore, the estimation was carried out according to the following references.

1. Employment rate (E(x)): This is the ratio of the number of available workers to the population of the working age group. The formula used to calculate the employment rate for year x is:

E(x) = (A(x)* 100) / (P(x)*r)

where:

- A(x) represents the number of workers available in year x.

- P(x) represents the population in year x.

- r is the proportion of Indians aged 18 to 60 to the total population of India.

2. Population growth estimates: Population estimates for each year (2019-2022) were obtained by calculating the annual population growth based on historical data. For example, to estimate the population in 2022:

- P(2019) = 1,367,604,444

- P(2020) = 1,378,604,444

- P(2021) = 1,391,994,444

Average population increase by 2022 (P (2022)) was estimated to be = 444,441,441,850,000.

3.Employment rate projection for 2022: Using the derived population estimates for 2022 and assuming a constant number of available workers per year, the employment rate for 2022 is calculated using the formula above.

4.Conclusion: Based on the estimated employment rate in 2022 (42%), it was predicted that approximately 10% of the working population (17 million people) will be able to purchase an electric vehicle by the end of his 2024.

DATA SOURCES:

- https://samples.mordorintelligence.com/69655/Sample%20-%20India%20Electric%20Vehicles%20Market%20(2020%20-%202025)%20-%20Mordor%20Intelligence.pdf
- https://jmkresearch.com/registered-ev-sales-in-india-in-2020-dropped -by-26- on-yoy-basis/
- https://jmkresearch.com/registered-ev-sales-drop-20-y-o-y-in-fy2021/
- https://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=12

Dataset:

Dataset 1: EV Statistics

- https://electricvehicles.in/electric-vehicles-sales-report-in-india-2018/

It includes various categories of electric vehicles such as two-wheelers, three-wheelers, cars, and buses. Each row represents a different state, and the 4,444 columns show the number of EVs in each category for that state.

The key columns are:

- State: Name of the Indian state.
- Two-wheelers (categories L1 and L2 as per the Central Motor Vehicles Rules): Number of two-wheelers falling under a particular category as per the Central Motor Vehicles Rules.
- Tricycles (Category L5 Low Speed as per CMVR): Number of tricycles classified in a particular category as per CMVR.
- Passenger Vehicles (Category M1 according to CMVR): Number of passenger vehicles that fall into a particular category according to CMVR.

Analyzing this dataset will help you understand the distribution of electric vehicles in different states of India, identify regions with high penetration rates, and assess overall trends in electric vehicle usage in the country.

Dataset 2: Indian Cars Purchasing Behaviour Survey

- https://www.kaggle.com/karivedha/indian-consumers-cars-purchasingbehaviour

This dataset includes a personal purchase of his cars in India. This includes a variety of attributes such as age, occupation, marital status, education, number of dependents, credit history, salary details, car brand and price preferences, and more.

Key columns include:

- Age: The age of the person.

– Occupation: Individual's occupation (employee, tradesman, etc.).

– Marital Status: Individual's marital status (e.g. single, married).

– Educational background: The individual's educational background.

– Personal Loan: Whether you have a personal loan (yes/no).

– Mortgage: Whether the person has a mortgage (yes/no).

– Wife Works: Whether the person's wife works (yes/no).

- Salary: The person's salary.

- Wives' salaries: wives' salaries.

- Total Salary: Total salary for the individual and his or her spouse.

- Price: favourable price range for purchasing a car.

This dataset enables analysis of various factors that influence car purchasing decisions in India.

Preprocessing the data:

If you look at the category, you will see that it can be mapped to another category within the same attribute (i.e. no).

```
[ ] df.loc[df['Wife Working'] == 'm']
```

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Make	Price
11	35	Salaried	Married	Graduate	4	Yes	Yes	m	1400000	0	1400000	Baleno	700000

After proper classification, we look for possible null entries in the dataset. In our case there is no such entry.

```
[ ] ## Double checking the percentage of empty entries column wise
    df.isnull().sum() / df.shape[0] * 100.00
```

```
Age                   0.0
Profession            0.0
Marrital Status       0.0
Education             0.0
No of Dependents      0.0
Personal loan         0.0
House Loan            0.0
Wife Working          0.0
Salary                0.0
Wife Salary           0.0
Total Salary          0.0
Make                  0.0
Price                 0.0
dtype: float64
```

Since you cannot use categorical variables for K-means clustering, encode different attributes in copies of the original dataset and use these to train the model.

```
[ ] obj_df = X.replace(encoding)
    obj_df.head()
```

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Price
0	27	0	0	1	0	1	0	0	800000	0	800000	800000
1	35	0	1	1	2	1	1	1	1400000	600000	2000000	1000000
2	45	1	1	0	4	1	1	0	1800000	0	1800000	1200000
3	41	1	1	1	3	0	0	1	1600000	600000	2200000	1200000
4	31	0	1	1	2	1	0	1	1800000	800000	2600000	1600000

Finally, before implementing the K-means clustering algorithm, scale the entire dataset using the StandardScaler() function.

```
[ ] X_scaled = StandardScaler().fit_transform(obj_df)
    X_scaled = pd.DataFrame(X_scaled,columns=['Age', 'Profession', 'Marrital Status', 'Education', 'No of Dependents',
                                              'Personal loan', 'House Loan', 'Wife Working', 'Salary', 'Wife Salary',
                                              'Total Salary','Price'])

    x = X_scaled.to_numpy()
    X_scaled
```

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Price
0	-1.498630	-0.739510	-2.366432	0.876275	-1.642313	1.446980	-0.772512	-1.051847	-1.397118	-0.887055	-1.406760	-0.904843
1	-0.211304	-0.739510	0.422577	0.876275	-0.136859	1.446980	1.294479	0.950708	-0.501877	0.108995	-0.258937	-0.445579
2	1.397855	1.352247	0.422577	-1.141195	1.368594	1.446980	1.294479	-1.051847	0.094950	-0.887055	-0.450240	0.013685
3	0.754191	1.352247	0.422577	0.876275	0.615867	-0.691095	-0.772512	0.950708	-0.203464	0.108995	-0.067633	0.013685
4	-0.854967	-0.739510	0.422577	0.876275	-0.136859	1.446980	-0.772512	0.950708	0.094950	0.441012	0.314975	0.932213
...	...	...	...	...	...	...	...	...	...	...	...	...
94	-1.498630	1.352247	-2.366432	-1.141195	-1.642313	-0.691095	-0.772512	-1.051847	0.990190	-0.887055	0.123671	0.932213
95	2.202434	-0.739510	0.422577	0.876275	0.615867	-0.691095	-0.772512	0.950708	3.079085	1.271054	2.706274	0.932213
96	2.363350	1.352247	0.422577	-1.141195	-0.136859	1.446980	1.294479	-1.051847	0.691777	-0.887055	-0.067633	-0.215947
97	2.363350	-0.739510	0.422577	0.876275	-0.136859	-0.691095	-0.772512	0.950708	1.437811	1.271054	1.654102	0.702581
98	2.363350	-0.739510	0.422577	0.876275	-0.136859	1.446980	1.294479	-1.051847	0.691777	-0.887055	-0.067633	-0.215947

99 rows × 12 columns

Segment Extraction:

Use demographic research to perform market segmentation.

This involves selecting 100 people from the total population and collecting information relevant to our purpose of determining the likelihood of purchasing a vehicle. Since we are trying to find the ideal objective part for market penetration, we divide the market into different sections. There are two common methods of placement: sound judgment, characterization, and information-driven grouping.

Here we perform one of information-driven groupings (i.e. K-means bundling).

Algorithm:

K-Means

K-Means clustering is a type of unsupervised learning used when you have unlabelled data (that is, data with no defined categories or groups). The purpose of this algorithm is to find groups in the data, and the number of groups is represented by the variable K. The algorithm works iteratively, assigning each data point to one of K groups based on the features provided. Data points are clustered based on feature similarity. The results for the K-means clustering algorithm are:

1.K cluster centroids that can be used to label new data.

2. Labels for the training data (each data point is assigned to a single cluster) The "average" in K-means refers to the averaging of the data. In other words, find the center of gravity.

The steps for K-means clustering are as follows:

1. Specify the number of segments k required.

2.Randomly select k observations (consumers) from dataset X and use them as an initial set of cluster centroids. C = {c1, . . . , ck}.

3. Assign each observation xi to the closest cluster centroid to form a partition of the data, that is, k market segments S1, . . . ,Sk where

$$\mathcal{S}_j = \{\mathbf{x} \in \mathcal{X} | d(\mathbf{x}, \mathbf{c}_j) \leq d(\mathbf{x}, \mathbf{c}_h),\ 1 \leq h \leq k\}$$

This means that each consumer in the data set is assigned to one of the initial segment representatives. This is achieved by calculating the distance between each consumer and each segment representative, and then assigning the consumer to the market segment with the most similar representative.

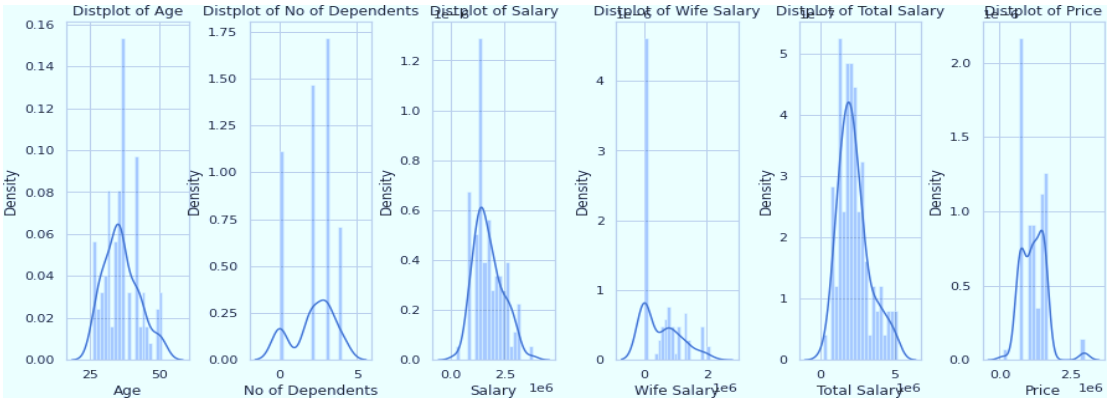
4. Recompute the cluster centroids (segment representatives) by holding cluster membership fixed, and minimising the distance from each consumer to the corresponding cluster centroid.

$$\mathbf{c}_j = \arg\min_{\mathbf{c}} \sum_{\mathbf{x} \in \mathcal{S}_j} d(\mathbf{x}, \mathbf{c}).$$

5. Repeat from step 3 until convergence or a pre-specified maximum number of iterations is reached. This is when the stepwise process of the partitioning algorithm stops and the segmentation solution is declared to be the final one.

Demographic Analysis

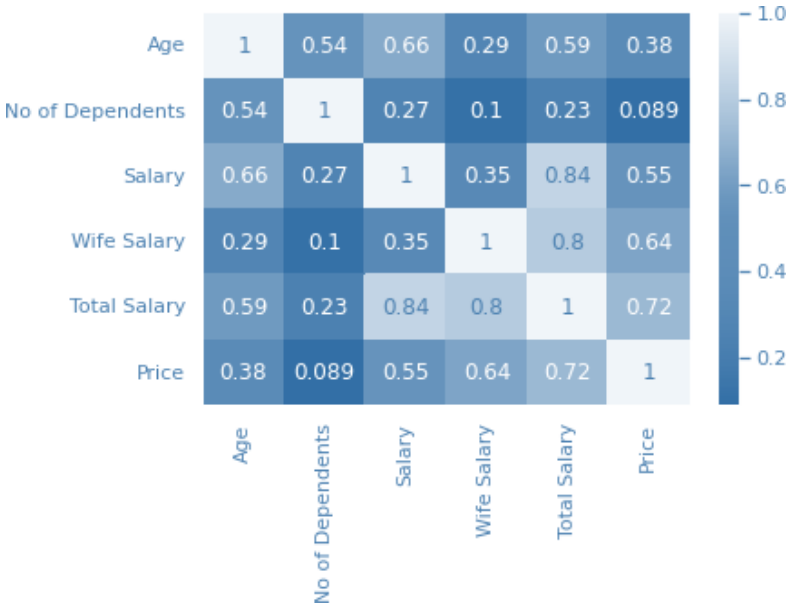
Demographic segmentation groups customers and prospects by focusing on specific characteristics such as age, gender, income, education, occupation, and marital status. Demographic segmentation is based on the assumption that consumers within the same demographic group have similar needs. customer demographic segmentation helps businesses develop market reach for better marketing strategies. When organizations consider demographic segmentation, they focus on the people who are most likely to purchase their products. This will help you identify your target market. We used the same dataset used for behavioral and psychological analysis. Also, the following graph will help you understand the socio-demographic structure of the market.



Observations from Distribution:

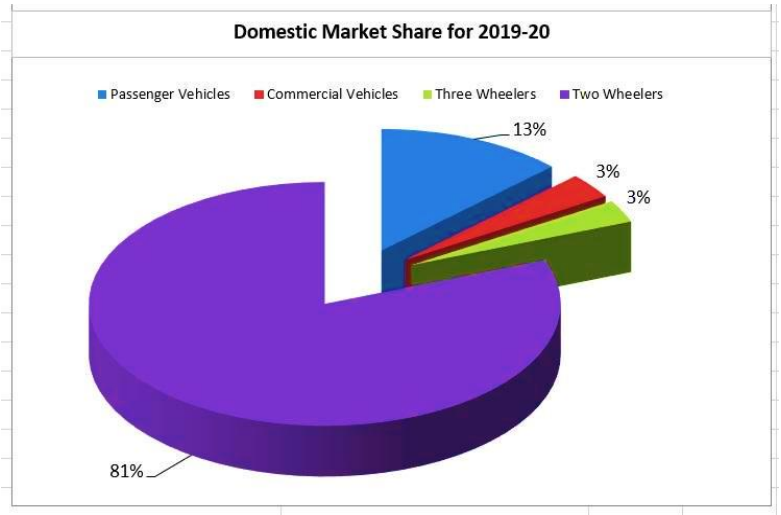
- People between the ages of 25 and 50 make up the largest portion of the consumer market.

- Most people with an average gross salary of around 30 million rupees tend to buy more vehicles.



Observations from the heat map:

No significant new relationships were found, which confirms previous observations.

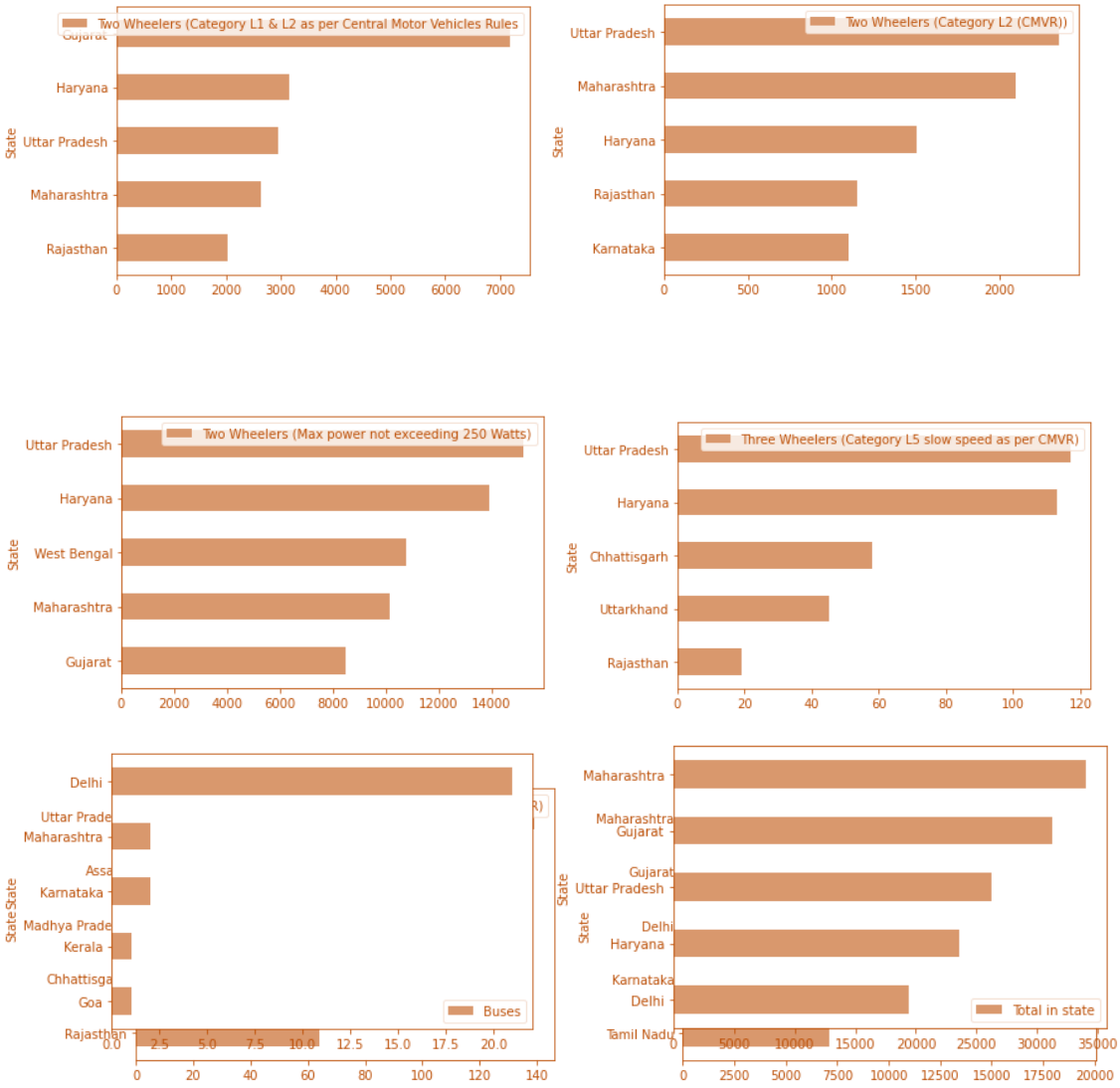


The pie chart above shows the domestic market share of Indian automobiles, taken from the Society of Indian Automobile Manufacturers (SIAM) (see Resources). It can be seen that the market share of two wheelers in India is very large compared to other types of vehicles. Therefore, it would be beneficial for electric vehicle startups to focus on two-wheeled electric vehicles.

Geographic analysis:

A component that nicely complements a marketing strategy that targets products or services based on the location of consumers. The division into countries, states, regions, cities,

universities and regions is done to understand the target groups and market the products/services accordingly. Here, we have created a breakdown for each state and union territory of India. The geographic analysis used a dataset of sales of different types of electric vehicles by state. This will help you understand your target region. Based on the type of EV , states with a high number of EVs can be targeted as people in these states are more likely to buy them. Below is a bar chart showing the five states with the highest sales of certain types of EVs.



Depending on the type of EV a startup has, it may target his state. This market for most of these electric vehicles is fairly developed in this state because consumers must be willing to purchase electric vehicles and there are factors such as cost compared to the average consumer income.

It is important to consider that it is a city. And resources should be considered for electric vehicle charging (charging stations, etc.) and it is important to be able to maintain it

Model Usage:

First, we try to find the ideal K value using an elbow strategy.Here we look at as the inner bunch quantity square (WCSS) and try to find where it decreases rapidly. This will make your

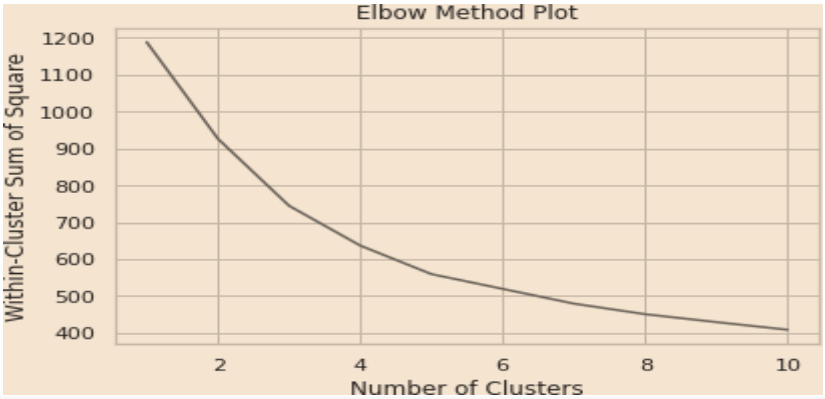
chart look like this. There is an elbow. The ideal K value is the K value that associates with this point.

```
[44] wcss = []

     for i in range(1, 11):
         kmeans = KMeans(n_clusters = i, init = 'k-means++',
                         max_iter = 300, n_init = 10,random_state = 0)
         kmeans.fit(X_scaled)
         wcss.append(kmeans.inertia_)
```

```
plt.plot(range(1, 11), wcss)
plt.title('Elbow Method Plot')
plt.xlabel('Number of Clusters')
plt.ylabel('Within-Cluster Sum of Square') # Within cluster sum of squares
plt.tight_layout()
plt.show()
```

If you look at the plot, you can see that there are two points where the elbow forms (this is indicated by the slight bend at K=3 and K=5). After determining the best possible K value, we try to find a K value that allows us to cluster correctly.




```
[49] kmeans = KMeans(n_clusters = 3, init = 'k-means++',
                     max_iter = 300, n_init = 10,random_state = 42)
     kmeans.fit(X_scaled)
```

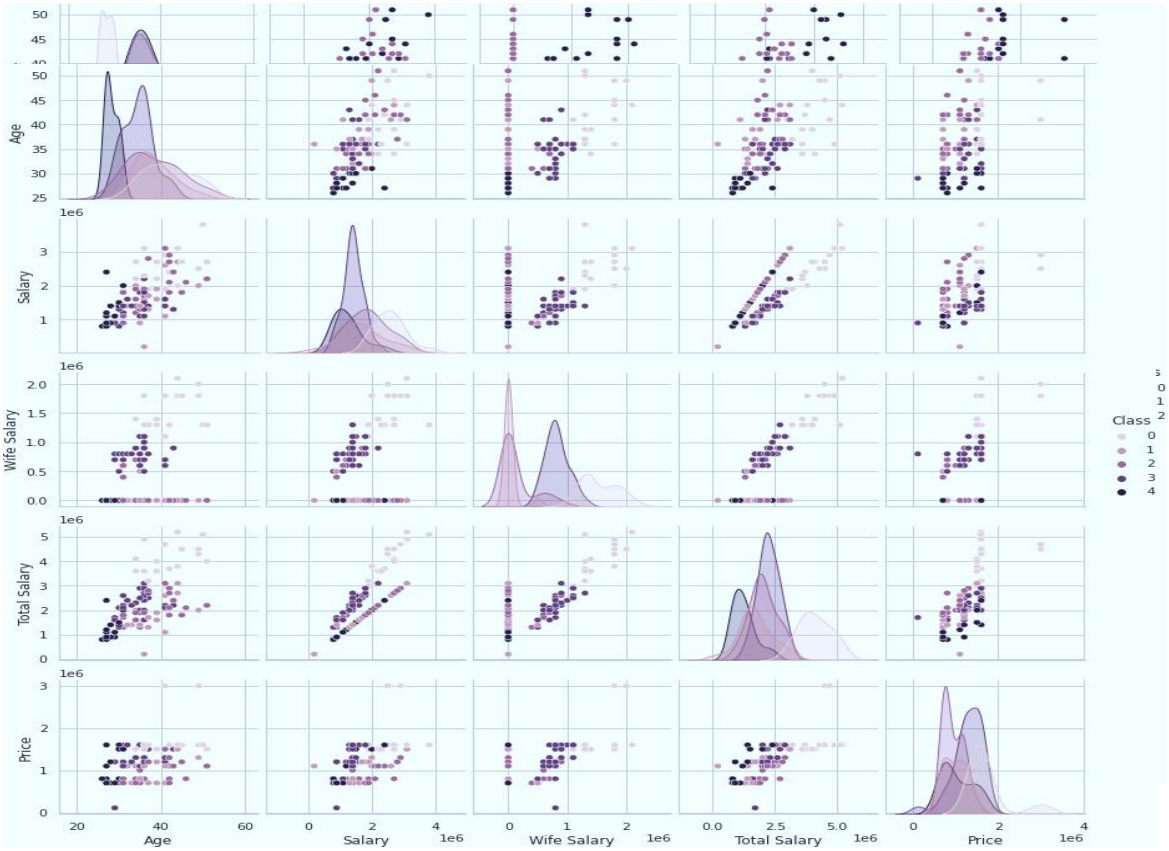
```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=42, tol=0.0001, verbose=0)
```

Therefore, we try to train K-means clustering using K=3 and K=5. From behavioral, psychological, geographical, and demographic analyses, we were able to identify several characteristics that influence consumer grouping. However, by examining the clustered dataset, we were able to find his five attributes (i.e. age, salary, wife's salary, total salary, and price) that contribute the most to clustering. This can be confirmed in the following pair diagram for conditions K=3 and K=5. In this case, we can see that the dataset is naturally clustered. From here we can see that the model is trying to group people based on their total income. Where:

- Class 1 is the group of people whose total salary is close to their salary (husband's

salary.

- Class 2 is a group of people whose total salary is higher than the salary (her husband's salary.
- Class 0 is a group of people whose total salary is close to the salary (husband's girlfriend's salary of people, but whose overall salary is relatively low compared to other groups.



K = 3 & K =5

Target segment:

Young people are more likely to purchase new technology products, especially electric vehicles, because they are aware of the environmental benefits and want to make a difference. Although expensive, the report says the fact that electric cars are less affordable could be a disadvantage, as younger populations are less likely to buy expensive cars. The proposal is to target people who are keen to try new technology but are wealthy enough to afford an electric car. These people are probably in their 30s to 40s and number 4,444.

People in urban areas with existing infrastructure and education about the technology and its benefits tend to purchase electric vehicles more often. People who are married and have dependents are likely to be targeted because they are more likely to buy a car. The average salary of someone who buys a car is around 3 million yen, and most car purchases are in the 1to20 million-yen range, with motorcycles being less. These aspects also need to be considered. In summary, the target segment should consist of electric vehicles with acceleration of 7.5-10 seconds, high comfort and value for money, price range It focuses on states that should Karnataka, Tamil Nadu, Rajasthan

MARKET MIX:

Product pricing is both an art and a science. The most important thing is to know and understand your production costs. From there, you can make adjustments based on product characteristics, specific pricing strategies, customer price sensitivity, customer values, and other factors. The marketing mix helps us understand what our product or service can offer our customers and plan a successful product offering. We help you plan, develop, and implement effective marketing strategies. Use to find out if your products and services are right for your customers.

Products:

Product types will of course vary from EV startup to EV startup, but in the course of our analysis, we concluded that since India has the largest automobile market, it would be best to enter the market with two-wheelers. It has come to this Share Two-Wheeler. Most people will buy a two-wheeler. Because it is cost-effective and supported by current infrastructure. Another product type that EV startups can consider is public transport vehicles, as current government policies support the transition of public transport to electric powertrains.

Price:

Affordability is a key issue in the development of electric vehicles. It is important to remember that to appeal to consumers, a company's products must be cost-effective both in purchasing and maintaining them. The ideal price for the product is between £4,444.10 and £20,000, as most people buy in this range.

Place:

Infrastructure is another important aspect to consider when developing and launching products. These 4,444 cities are places that need infrastructure development, so you should target the country's major cities. Another reason for targeting 4,444 cities is that they have a large educated population who are willing to purchase electric vehicles because they are aware of the environmental benefits. Our geographic analysis has produced a list of top states with good markets for different types of vehicles.

Promotions:

Promotions vary by product. The best advertising possible is to educate people about the benefits of electric vehicles/HEVs/PHEVs over fuel-based vehicles. If a startup proposes an affordable product using, it must be promoted.

Most Optimal Market Segment

There are many EV manufacturers in the country such as Hero Electric, Tata Motors, Other Energy, Ashok Leyland and Hyundai Kona Electric. Tesla has also arrived. The investment in , policy and everything else will be bigger because it's an auto industry and demand is higher, but it will take time for to become fully established in India. The main results of this project are:

- The electric vehicle industry, which has not fared very well due to the devastating effects of the coronavirus pandemic, will make a huge leap forward in the coming years.
- The use of electric vehicles will bring about major changes in terms of the environment, atmosphere, noise, etc. It's environmentally friendly and makes a big difference in terms of post electricity and more.
- Companies should plan to establish local operations in India by partnering with local companies or setting up their own manufacturing/development units, possibly in combination with imports of certain his components.
- We expect the two-wheeler and three-wheeler commercial fleet market to continue to grow in India, supported by growth in particularly last kilometer delivery/intra-city freight services.
- The company needs to identify opportunities across its supply chain in the battery, EV

components, and charging infrastructure segments, including the machinery and equipment needed to set up production facilities, train and deploy skilled workers, etc.

- The company started its operations from Metro City, India and was planning to set up after which it expanded significantly to other cities in the same state as Metro City.

This helps to ease the expansion of the company as has prior knowledge of the business world of the metropolis and 's supply chain network becomes easier in the long run.

In summary, electric cars are the future – "*Go Green Go Electric*".