Market Segmentation Analysis of EV Market

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INTRODUCTION -

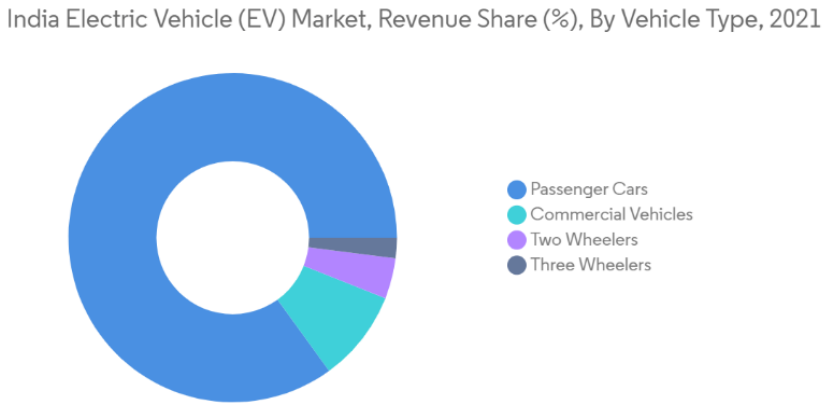
ACTUAL MARKET SITUATION FOR THE LAND OF EVs -

The Indian Electric Vehicle (EV) Market is Segmented by Propulsion Type (Battery Electric Vehicle, Plug-in Electric Vehicle, and Fuel Cell Electric Vehicle) and Vehicle Type (Passenger Cars, Commercial Vehicles, Two-wheelers, and Three-wheelers).

The Indian electric vehicle market was estimated at USD 1,434.04 million in 2021, and by 2027, it is anticipated to have grown to USD 15,397.19 million, registering a CAGR of 47.09%. (2022-2027).

48 percent of the 168 percent rise in sales projected for 2021 came from two-wheelers, 47 percent from three-wheelers, followed by 4 percent from passenger vehicles and 0.36 percent

from electric buses. According to the IVCA-EY-IndusLaw, factors including the demand for personal mobility and the increase in gasoline and diesel prices are supporting the spike in EV sales. Twenty percent of EV registrations in India's most populous state, Uttar Pradesh, saw the majority of EV sales.



Government Role and Trends:

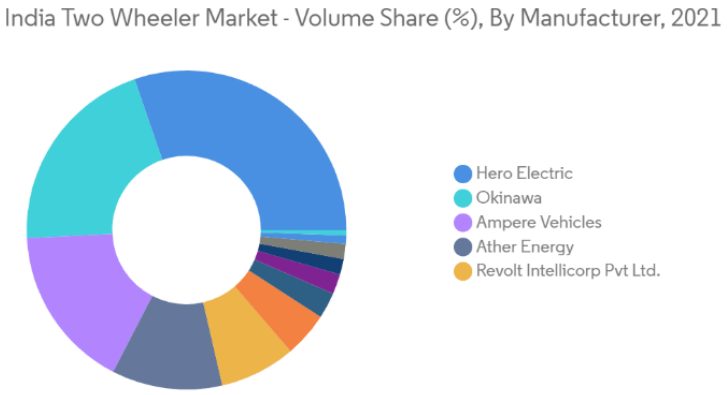
For the purpose of reducing emissions in accordance with international agreements and fostering e-mobility in the wake of rising urbanisation, the Indian government has launched a number of efforts to encourage the production and acceptance of electric vehicles in India.
The Indian government has given tax breaks and subsidies to EV producers and buyers in order to boost the domestic EV market. The government has levied a 15% customs levy on parts used to make electric vehicles and a 10% duty on imported lithium-ion cells in accordance with the phased production proposal. The updated PMP duty is scheduled to begin in April 2021.

Electric two-wheeler growth expectations:

Despite the fact that the COVID-19 epidemic caused lockdowns and supply chain disruptions, rising gasoline and diesel prices, government incentives, and a surge in spending for building charging infrastructure in the nation are likely to spur demand. For instance, approximately

152,000 electric two-wheelers were sold in the nation in FY 2020 as opposed to 126,000 units in FY 2019.

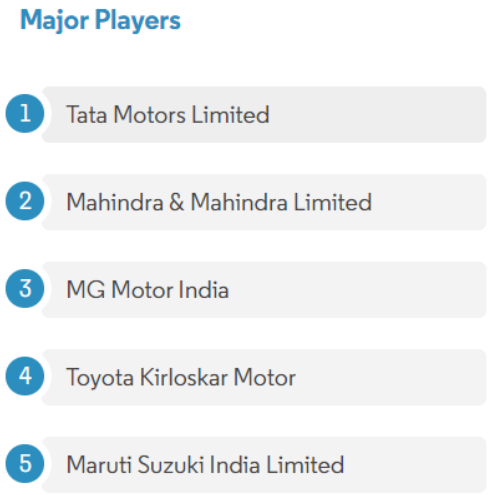
Electric motorcycles and scooters are common vehicles in the two-wheeled electric market. They are simpler to manoeuvre through traffic than traditional two-wheelers. Low-speed (up to 25 km/h) and medium-speed (up to 40 kmph) electric two-wheelers with traditional lead-acid batteries are anticipated to rule the market during the projection period.
This is primarily because they are already competitive with ICE vehicles in terms of upfront cost. However, several new models are anticipated to be used in the market in the upcoming years as more businesses become eligible for FAME-II incentives. To meet the growing demand in the nation, some of the major two-wheeler rental companies have already begun making significant investments in growing their fleet of vehicles.



Competitive landscape:

Due to the inexpensive and readily accessible labour, the Indian EV market is relatively concentrated with the participation of large manufacturers. By obtaining funding from investors and entering untapped cities, the businesses are also growing their market share. To establish their market presence, businesses develop new models and make significant R&D investments. To obtain a competitive advantage over rivals, however, market leaders are launching new models. For example,

- The new Tigor EV, which uses Tata's cutting-edge Ziptron high-voltage architecture and a permanent magnet synchronous electric motor delivering 75 hp and 170 Nm, was introduced by Tata Motors in August 2021. With these output numbers, 5.7 seconds from 0 to 60 kph is possible.
- Audi introduced its e-tron SUV and e-tron Sportback electric vehicles in July 2021. There is an e-tron 50 model of the SUV that has a 71 kWh battery and two electric motors available. The claimed driving range of this configuration, which produces 308 horsepower and 540 Nm, is between 264 km and 379 km (WLTP) on a single charge.
- Ampere Electric, a fully-owned subsidiary of Greaves Cotton Ltd. that specialises in electric mobility, said in February 2021 that it will invest INR 700 crore over ten years in stages to build a top-tier e-mobility manufacturing facility in Ranipet, Tamil Nadu. The corporation and the Tamil Nadu government signed a Memorandum of Understanding (MoU) to this effect.



Fermi Estimation:

Wild Guess: Around 8-10% of people will have electric vehicles in India by the end of 2023.

Educated Guess:

Employment rate = it is the ratio of a number of the available labor force to the population of people of the working age.

I think there are about 1.5 billion Indians in the world. Let's assume that only people over 18 and under 60 work, assuming that they account for around 60% of the population then that would make 0.9 billion Indians in the working class.

Out of the 0.9 billion people not all are employed, assuming only 2022 had a 45% employment rate that would bring the number to around 405 million.

Since not everyone can afford an electric vehicle, let's assume only people above the middle class can afford an electric vehicle, that would be 40 million. Not everyone buys an electric vehicle. Let's assume out of these 40 million only 10 million are willing to buy an electric vehicle.

Variables and Formulas:

Let E(x) be the employment rate of the year x (in %).

Let P(x) be the population of the year x.

Let A(x) be the number of available Labor in the year x.

Let r be the ratio of Indians between the age of 18 and 60 to the total population of India.

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

This formula will formulate the Employment ratio for the year x.

Gathering More Information :

Estimation for the population of the year 2022 can be obtained by the increase in population each year

P(2019)= 1.3676 billion

P(2020)= 1.3786 billion

P(2021)= 1.39199 billion

P(2020)-P(2019)= 11million

p(2021)-P(2020)= 13.39 million

the mean would be 12.195 million

thus P(2022)= 1.44185 billion

assuming A(x) is constant every year= 471,688,990

r=0.6

C=0.75

E(2022) = (471,688,990/(1,441,850,000*0.6))*0.75

E(2022) = 42%

Conclusion :

By this analysis, I conclude that by the end of the year 2023 there would a Employment rate of 42%. That would make 42% of 405 million i.e. 170 million. Out of these 170 million only 10% afford EV'S. So around 17 million people will have EV's by the end of 2023"

Data Sources:

This is a dataset of electric vehicles.

One of the more popular data science datasets is the mtcars dataset. It is known for its simplicity when running analysis and visualizations.

When looking for simple EV datasets, there don't seem to be any. Also, given the growth in this market, this is something many would be curious about. Hence, the reason for creating this dataset.

For more information, please visit the data source below.

https://www.kaggle.com/datasets/geoffnel/evs-one-electric-vehicle-dataset

TASKS:

Some basic tasks would include

1. Which car has the fastest 0-100 acceleration?
2. Which has the highest efficiency?
3. Does a difference in power train affect the range, top speed, and efficiency?
4. Which manufacturer has the most number of vehicles?
5. How does price relate to rapid charging?

CONTENT:

I've included two datasets below:

1. 'ElectricCarData_Clean.csv'

   -- original pulled data.
2. 'ElectricCarData_Norm.csv'

   -- units removed from each of the rows

   -- rapid charge has a binary yes/no value

Column Name | Description

Brand | Manufacturer of the vehicle

Model | Model name

Accel | Acceleration as 0-100 km/h

TopSpeed | The top speed in km/h

Range | Range in km

Efficiency | Efficiency Wh/km

FastCharge | Charge km/h

RapidCharge | Yes / No

PowerTrain | Front, rear, or all-wheel all drive

PlugType | Plug type
Bodystyle | Basic size or style
Segment | Market segment
Seats | Number of seats
PriceEuro | Price in Germany before tax incentives

The point of both is to have users practice some data cleaning.

CREDITS:

There are two credits and sourcing that need to be mentioned:

1. Datasource: EV-database.org/
2. Banner image: freepik - author - 'macro vector'

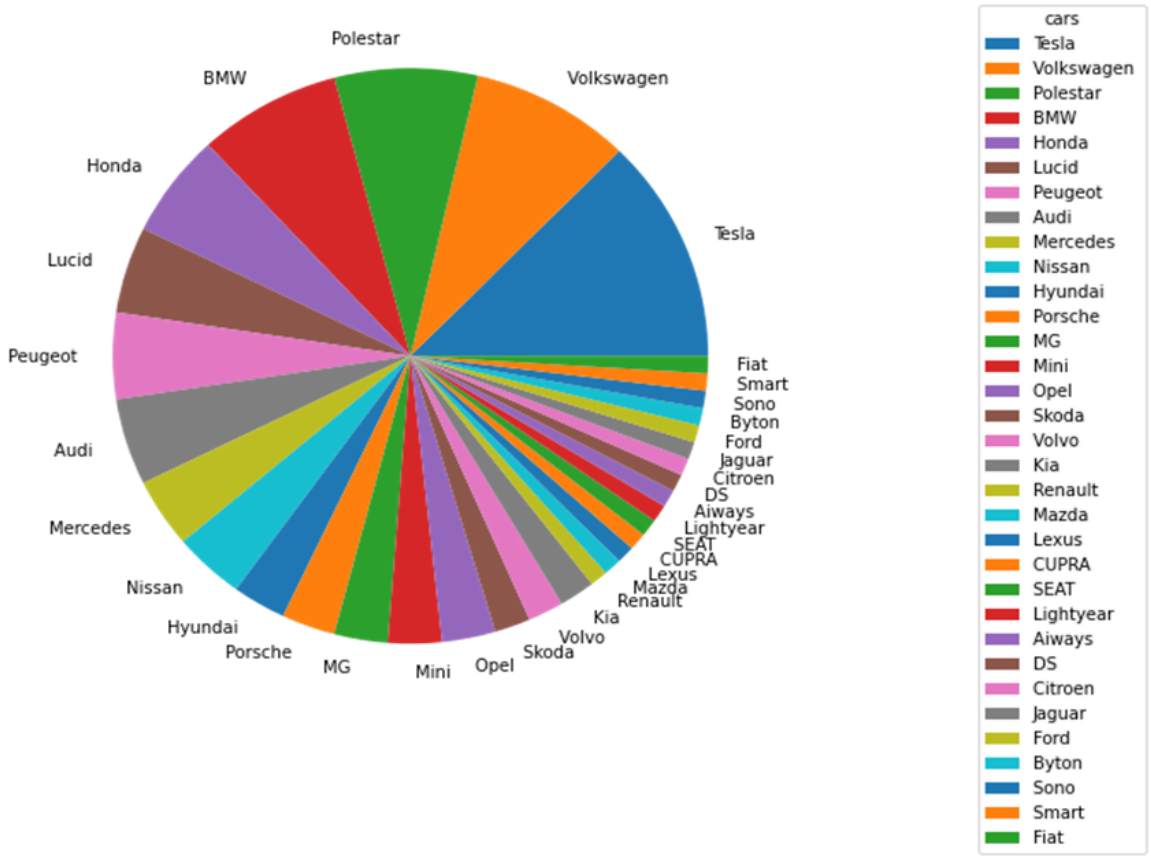
UPDATES:

There will be future updates when we can attain additional data.

Data Pre-processing:

1. Categorical Variables:

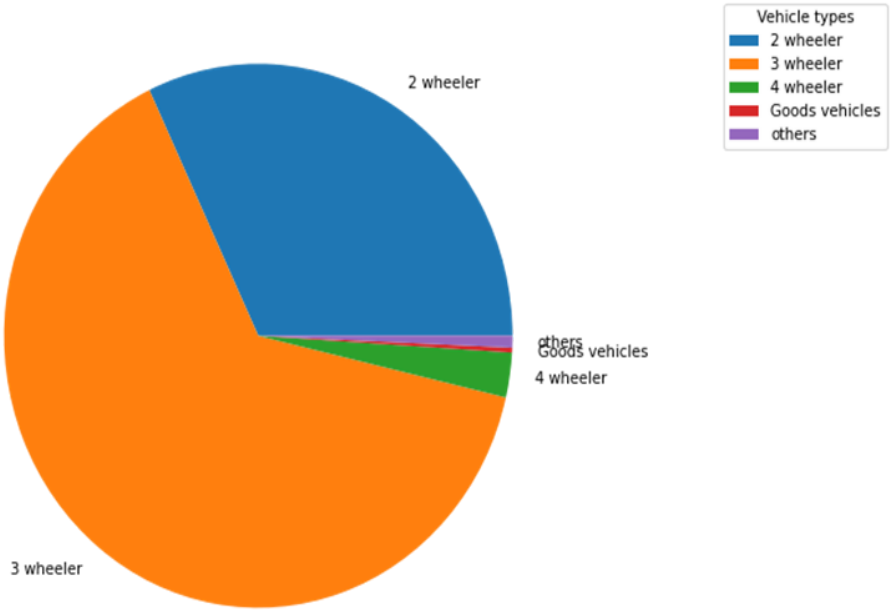
- We used three datasets for the EV market segmentation. The datasets consist of the quality, quantity of the vehicles, and geographical aspects of starting an EV business.
- From the first dataset we selected a few variables like car Brand, Range, and Efficiency.
- Introduced a new variable “Segment” in which we divided the price ranges into 7 categories based on the price of the vehicle.
- Coming to the geographical aspects we only considered variables like the name of the state, location of the charging stations, and type of power supply.



EV Brands

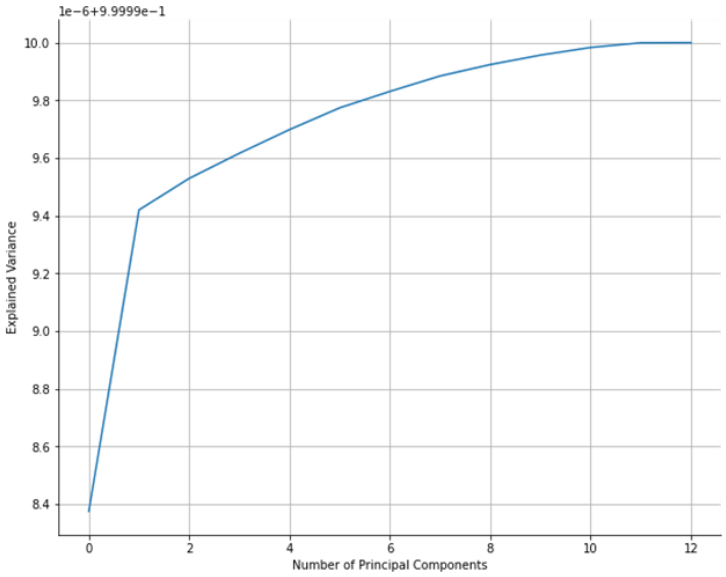
2. Numeric Variables:

- Converted the categorical variables into numeric variables for the dataset that consists of the quality and quantity of EV vehicles to check for correlation.
- We used variables like 2-wheeler, 3-wheeler, and 4-wheeler vehicles for the estimation of vehicle types and considered the total number of vehicles used per state.



Principal Component Analysis:

- We have used the numeric data of vehicle type data for performing “Principal Component Analysis”.
- Extracted new variables using PCA in which we observed that the first two variables comprise 90% of the variance of the data.
- PCA helps to use less data when we have a very large amount of data which in return helps in reducing a lot of computation.

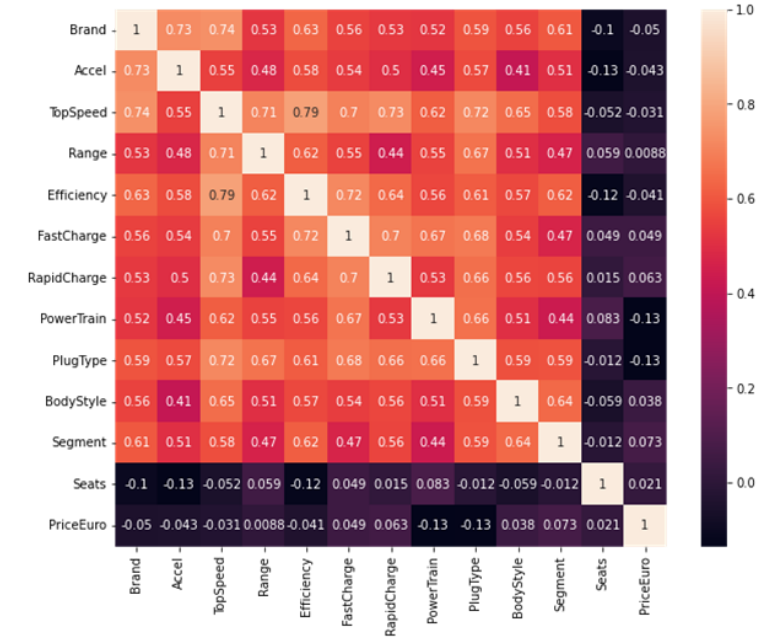


PCA

Segment Extraction -

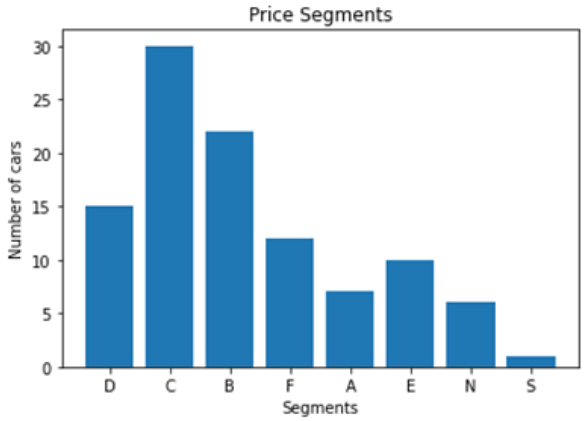
- After successfully completing the Data pre-processing part we explored the data through visualization using python libraries like matplotlib and seaborn.
- For categorical variables we used bar plots and histograms to check the quantity and quality of the respective variable.
- After when the categorical data is converted into numeric data we used the seaborn library to plot the correlation matrix to eliminate the unwanted variables.

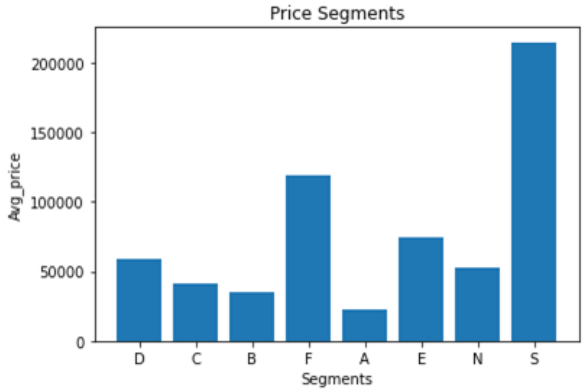
1. Extracting Segments by exploring data:



HeatMap

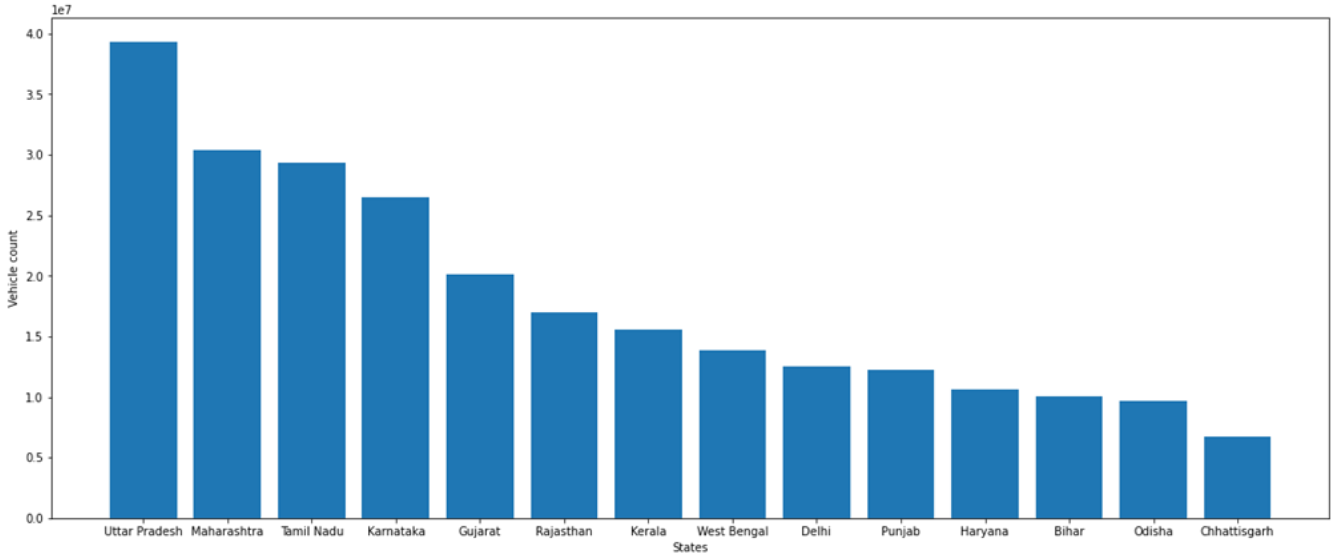
- From the above heatmap we can understand that almost 50% of the variables are highly correlated so we can take a maximum of 3-5 variables as our segmentation variables. In this case, we took “Brand, Range, Efficiency, Segment, and Seats”.





Price Segments

- In the above bar plot we can understand that segment C has the highest demand when compared to other segments followed by segments B and D; so we can focus more on segments B, C, and D out of which most of the car brands that are purchased are Tesla, Volkswagen, BMW, Polestar and Honda.
- When the above-extracted segments are considered most of the cars that have been purchased are 2 and 3-seater as they were more economical.



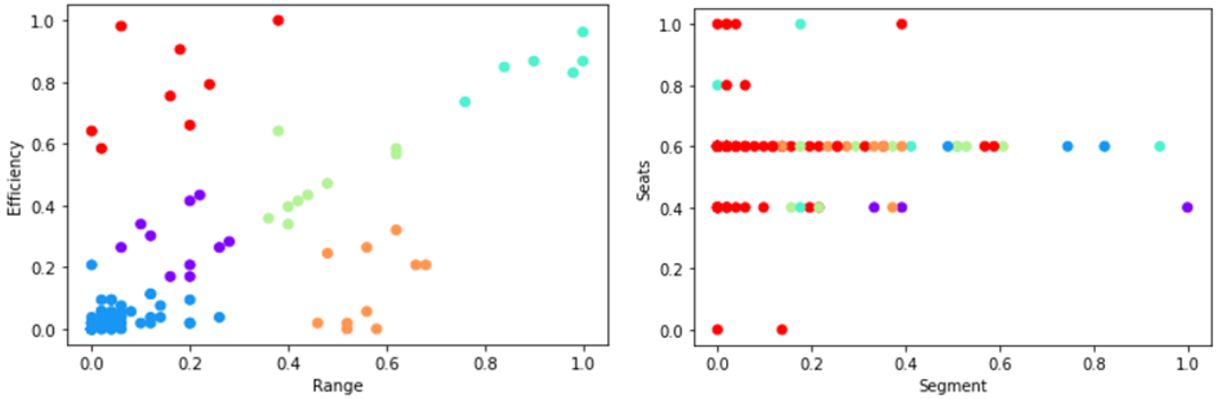
Vehicle Count In States

- When it comes to places where most of the EVs are being used are Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka, Gujarat, and Rajasthan; so, it would be better if we consider the above places first while starting a business.

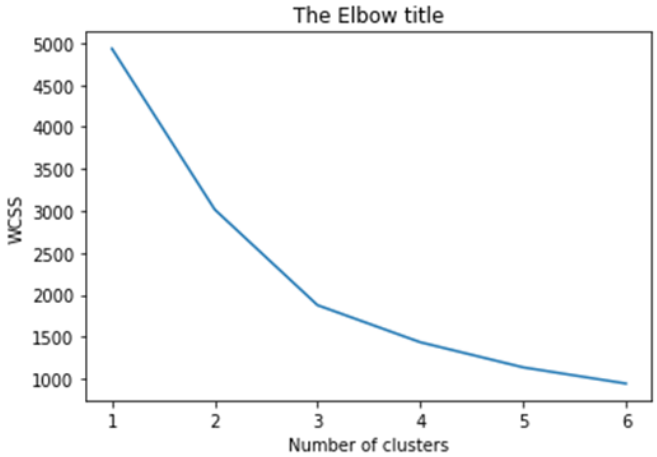
2. <u>Extracting Segments using K-means clustering:</u>

- K-means clustering is an unsupervised machine learning technique used to extract unidentified patterns in the data.

- This algorithm is iterative; it improves the partition in each step, and is bound to converge, but not necessarily to the global optimum.
- The key idea is to systematically repeat the extraction process for different numbers of clusters (or market segments), and then select the number of segments that leads to either the most stable overall segmentation solution, or to the most stable individual segment.
- For clustering the segments we used Range and Efficiency variables and normalized the data in order to plot against other variables.



- To get an idea of the number of clusters we need to perform we can use the elbow method.



Profiling and Describing Potential Segments:-

India Electric Vehicle Market Report Highlights

- **In terms of product, the BEV segment dominated the market in 2020 and is anticipated to value at USD 116.80 billion by 2030. This can be attributed to the increasing preference of consumers towards EVs over ICE vehicles and restrictions on vehicular CO2 emissions.**
- **The passenger cars segment is expected to expand at the highest CAGR of around 106% over the forecast period. The growth can be attributed to increasing investments by the government in EV infrastructure, along with tax benefits offered to consumers.**
- **The rising popularity of electric vehicles is prompting the leading automotive manufacturers to launch electric vehicles in India, which is anticipated to create growth opportunities for the market in the country.**

Market Dynamics

Reduction in Battery Cost, FAME Scheme & other Government Initiative for Support of Eco-frienldy Vehicle Likely to Spur EVs Demand in India

According to our India electric vehicle market study on the basis of extensive primary and secondary research, one of the major trends driving the growth of electric vehicle market is improved EV technology with reduction in battery cost, which is making electric vehicles more economical and eco-friendly options than ICE vehicles.

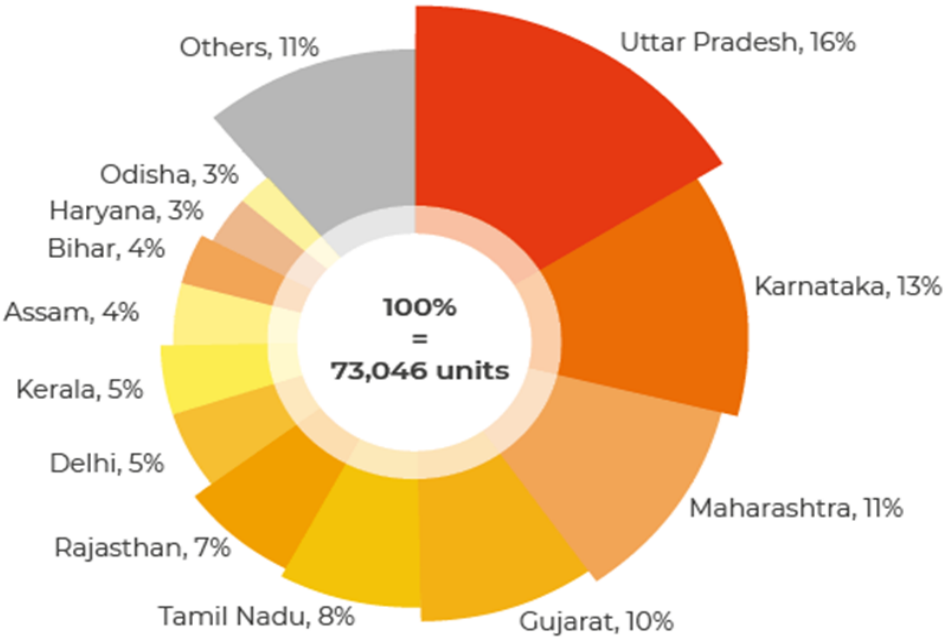
According to the report, the major driver in the Indian electric vehicle market is government initiative and policies to support the deployment and adoption of electric vehicles across the country. The FAME scheme

introduced by the Indian government offers subsidies on the retail price of electric vehicles ranging from USD 165 to USD 2,010 which is applicable for all electric vehicle segments.

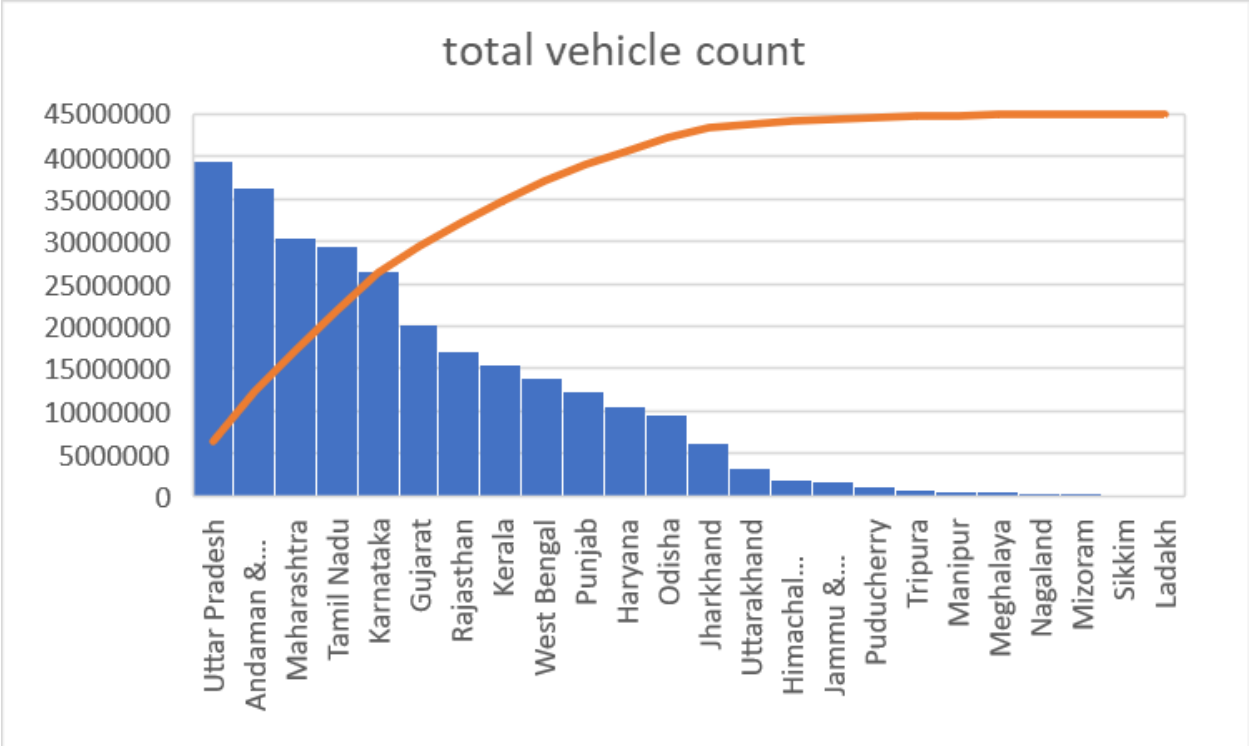
Markets segments

The electric vehicle market in India is in its nascent stages at present, it is poised to emerge as one of the leading electric vehicle markets in the world. The Indian government has been pursuing consistent and committed efforts and has already drafted dedicated EV policies and rolled out various demand and supply incentives as part of the efforts to encourage the adoption of e-mobility across various market segments. For instance, India's Department of

Potential Market Segments:- On the basis of technology type battery electric vehicles accounted for the largest revenue share as more than 0.4 million electric bikes and 1 million e-rickshaws are running on Indian roads as compare to few thousand electric hybrid passenger vehicles. Geographically, Tier-I cities accounted for the highest revenue share of electric vehicles as the major sales of e-rickshaw and hybrid cars is in metros cities. Tier-II cities will be benefitted by the government initiatives and are anticipated to grow significantly over the forecast period.



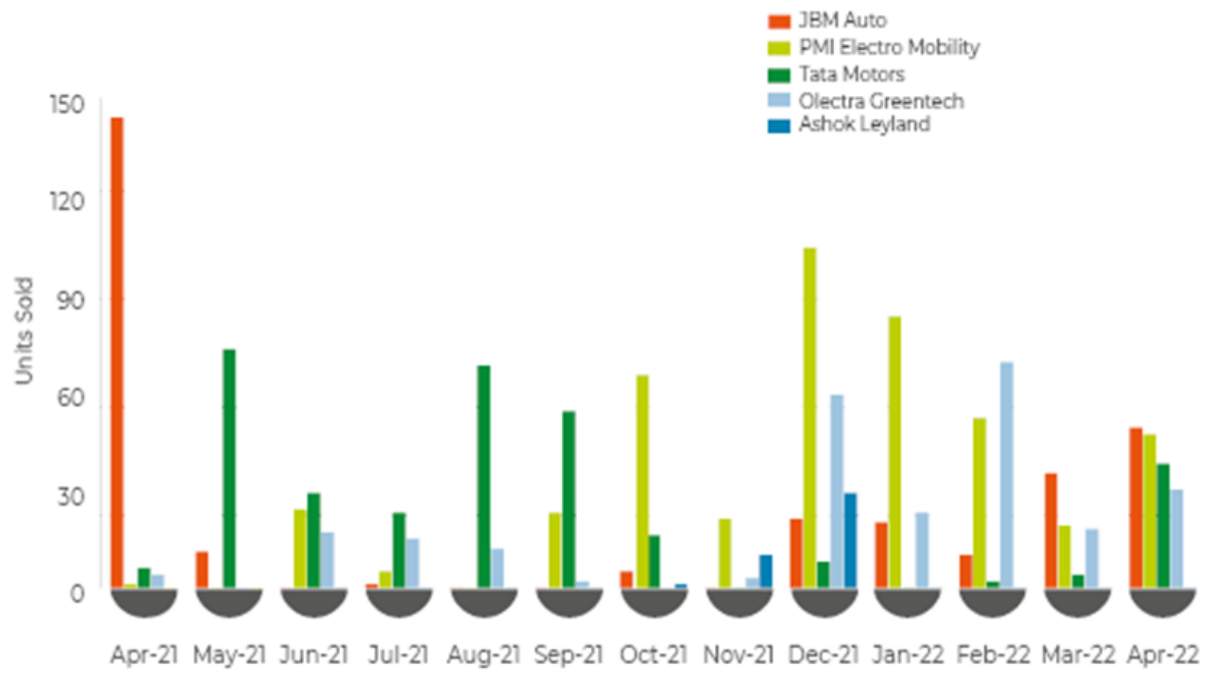
EV Avialable



Vehicle Count

Our India electric vehicle market report comprises the following companies as the key players in the India electric vehicle market.(Vehicle data set)

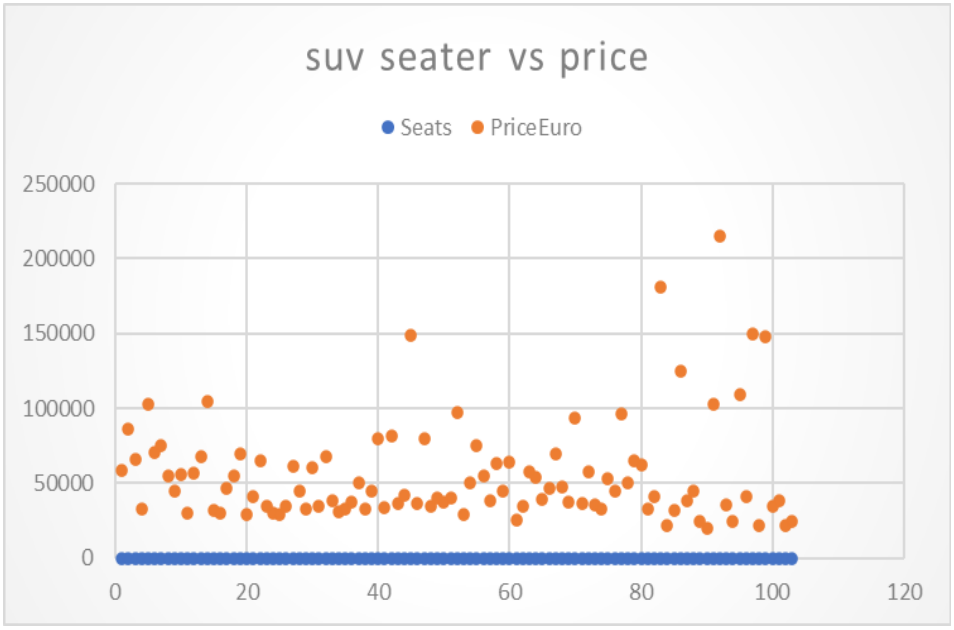
- Toyota
- Maruti Suzuki
- Mahindra Motors
- BMW
- Tata Motors
- Lohia Auto Industries
- Heroelectric
- BSA Motors
- TVS



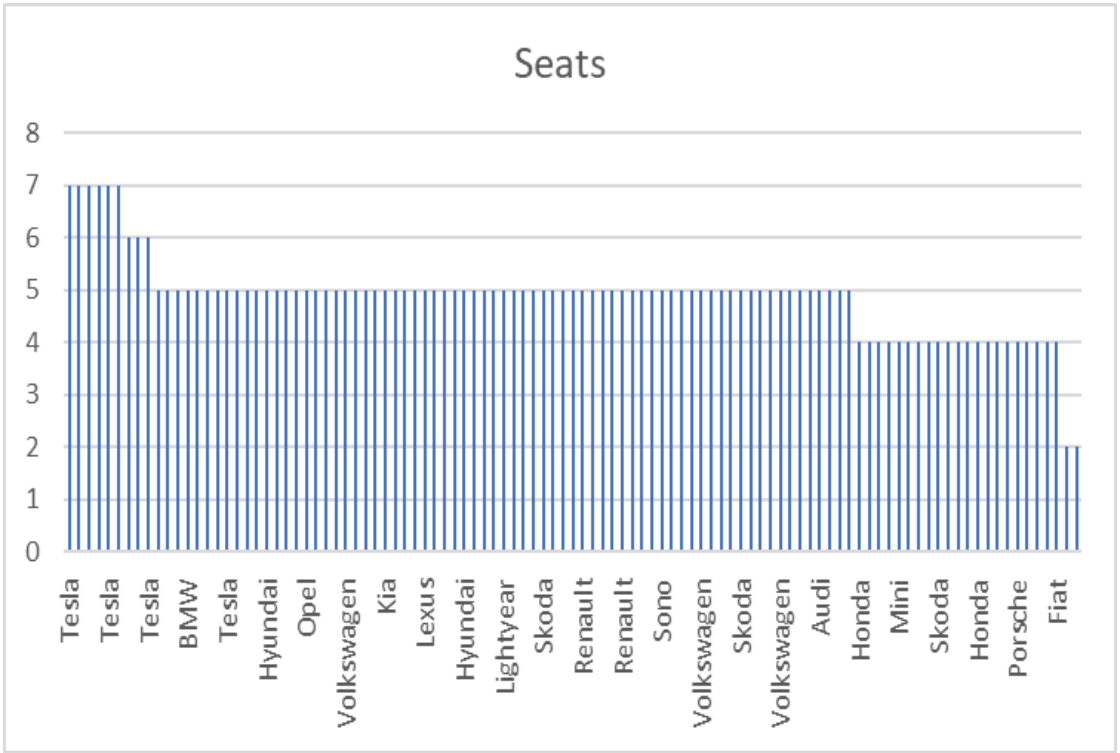
Units sold

Types of EVs and their prices often determine their popularity in a particular demographic region.(Kaggle dataset) The family size directly influences the number of seats on an EV and is

directly proportional to the price of the ev with mild variations depending on the brand(consumer mid range) to luxury brands.



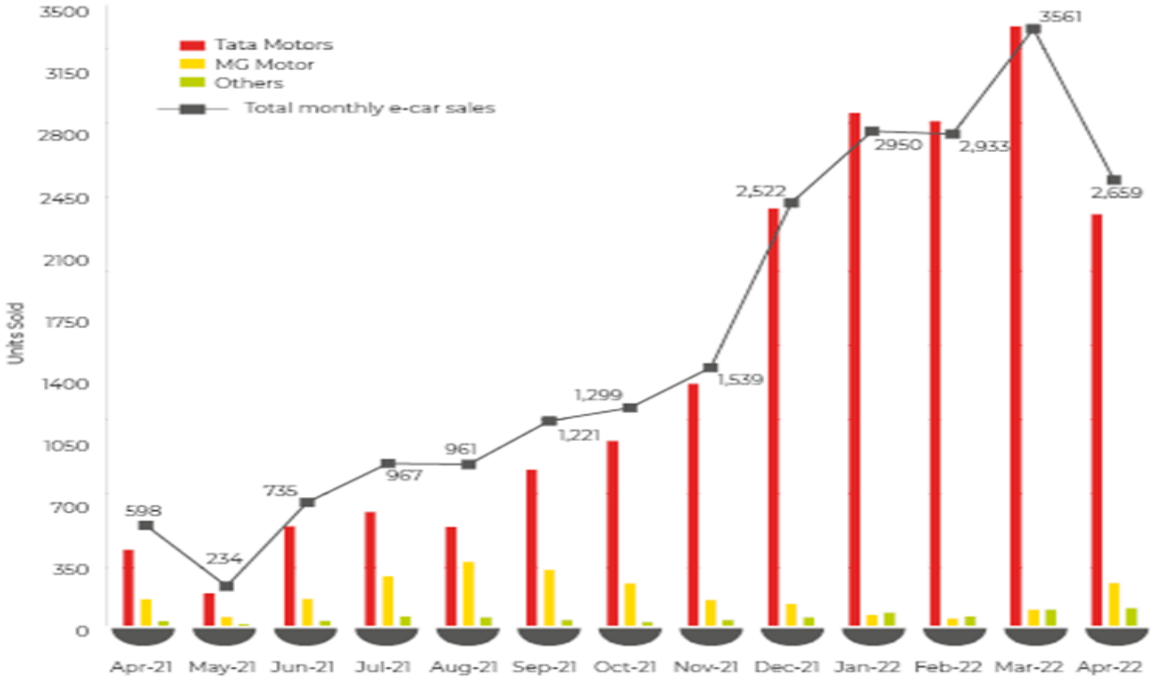
suv seater vs price



Seats

Moreover mainly EV cars are sorted based on their power performance, majority of cars run on three power ranges

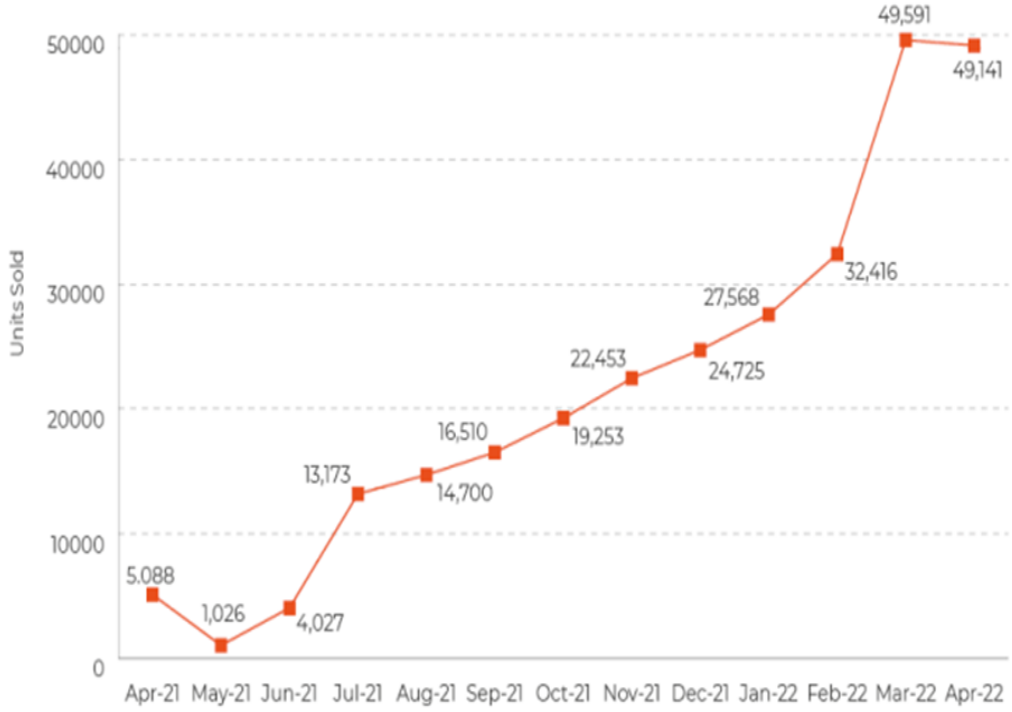
As depicted in the figure below, EV registrations in April 2022 were driven by electric two-wheelers and passenger-type electric three-wheelers, which together accounted for 92.92% of total registrations in the month. The shares of these categories were followed by E-Cars (3.64%), cargo-type electric three-wheelers (3.17%), and so on.



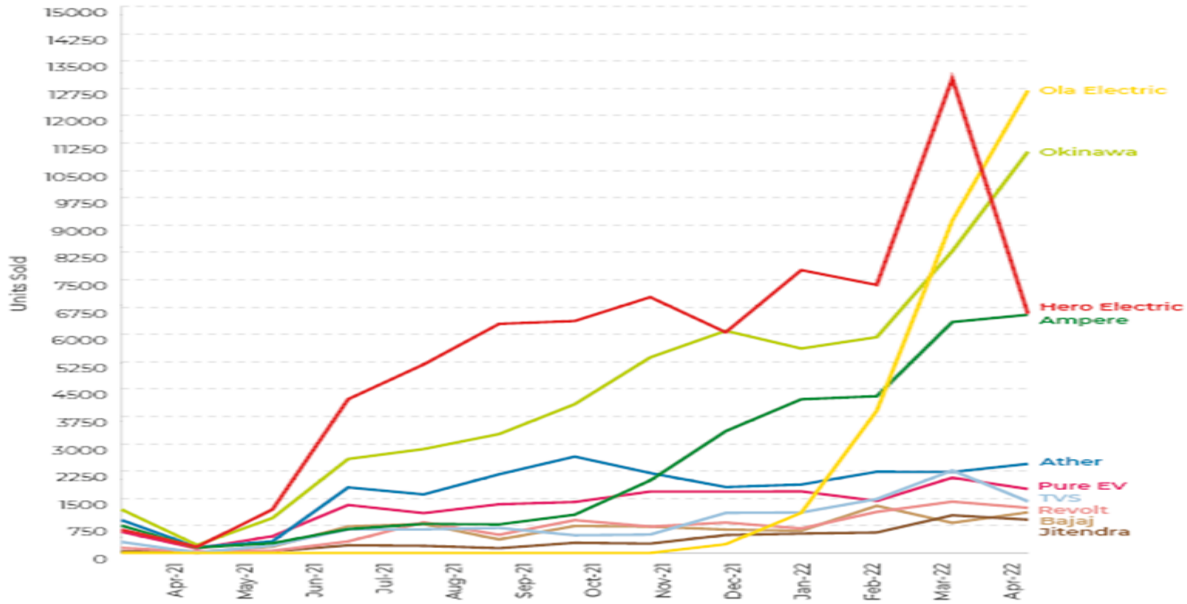
Different companies

PROFILING UPSTREAM DEMANDS

The trend analysis of the demand in the datasets show a steep upward trend for the consumer segment of the electric vehicle space.



TOP EV players and their market share:



The report covers the present ground scenario and the future growth prospects of the India electric vehicle market for 2016-2024 along with the total sales of electric vehicles in every

region. We calculated the market size and revenue share on the basis of revenue generated from the sales of electric vehicles by various industry players across India.

India Electric Vehicle Market Outlook 2016-2024, has been prepared based on an in-depth market analysis from industry experts. The report covers the competitive landscape and current position of major players in the India electric vehicle market. The report also includes Porter's five force model, SWOT analysis, company profiling, business strategies of market players and their business models**.** India electric vehicle market report also recognizes value chain analysis to understand the cost differentiation to provide competitive advantage to the existing and new entry players.

Selection of Target Segment -

Market segmentation involves dividing a large homogenous market of potential customers into clearly identifiable segments. Customers are divided based on meeting certain criteria or having similar characteristics that lead to them having the same product needs. Segments are made up of customers who will respond similarly to marketing strategies. They share common interests, needs, wants, and demands.

The different types of market segmentation -

- **Demographic Segmentation** -This is the most common type of segmentation. A target audience is divided based on qualities such as age, gender, occupation, education, income, and nationality. Demographic segmentation is the easiest way to divide a market. Mixing demographic segmentation with another type of market segmentation can help to narrow your market down even further.

  The information required for demographic segmentation is easy to gather and doesn't cost a company too much to obtain.

- **Behavioral Segmentation** - A company can segment its market based on consumers' behaviors. Dividing your target audience based on their behaviors allows you to create specific messaging that will accommodate those behaviors. What actions were taken on a website?

  1. What are their online shopping habits?

2. How loyal are they to the brand/ product?
3. What is the usage rate of your product?
4. What need is a consumer trying to satisfy?

This information is relevant because it's directly related to how a consumer interacts with your products. Therefore, marketers can market more effectively to customers by knowing their behaviors.

- **Geographic Segmentation -** This involves splitting up a market based on location. Even though this is a basic form of segmentation it is highly effective. Knowing where a customer is located can help a company better understand the needs of their customers and companies can then target customers with location-specific ads. Dividing a segment based on the characteristics of their location, allows marketers to be even more specific with their targeting and messaging.
- **Psychographic Segmentation -**This form of segmentation is very similar to demographic segmentation however, it deals with characteristics that are related to mental and emotional attributes. Psychographic segmentation divides a group of customers based on their personality traits, values, interests, attitudes, and lifestyles. However, psychographics gives marketers valuable insights into customers' motives, preferences, and needs. It is psychographic information that informs you why people purchase or don't purchase a product or service.

The basic benefits of Market Segmentation -

- **Greater company focus -**
  When a company has identified specific market segments, it helps them to focus on what segments they want to target with specific products/ services/ content/ blogs and campaigns. When a company focuses on specific segments, they ensure they are targeting the right segment with the right product which will see the greatest ROI.
- **Better serve a customer's needs and wants -**
  Having defined segments enables companies to satisfy a variety of customer needs by offering different bundles and incentives. Different forms and promotional activities will be used for different segments based on that segment's needs/ wants and characteristics.

- **Market competitiveness -**

  When a company is focusing on a specific segment, its market competitiveness increases. Which in turn will lead to a higher ROI. The company is focused on specific segments and learns everything they need to know about that segment, to market their products to them.

- **Market expansion -** With geographic segmentation as discussed earlier, the market expansion is possible immediately. When a company understands its segments and how to market to a segment in a particular location, it can expand immediately into another nearby location. If segmentation is based on demographics, then once the company knows its demographic segment it can expand in that segment with similar products.

- **Targeted communication -** Even when product features and benefits are the same, it is important for companies to target segments with specific communication. For example, if your segment was senior engineers, they may respond better to technical information about a product in the form of white papers or infographics, but a project manager might respond better to information regarding cost savings, efficiencies, etc in the form of a blog, case study or video. The key is to understand your segments and target communication relevant to them on the relevant platforms.

The main reason behind segmentation -

Segmentation helps marketers to be more efficient in terms of time, money, and other resources. Market segmentation allows companies to learn about their customers. They gain a better understanding of customers' needs and wants and therefore can tailor campaigns to customer segments most likely to purchase products.

Customizing The Market Mix:

Coming to this section to achieve the success from segmentation the company must focus on the 4Ps: Product, Price, Promotion and Place. Lets have a summary about these for our topic.

Product :- If the company goes with the decision to go with a product based approach, based on the clusters we have chosen. The company must choose among three classes like economical,average,luxorious kind of these classes and proceed with it.
They can choose among these by getting the count of the individual attributes in a cluster and they can come to a conclusion about the type of product it is going to proceed with.

Price:- Based on the product they have chosen, the price varies. In case if the company decides to launch in places like metropolitan,cosmopolitan,etc it can change the product type based on the price and the place they've chosen. Everything can be derived from the clusters we have divided.

Promotion:- Since the company is a startup, it must focus on product as well as promotion. For example if the company goes with luxurious cars, then it must bring in some well-known people to promote it. They must make themselves well known by taking part in local activities, and they can post reviews of the product on internet, they can use online advertising which is very popular these days and proved to be a successful idea.

Place:- Coming to the geographical aspect,from above data we can observe that most of the vehicles are in Uttar Pradesh, but one point to consider here is the population of Uttar Pradesh. Instead of going just by the count they can go with ratio between population and electric vehicles, which is low right now, but will be a better measure.While choosing a place the product and price also will be changed. We should look at the type of vehicles that are sold across the state and make a wise decision.

So, finally we can say that everything changes when you are focused on one thing. So the company must make a wise decision on where/ with what product they want to start their business with.

Potential Customer Base In Early Market

Heavy Industry (DHI), under the National Electric Mobility Mission Plan (NEMMP) 2020, has formulated the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme to support the development of both Hybrid Vehicles (HV) and Electric Vehicle (EV) markets as well as that of their manufacturing eco-systems.

The growing popularity of electric vehicles is prompting the leading automotive manufacturers to launch electric vehicles in India. For instance, in October 2019, Maruti Suzuki, a leader in the conventional vehicle market, announced plans to launch electric vehicles for personal use for the Indian market in the following years. Similarly, in August 2021, Tata Motors launched the Tata Tigor EV in the Indian market. As the market continues to evolve and the consumer preference continues to shift from conventional vehicles to electric vehicles, more and more conventional vehicle manufacturers are expected to launch electric vehicles in the Indian market, thereby driving the growth of the market over the forecast period.

The outbreak of the COVID-19 pandemic triggered a global economic slowdown. The electric vehicle market is particularly vulnerable to any global economic slowdown owing to its reliance on global sourcing for the core battery technology. Moreover, the initial purchase price of electric vehicles tends to be higher than the gasoline-fired and hybrid vehicles, which particularly restrains the adoption of electric vehicles among price-sensitive customers. However, the Indian electric vehicle (EV) market was unaffected by the outbreak of the pandemic. In India, the registration of new electric passenger cars increased by 109% y/y in 2020, with 5,905 new vehicle registrations noted during the year.

Github Link To The Code Implementation:

https://github.com/THEPARTHMAHAJAN/EV-MARKET-SEGMENTATION