

Team Lead: - Rishi Solanki

Customer Segmentation Analysis Report

Problem Statement and Introduction:

What is Situation?

The electric vehicle (EV) company is gearing up to launch a new two-wheeler EV in the market. To ensure a successful launch and effective marketing strategy, the company recognizes the importance of understanding its target audience. Hence, the need for customer segmentation analysis arises.

What is Market Segmentation Analysis?

Market segmentation analysis involves dissecting customer data to identify distinct groups based on various factors such as demographics, geography, psychographics, and purchasing behavior. This analysis helps in understanding the diverse preferences and needs of customers, allowing companies to tailor their marketing strategies accordingly.

Data Overview:

The company has access to a dataset containing information on 3000 customers, with each entry comprising 14 different attributes. These attributes include customer demographics, vehicle specifications, purchasing behavior, and service ratings.

Why Customer Segmentation Analysis?

Customer segmentation analysis is crucial for targeted marketing and product development. By categorizing customers into specific groups, the company can tailor its marketing efforts to suit the preferences of each segment. Additionally, insights gained from segmentation analysis enable the company to make informed decisions regarding product features, pricing, and color availability, thus maximizing customer satisfaction and market penetration.

Examples for Better Understanding:

1. For instance, through segmentation analysis, the company may discover a segment of young urban professionals who prioritize eco-friendliness and technology in their vehicle purchases. By offering EV models with advanced features and sleek designs, the company can effectively target this segment.
2. Alternatively, segmentation analysis might reveal a segment of budget-conscious consumers who prioritize affordability and practicality. In response, the company could develop entry-level EV models with competitive pricing and low maintenance costs to cater to this specific market segment.

Market Segmentation Analysis Process

Step 1: Data Preparation

First, I created hypothetical data using Python. This involved synthesizing information from real electric vehicles (EVs) obtained from bikedekho.com and generating details for 3000 customers across 14 different attributes.

Step 2: Data Analysis and Insights

Next, we analyzed the data to uncover valuable insights. For example, we observed that urban areas have a higher concentration of EV purchases among individuals aged 18-25. Additionally, we discovered that 95% of customers prefer EV models with EMI facilities, indicating a demand for easy purchase options.

Step 3: Machine Learning Modeling

In this step, we employed machine learning techniques to identify patterns within the data. By providing the dataset to machine learning algorithms, we enabled them to autonomously group customers based on various characteristics. The output of this process is available in the coding section of my GitHub repository.

Step 4: Result Interpretation

Once the machine learning models completed the grouping process, we downloaded the results. These results, available in my GitHub repository, consist of two columns: customer ID and different groups. By examining this data in Google Sheets and plotting graphs, we gained a clear understanding of the segmented customer groups.

Important Suggestions as per Analysis

Group 1:

This segment comprises primarily young urban professionals aged 25-35 who prioritize quick charging times and top-speed performance. They are willing to spend the highest amount, ranging between 140,000 to 145,000 rupees, and prefer EV models with sleek designs and vibrant color options. With 45% good ratings and 30% average ratings, they have a high satisfaction level. Additionally, they have a wide range of color availability, with more than 7 options. The top speed of their preferred EVs is around 80 kmph, and the ratio of urban to rural users is 53:47.

Group 2:

Customers in this group are typically middle-aged individuals residing in suburban areas. They prioritize affordability and practicality, spending the least amount on EVs. Their preferred EVs have the lightest weight, around 94 kg, with a top speed ranging between 60 to 65 kmph. Despite the lower spending, this group constitutes the largest segment, with over 620 customers.

Group 3:

This group prefers EVs with extended warranties, lasting 8 years, despite having the longest charging times of 6 to 6.5 hours. They prioritize high top speeds, up to 120 kmph, and have the highest range of around 180 to 195 km in single charge. With a user distribution of 45% rural and 55% urban, they seek practicality and reliability in their EVs.

Group 4:

Customers in this group are willing to spend more than 120,000 rupees on EVs, with a focus on aesthetic appeal and practicality. Despite a lower top speed of 70 to 75 kmph, their EVs have a relatively short charging time of around 4 hours. With a range of 120 km in single charge, they find value in the attractive design and suitability for the Indian market.

Group 5:

This group prefers EVs with unique transformer-like appearances and practical features. Despite a limited color availability of only 3 variants, they prioritize functionality over aesthetics. Their EVs offer a good balance of top speed (80 kmph) and range (100 km in single charge), albeit with a longer charging time of more than 5 hours. Despite this drawback, the distinctive robotic looks make their EVs stand out in the market.

What Specific Electric Vehicle Details Align with the Requirements of Different Groups?

Group-1		
Features	Specification-1	Specification-2
Range	145 km/charge	145 km/charge
Motor Power	4.4 kW	4.4 kW
Motor Type	BLDC	BLDC
Front Brake	Disc	Disc
Rear Brake	Drum	possible
Body Type	Electric Scooters	Electric Scooters
Braking Type	Combi Brake System	Combi Brake System
Charging Point	Yes	Yes
Fast Charging	Yes	Yes
Mobile Connectivity	Bluetooth, WiFi	Bluetooth, WiFi
Clock	Yes	Yes
LED Tail Light	Yes	Yes
Speedometer	Digital	Digital
Tripmeter	Digital	Digital
Mobile Application	Yes	Yes
Geo-fencing	Yes	possible
Anti Theft Alarm	Yes	Yes
Calls & Messaging	Yes	Yes
Navigation assist	Yes	Yes
Low battery alert	Yes	Yes

Group-2		
Features	Specification-1	Specification-2
Range	85 km/charge	85 km/charge
Motor Power	1.5 kW	1.5 kW
Motor Type	BLDC	BLDC
Front Brake	Disc	Disc
Rear Brake	Disc	Disc
Body Type	Electric Scooters	Electric Scooters
Braking Type	Combi Brake System	Combi Brake System
Charging Point	Yes	Yes
Mobile Connectivity	Bluetooth	Bluetooth
Clock	Digital	Digital
Speedometer	Digital	Digital
Tripmeter	Digital	Digital
Mobile Application	Yes	Yes
Geo-fencing	Yes	Yes
Anti Theft Alarm	Yes	possible
Low battery alert	Yes	available

Group-3		
Features	Specification-1	Specification-2
Feature	Ola S1 Pro Specifications	Ola Specifications
Range	195 km/charge	195 km/charge
Motor Power	11 kW	11 kW
Motor Type	Mid Drive IPM	Mid Drive IPM
Front Brake	Disc	Disc
Rear Brake	Disc	Disc
Body Type	Electric Scooters	Electric Scooters
Braking Type	Combine Braking System	Combine Braking System
Charging Point	Yes	Yes
Fast Charging	Yes	Yes
Mobile Connectivity	Bluetooth, WiFi	Bluetooth, WiFi
Clock	Yes	Yes
Speedometer	Digital	Digital
Tripmeter	Digital	Digital
Mobile Application	Yes	Yes
Geo-fencing	Yes	available
Anti Theft Alarm	Yes	Yes
Calls & Messaging	Yes	Yes
Navigation assist	Yes	possible
Low battery alert	Yes	Yes

Group-4		
Features	Specification-1	Specification-2
Range	113-127 km/charge	113-127 km/charge
Motor Power	4.2 kW	4.2 kW
Motor Type	BLDC	BLDC
Front Brake	Drum	Drum
Rear Brake	Drum	Drum
Body Type	Electric Scooters	Electric Scooters
Braking Type	Combine Braking System	Combine Braking System
Charging Point	Yes	Yes
DRLs	Yes	Yes
Mobile Connectivity	Bluetooth	Bluetooth
Clock	Yes	Yes
LED Tail Light	Yes	Yes
Speedometer	Digital	Digital
Odometer	Digital	Digital
Tripmeter	Digital	Digital
Mobile Application	Yes	Yes
Geo-fencing	Yes	available
Calls & Messaging	Yes	Yes
Navigation assist	Yes	Yes
Low battery alert	Yes	Yes
Roadside Assistance	Yes	Yes

Group-5		
Features	Specification-1	Specification-2
Range	100 km/charge	100 km/charge
Motor Power	6 kW	6 kW
Motor Type	PMSM	PMSM
Front Brake	Disc	Disc
Rear Brake	Drum	Drum
Body Type	Electric Bikes	Electric Bikes
Braking Type	Combi Brake System	Combi Brake System
Charging Point	Yes	Yes
Fast Charging	Yes	Yes
Mobile Connectivity	Bluetooth, WiFi	Bluetooth, WiFi
Riding Modes	Yes	Yes
Cruise Control	Yes	possible
Navigation	Yes	Yes
LED Tail Light	Yes	available
Speedometer	Digital	Digital
Odometer	Digital	Digital
Battery Warranty	3 Years or 30,000 Km	3 Years or 30,000 Km
Vehicle Warranty	5 Years or 50,000 Km	5 Years or 50,000 Km
Portable Home Charger	5 Hr 15 Min (0-80%)	5 Hr 15 Min (0-80%)
Roadside Assistance	Yes	Yes
Mobile Application	Yes	Yes
Geo-fencing	Yes	Yes
Charging Station Locator	Yes	Yes
Anti Theft Alarm	Yes	Yes
Calls & Messaging	Yes	Yes
Low battery alert	Yes	Yes

Links:-

- **Git-Hub:** [Click Here](#)
- **Data-Set Link:** [Click Here](#)
- **My LinkedIn Link:** [Click Here](#)
- **Grouping Result Link:** [Click Here](#)
- **Information Source (All Specification):** [Click Here](#)

Conclusion:

In this report, I address the problem statement, outline our chosen method for solving it, and provide answers to two key questions: first, the details of the groupings targeted; and second, the necessary inclusions, additions, or modifications for our upcoming electric vehicle.

Team Member1: - Shambhavi Belagali

Electric Vehicle Market Segmentation India Analysis Report

Problem Statement:

As a team working under an Electric Vehicle (EV) Startup, our task is to analyze the Indian EV market and identify the most promising customer segments for our entry strategy. This involves conducting segmentation analysis to understand the diverse needs and preferences of potential EV customers. Our goal is to target segments that are most likely to adopt EVs, considering factors such as geographic, demographic, psychographic, and behavioral characteristics.

Introduction:

In this analysis, we aim to understand customer segmentation using a dataset containing various attributes such as age, income, occupation, location, electric vehicle ownership, vehicle type preference, charging level, and environmental consciousness. Our goal is to identify patterns in the data that can help us segment customers into meaningful groups.

The Indian EV market presents a significant opportunity for our startup to introduce electric vehicles tailored to the needs of various customer segments. To maximize our chances of success, we need to identify and prioritize segments with the highest potential for EV adoption. This requires a comprehensive analysis of available data sources and the creation of meaningful segments that align with our business objectives.

Approach:

Data Collection: We will gather data from multiple sources, including market research reports, government databases, industry surveys, and consumer feedback. This data will provide insights into geographic distribution, demographic profiles, lifestyle preferences, purchasing behavior, and attitudes towards EVs among Indian consumers.

Segmentation Analysis: Using the collected data, we will conduct segmentation analysis to categorize potential EV customers into distinct groups based on shared characteristics. This may include geographic segmentation (urban vs. rural), demographic segmentation (age, income, education), psychographic segmentation (lifestyle, values, attitudes), and behavioral segmentation (purchase behavior, usage patterns).

Identification of Feasible Segments: We will identify segments that show the highest propensity for EV adoption, considering factors such as environmental consciousness, willingness to pay for eco-friendly products, access to charging infrastructure, and existing preferences for alternative transportation modes.

Segment Prioritization: Based on the analysis, we will prioritize segments that offer the greatest market potential and align closely with our startup's capabilities and objectives. This may involve targeting specific demographic groups, geographic regions, or industry sectors where EV adoption is projected to grow rapidly.

Strategy Development: With the identified segments, we will develop a tailored market entry strategy that addresses the unique needs and preferences of each segment. This may include product positioning, pricing strategies, distribution channels, marketing campaigns, and partnerships with relevant stakeholders.

Dataset Overview:

The dataset consists of 500 entries, each representing a unique customer. It includes demographic information such as age and income, as well as lifestyle and behavioral attributes like occupation, location, electric vehicle ownership, vehicle type preference, charging level, and environmental consciousness.

Exploratory Data Analysis (EDA):

Before diving into clustering, we performed exploratory data analysis to gain insights into the dataset:

- We visualized the distribution of age and income, which showed that most customers are between 25 to 55 years old, with varying income levels.
- The distribution of occupations revealed a diverse mix of professions among customers, including doctors, teachers, engineers, artists, chefs, writers, nurses, programmers, lawyers, and managers.
- Customers were evenly distributed between urban and rural locations.
- Electric vehicle ownership was split roughly equally between customers who own electric vehicles and those who do not.
- Preferences for vehicle types varied, with SUVs, sedans, hatchbacks, and e-scooters being the top choices.
- Charging levels were distributed across high, medium, and low categories.
- Environmental consciousness levels were also varied, with customers showing differing degrees of concern for the environment.

Segmentation Analysis:

Using the collected data, we will conduct segmentation analysis to categorize potential EV customers into distinct groups based on shared characteristics. This may include:

- **Geographic segmentation (urban vs. rural):** Understanding the distribution of potential EV buyers across different regions of India.
- **Demographic segmentation (age, income, education):** Identifying demographic groups with a higher likelihood of EV adoption based on their socioeconomic status.
- **Psychographic segmentation (lifestyle, values, attitudes):** Analyzing consumer attitudes towards sustainability, technology adoption, and lifestyle preferences.
- **Behavioral segmentation (purchase behavior, usage patterns):** Examining past purchasing behavior and usage patterns of alternative transportation modes.

Identification of Feasible Segments:

We will identify segments that show the highest propensity for EV adoption, considering factors such as:

Environmental consciousness: Assessing the importance of eco-friendliness and sustainability in purchase decisions.

Charging infrastructure: Evaluating the availability and accessibility of charging stations in different regions.

Government incentives: Understanding the impact of subsidies, tax breaks, and incentives on EV purchasing decisions.

Urbanization trends: Analyzing the growth of urban populations and the corresponding demand for urban mobility solutions.

Segment Prioritization:

Based on the analysis, we will prioritize segments that offer the greatest market potential and align closely with our startup's capabilities and objectives. This may involve targeting specific demographic groups, geographic regions, or industry sectors where EV adoption is projected to grow rapidly.

Strategy Development:

With the identified segments, we will develop a tailored market entry strategy that addresses the unique needs and preferences of each segment. This may include:

Product positioning: Designing EV models that cater to the specific requirements of target segments, such as affordability, range, and performance.

Pricing strategies: Setting competitive pricing structures that appeal to different segments while ensuring profitability.

Marketing campaigns: Developing targeted marketing campaigns that resonate with the values and aspirations of each segment, leveraging digital media, social platforms, and influencer partnerships.

Partnerships and collaborations: Forming strategic alliances with ecosystem players, such as energy companies, technology providers, and ride-sharing platforms, to enhance market penetration and customer engagement.

Simplifying the Data with PCA:

We wanted to make the data easier to understand, so we used something called Principal Component Analysis (PCA):

- PCA helps us turn all the different information we have into just two main things.
- These two main things let us see where customers are similar and where they're different.

Grouping Customers:

We used a technique called k-Means clustering to group customers into three different types:

Group 1: These customers are younger, with medium incomes and all kinds of jobs. They like different types of cars, charge their cars in different ways, and have different levels of care for the environment.

Group 2: These customers are older and have higher incomes. They mostly live in cities, own electric cars, prefer SUVs and sedans, and care more about the environment.

Group 3: These customers are also older but have lower incomes and live in the countryside. They don't own electric cars as much, like different types of cars, and don't care as much about the environment.

Conclusion:

Understanding these different groups of customers can help companies offer products and services that suit their needs better. It can lead to happier customers, more sales, and stronger relationships between businesses and their customers.

Links:-

Git-Hub: - [Click Here](#)

Team Member 2: - Rahul Moolchandani

Electric Vehicle Market Segmentation India:

Introduction

In India the electric vehicle market is currently growing very fast and in future it is predicted to grow much more. Indians buy 40 lakh passenger vehicles every year. India has 21 crore two wheelers registered and 10 crore four wheelers registered.

As the stats suggest the two-wheeler market is very big as compared to others because in India two-wheeler is used for daily purposes and it is a cost effective and efficient mode of transportation. Vahan's government data site gives insights that only 6 lakhs out of all two-wheelers are electric. So, we can clearly see the potential of electric two-wheeler. This report focuses on electric two-wheelers.

Market Segmentation

Market segmentation is a marketing strategy in which select groups of consumers are identified so that certain products can be presented to them in a way that appeals to their interests.

Problem Statement

The challenge is to strategically position our EV business or startup in Indian market by using data driven insights and technical knowledge and customer reviews.

Objective

To take out insights for effectively segment the Indian market and recommend target segments for electric two-wheeler.

Idea Explanation

The EV India market is very big so to strategically position ourselves we can divide our customers in many way like two and four wheeler, capacity wise, riding range wise, etc.

In this report I have focused on the market segmentation based on price of electric two-wheeler that is known as pricing segmentation and other will based on reviews of consumer of electric two-wheeler that is known as behavioral segmentation. The main idea is to learn the pattern and predict according to that.

I'm using machine learning model k-means to make a cluster or group of same features consumer. The final output will be which segment to target if you are a new business in EV two-wheeler or to learn from existing businesses.

These machine learning models can also help existing EV companies to target the specific consumer for their products marketing and all and increase their sales.

Code

LINK –[Click here](#)

Code Explanation

- Dataset is based on sales of electric two-wheeler vehicles and the review of that particular customer using that vehicle. Data is collected through bikedekho and other platforms and also from Kaggle.
- Then the respective process is done of exploratory data analysis and pre-processing of data.
- For pricing segmentation we have excluded the review field from data and trained a k-means clustering machine learning algorithm which is creating a group or clusters of three that is low, medium and high price range vehicle with different features of vehicle.
- For behavioral segmentation we have excluded the price field from data and trained a k-means clustering machine learning algorithm which is creating a group or clusters of again three that is based on review of consumer as good, bad and ok with different features of vehicle.
- With these two models we have also segment the market on basis of some technical features also.

Conclusion

As mentioned in start the number of two-wheelers in India is very large and the low amount of EV in that but as Indian Government is working to spread the use of electric vehicle in India it will be a booming market in future. The business should choose their segment of consumers according to their products' features. The ideal strategic segment for EV two-wheel to position in the market will be mid-price range with good riding range and medium weight and high power and many more as per the statistics and data.

Team Member4: - Aswathi Ajit

EV Market Segmentation

Introduction

The electric vehicle (EV) market in India is witnessing a significant transformation, with the government and private sector both playing pivotal roles in shaping its future. This report delves into the various aspects of the EV charging station market in India, and focusing on the demand for electric vehicles. Electric vehicles (EVs) represent a transformative leap in transportation technology, offering a cleaner, more sustainable alternative to traditional gasoline-powered cars. At their core, EVs rely on electric motors powered by rechargeable batteries, eliminating the need for fossil fuels and significantly reducing greenhouse gas emissions.

The concept of electric vehicles isn't entirely new, with early experiments dating back to the 19th century. However, recent advancements in battery technology, coupled with growing concerns about climate change and air pollution, have propelled EVs into the spotlight as a viable solution for the future of transportation. One of the key advantages of EVs is their environmental impact. By running on electricity rather than gasoline, they produce zero tailpipe emissions, reducing air pollution and mitigating the harmful effects of greenhouse gases. This shift towards electrification also plays a crucial role in efforts to combat climate change by reducing reliance on fossil fuels.

Additionally, EVs offer significant potential for energy efficiency and cost savings. Electric motors are inherently more efficient than internal combustion engines, translating into lower fuel costs for consumers. Furthermore, as renewable energy sources like solar and wind power become more prevalent, the environmental benefits of EVs are further amplified. Despite these advantages, challenges remain, including concerns about battery range, charging infrastructure, and the environmental impact of battery production and disposal. However, ongoing research and development efforts are addressing these challenges, driving innovation in battery technology, charging infrastructure, and sustainable manufacturing practices.

EV vehicles in India

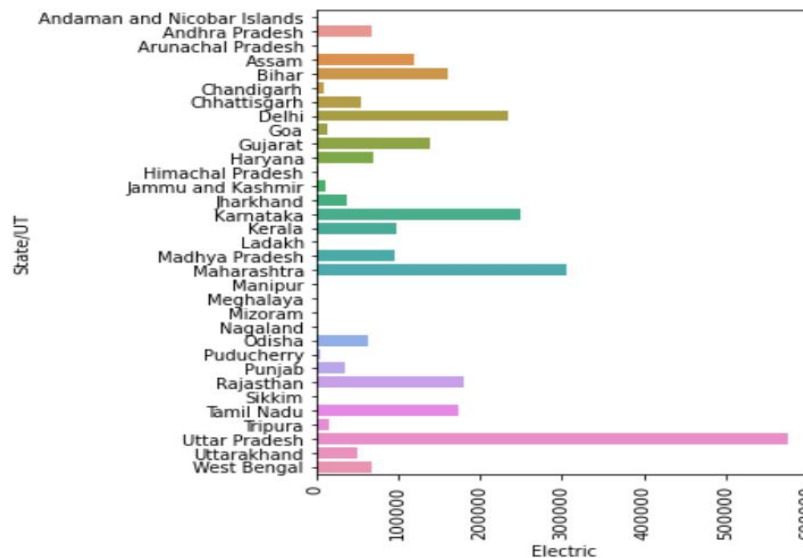
The global electric vehicle (EV) market is developing at a rapid pace. According to EV volumes, overall electric vehicles reached a global share of 8.3% (including battery electric vehicles [BEVs] and Plug-in hybrid electric vehicles [PHEVs]) in 2021 from 4.2% in 2020 with 6.75 million vehicles on the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

Ongoing electric vehicle adoption in India is based on the Paris Agreement to reduce carbon emissions, improve the air quality in urban areas, and reduce oil imports. The Indian automobile industry is the fifth largest in the world and is expected to become the third largest by 2030. The country is witnessing a steady rise in the adoption of EVs, driven by increasing environmental

concerns, favorable government policies, and advancements in technology. As per the India Energy Storage Alliance (IESA), the Indian EV industry is expected to expand at a rate of 36%. As the population rises and demand for vehicles grows, dependence on conventional energy resources is not a sustainable option as India imports close to 80% of its crude oil requirements. NITI Aayog aims to achieve EV sales penetration of 70% for all commercial cars, 30% for private cars, 40% for buses, and 80% for two and three-wheelers by 2030. This is in line to achieve net zero carbon emissions by 2070. Over the last three years, 0.52 million EVs were registered in India, according to the Ministry of Heavy Industries.

State wise electric vehicles count

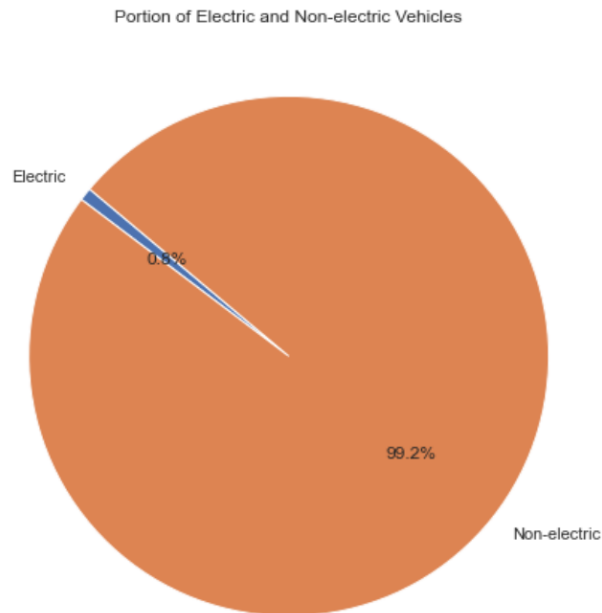
In India, Uttar Pradesh held the highest share in EV sales in 2021, with the number of units sold across all segments reaching 66,704, followed by Karnataka with 33,302 units and Tamil Nadu with 30,036 units. Uttar Pradesh dominated the three-wheeler segment, while Karnataka and Maharashtra led the two-wheeler segment and four-wheeler segment, respectively.



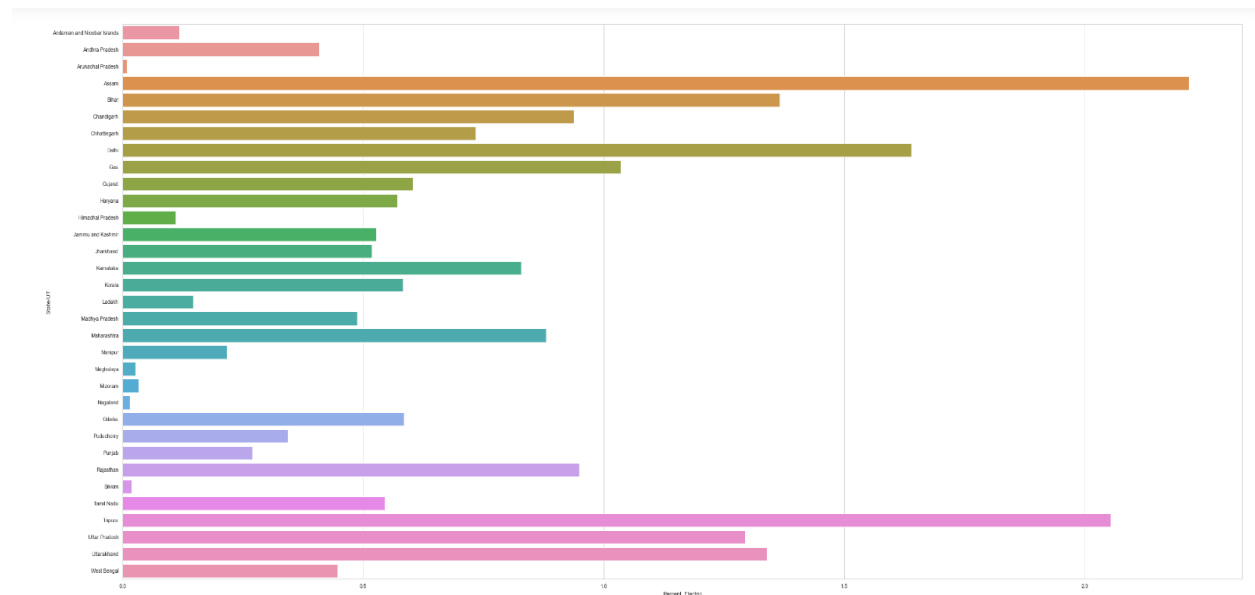
Hero Electric, Okinawa and Ather Energy controls the electric two-wheeler market in India with a combined market share of 64%. Hero Electric has a market share of 36% followed by Okinawa with 21%. Ather Energy with an 11.1% market share is slowly gaining market share, as the company is currently expanding its distribution network across India. In the passenger vehicle segment, Tata Motors enjoys a commanding position in electric vehicle space with a market share of 71%, led by their two key models, Nexon and Tigor EV. MG Motors India enjoys the second position and offers the longest-range EV (MG EZS provides 439 KM range on a single charge). Other Indian manufacturers have announced their models and is expected to be launched in the future. In India, Uttar Pradesh held the highest share in EV sales in 2021, with the number of units sold across all segments reaching 66,704, followed by Karnataka with 33,302 units and Tamil Nadu with 30,036 units. Uttar Pradesh dominated the three-wheeler segment, while Karnataka and Maharashtra led the two-wheeler segment and four-wheeler segment,

respectively. Data from the government's Vahan website shows that from April 2023 to March 2024, India saw the purchase of 1,665,270 EVs, averaging 4,562 EVs sold each day, a significant jump from the 3,242 daily sales the previous year.

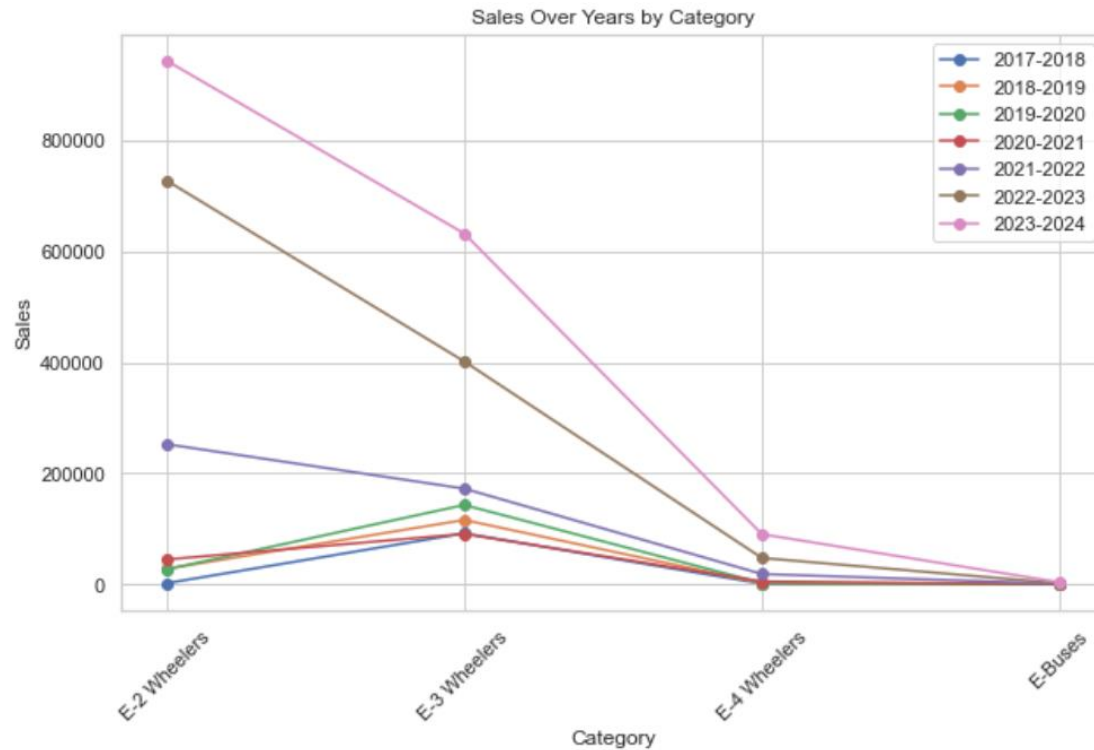
Of the total vehicles existing today in India, the percentage of electric to non-electric vehicle is,



Percentage of electric vehicles to that of the total; state wise is given as,

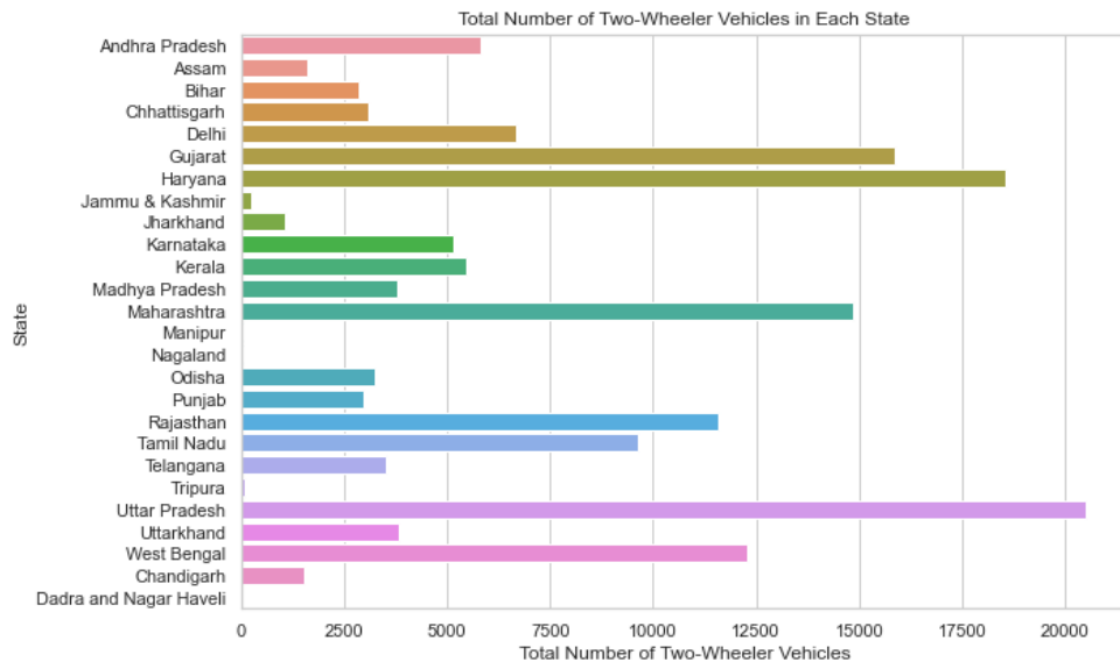
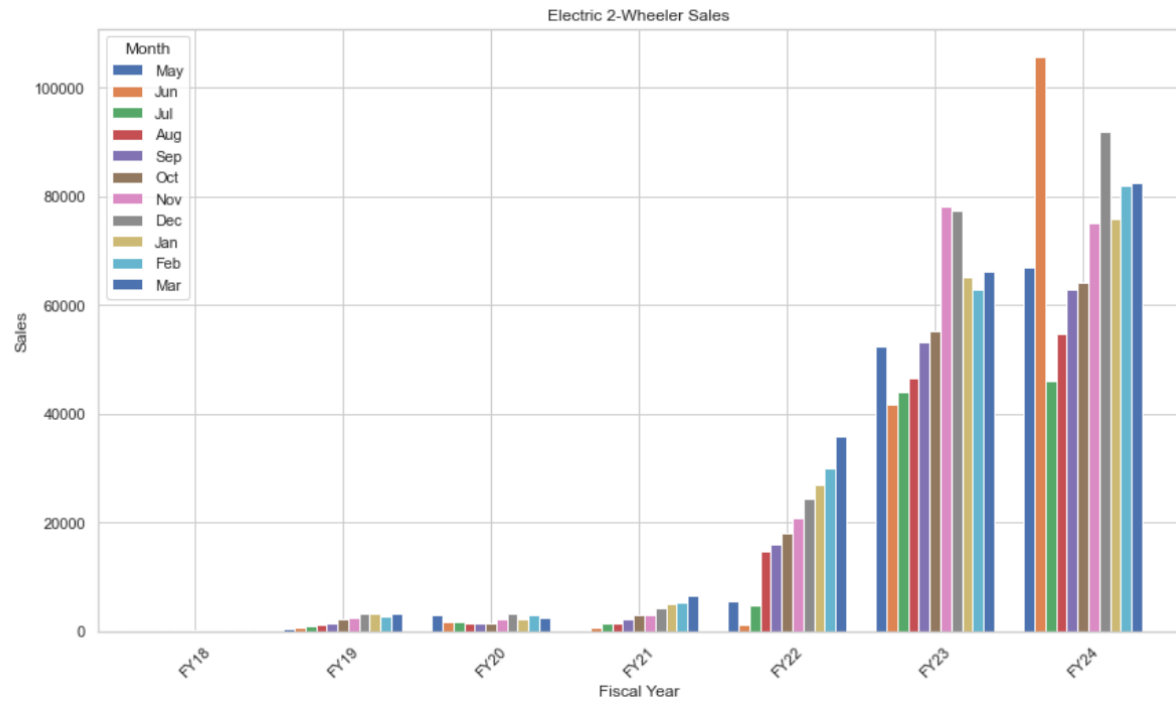


The sales of EV over the years have been showing a tremendous increase in terms of all types of vehicles, such as the two wheelers, four wheelers, electric buses. The trend can be seen as,

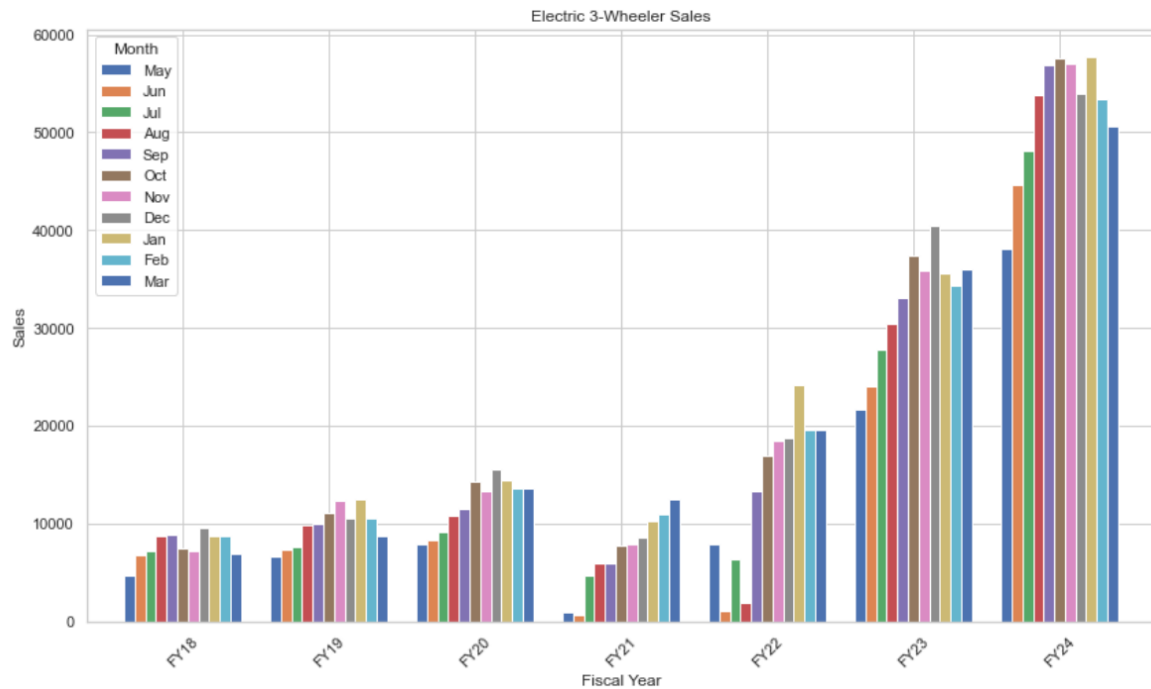


Electric two-wheelers sales trend:

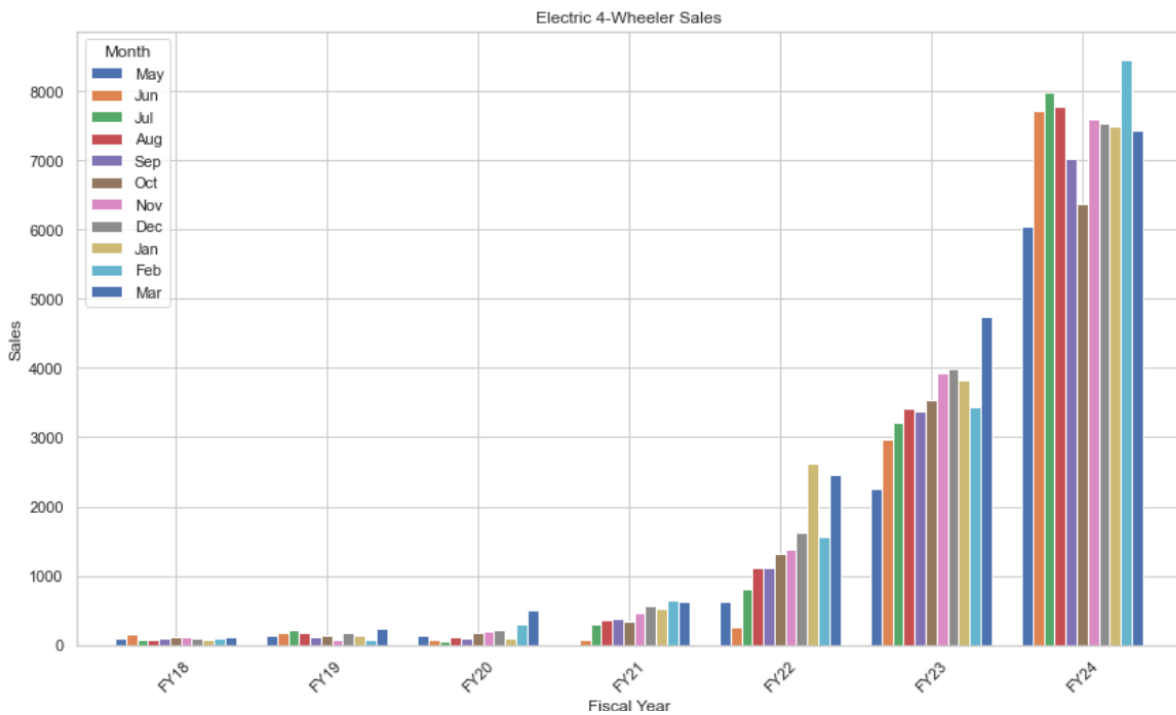
Two and three-wheelers led the surge in EV sales. Two-wheelers accounted for 56 per cent of all EV sales with 29 per cent year-on-year growth, while three-wheelers saw a 57 per cent growth and made up 38 per cent of sales. Together, these vehicles represented 94 per cent of all EV sales in the country. In FY21, the High-Speed Electric 2-Wheeler (HS-E2W) segment advanced significantly, registering 49% growth to reach 39,845 unit sales.



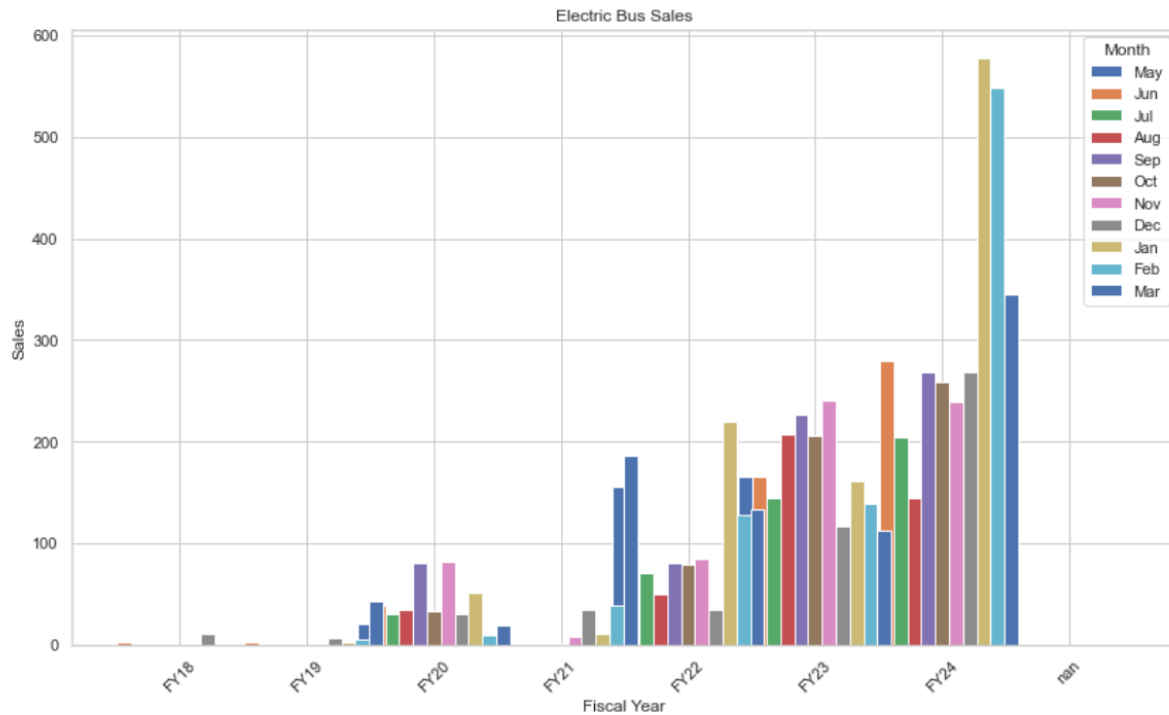
Electric three-wheelers sales trend:



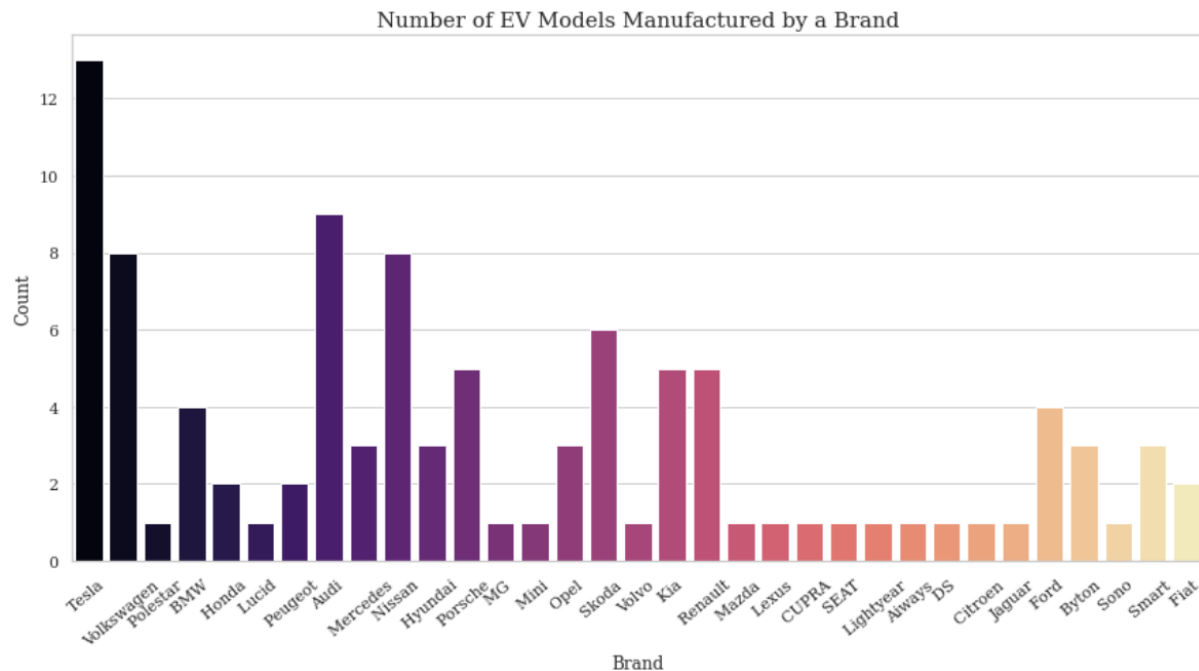
Electric four-wheelers sales trend:



Electric buses sales trend:



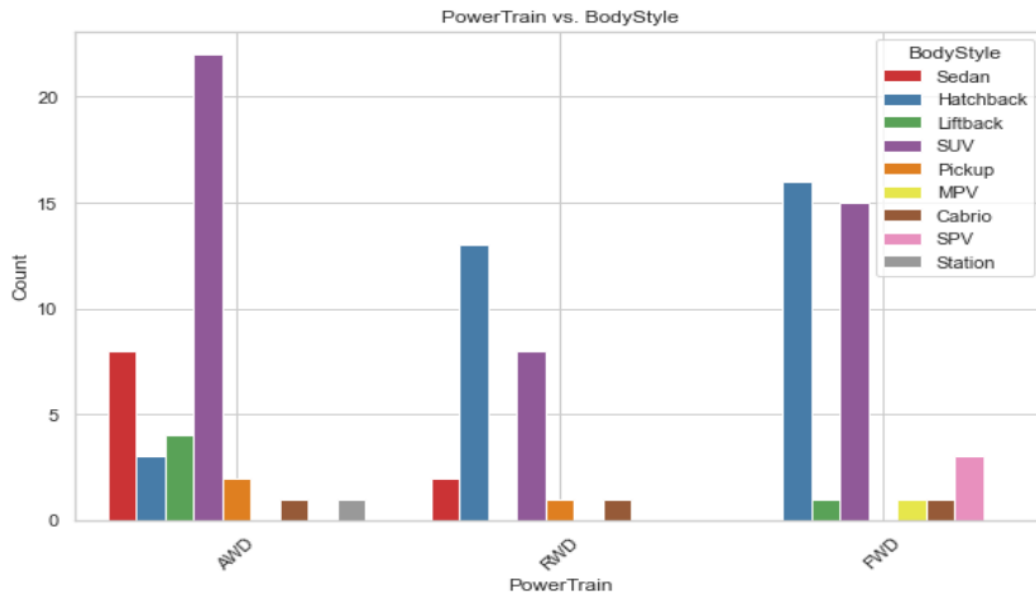
EV vehicle makers and their vehicle counts



A pair plot defined using the variables defined in the datasets is shown below. Data visualization to explore the pairwise relationships between different variables in a dataset.

Of these, on subdividing into further sessions,

Electric cars and SUVs also saw a notable increase, with sales jumping 89 per cent from the previous year to 90,033 units. Most customers prefer SUV and Hatchback cars.



Market Overview

EV charging infrastructure

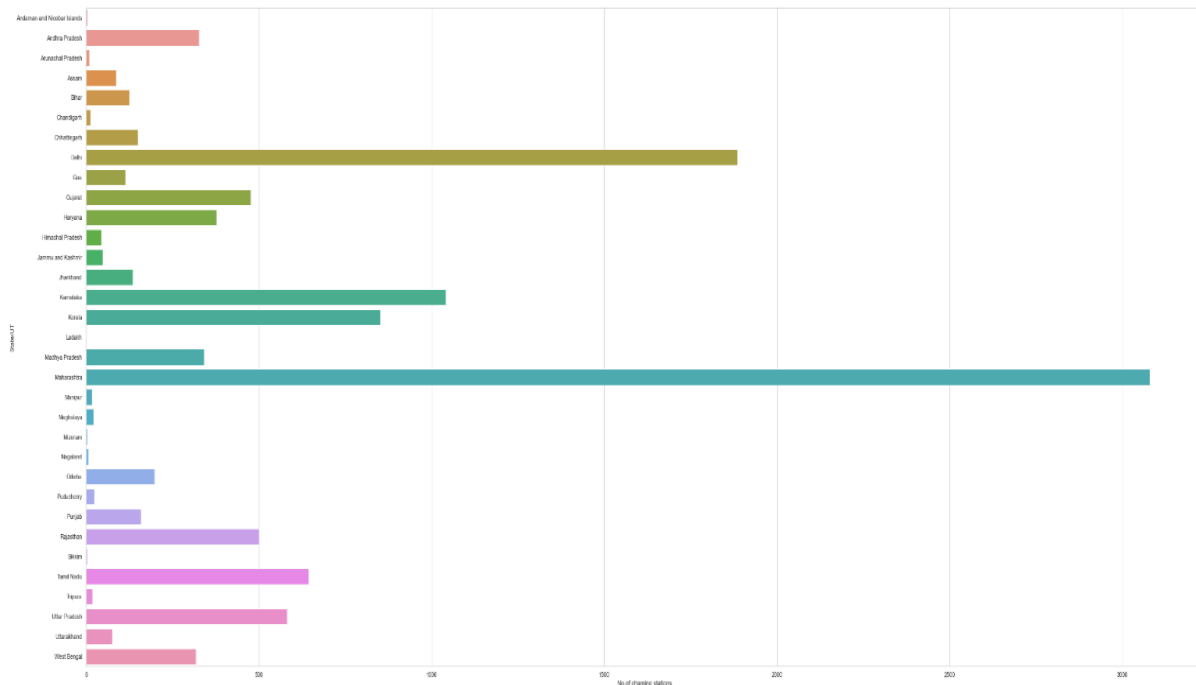
The growth in electric vehicles led to the coming up of the charging businesses. International experience suggests that various stakeholders/institutions have engaged themselves in planning and development of electric vehicle charging infrastructure. The EV charging infrastructure plays a crucial role in the EV ecosystem. It is the backbone that supports the operation of EVs and is a key determinant of the adoption and success of EVs in any market. The availability of a robust and widespread charging infrastructure can alleviate 'range anxiety' - one of the major barriers to EV adoption - and can thus significantly boost consumer confidence in EVs.

In the Indian context, the EV charging infrastructure is even more critical given the country's vast geographical expanse and dense population. The charging infrastructure needs to cater to a variety of EVs - from two-wheelers to cars to buses - each with different charging needs. It also needs to be accessible and affordable to ensure that EVs become a viable and attractive option for all sections of the society.

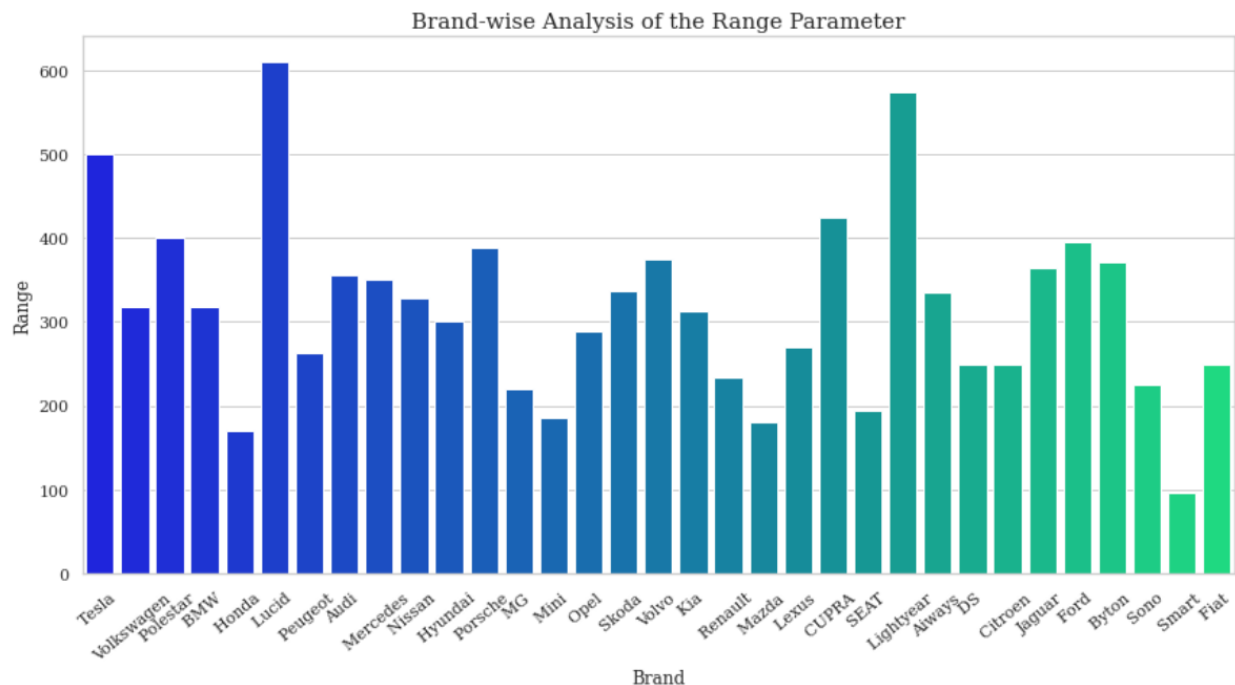
The EV charging infrastructure also has a significant role in the integration of renewable energy into the transportation sector. With the increasing share of renewables in India's energy mix, EV

charging stations powered by renewable energy can contribute to reducing the carbon footprint of the transportation sector. The EV charging infrastructure is not just a support system for EVs; it is a critical component of the overall EV ecosystem. Its development and growth will be instrumental in determining the trajectory of the EV market in India.

The number of charging stations within each state is given by,



The substantial disparity between the number of EVs and charging stations presents an inescapable problem known as range anxiety leading EV owners to constantly worry and dread the possibility of running out of power. In fact, 46 per cent of consumers drive less than 20 kilometers per day due to range anxiety. However, the battery life is not solely determined by the amount of charge it receives. Factors such as battery size, quality, vehicle charging capacity, charging station output, and weather conditions influence the vehicle's range. Larger batteries take longer to charge but offer better EV charging capabilities, while higher-capacity chargers reduce overall charging time. Moreover, batteries take longer to charge in cold weather compared to warm weather due to differences in their operating mechanisms.

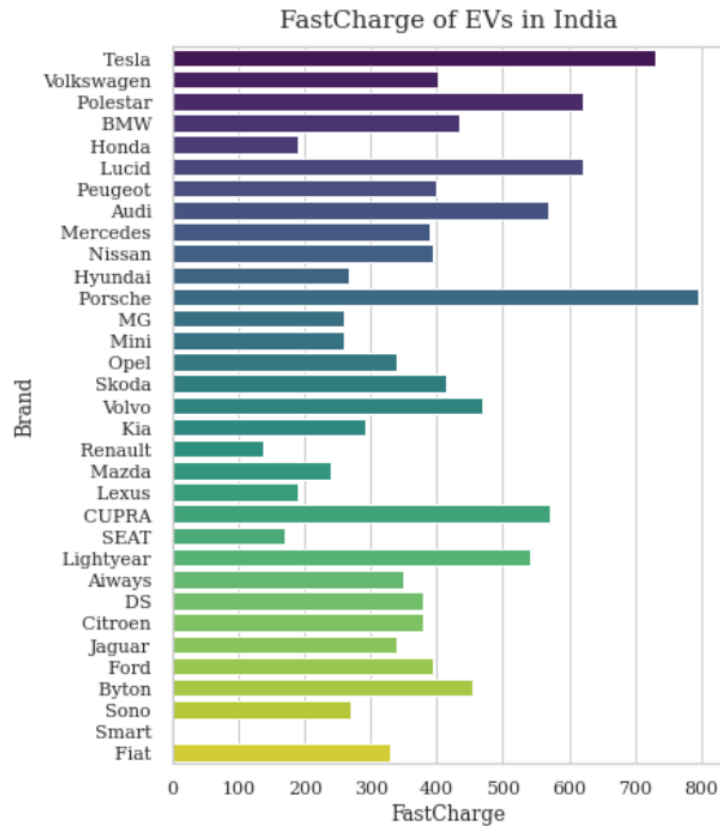


Based on range (Km), Lucid, Lightyear and Tesla have the highest range and Smart the lowest.

The EV push in India opens a plethora of business opportunities across three key segments – mobility, infrastructure and energy. These include opportunities in EV franchising, EV OEM market, battery infrastructure, solar vehicle charging and battery swapping technology among several others. According to NITI Aayog, the complete transition to EVs requires a total investment of US\$ 267 billion (Rs.19.7 lakh crore) in EVs, battery infrastructure and charging infrastructure.

The EV charging station market in India is in its early stages of development but is growing rapidly. As of 2021, there are over 1,800 public EV charging stations in India, a significant increase from just a few hundred in 2019. However, considering the size of the country and the government's ambitious EV targets, the current infrastructure is still inadequate.

The market is characterized by a mix of public and private charging stations. Public charging stations are typically located at places like petrol stations, parking lots, and shopping malls, while private charging stations are often installed at homes and offices. The government's recent move to allow setting up of EV charging stations without a license has opened up the market to a host of new players, including startups, power companies, and oil and gas firms. This is expected to accelerate the growth of the charging infrastructure in the country.



Comparing the fast charge options of various brands, Porsche has the highest and Renault the least.

Key Players in the Market

The EV charging station market in India is marked by the presence of several key players. These include both domestic and international companies. Some of the prominent players in the market include Tata Power, Fortum, ABB, Delta Electronics, and Exicom. Tata Power, one of the leading players, has already installed over 500 public charging points in more than 100 cities. Startups like Charzer and Magenta Power are also making their mark in the market with innovative solutions. For instance, Charzer has developed a low-cost, compact charging station that can be installed at small shops and restaurants, while Magenta Power has set up India's first solar-based EV charging station.

Types of EV Charging Stations

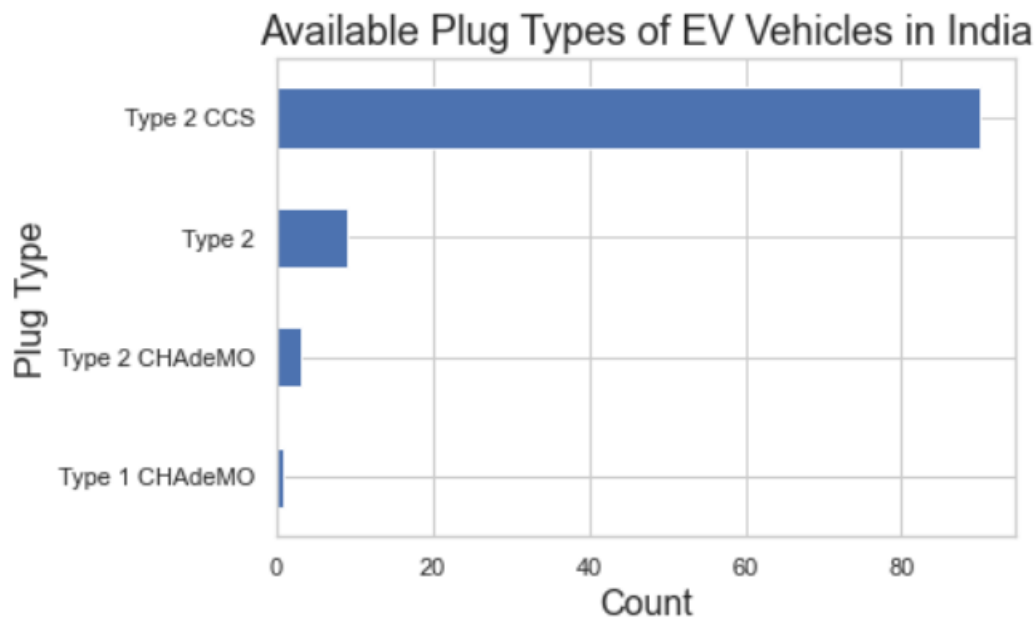
There are primarily three types of EV charging stations in India - AC (Alternating Current), DC (Direct Current), and Fast Charging stations.

AC Charging Stations: These are the most common type of charging stations and are typically used for charging at homes and offices. They use the regular household current and take longer to charge an EV.

DC Charging Stations: These stations convert the AC power to DC for charging the EVs and are faster than AC chargers. They are typically used in public charging stations.

Fast Charging Stations: These are the fastest type of chargers and can charge an EV to 80% in less than an hour. They are more expensive and are usually installed at public charging stations along highways and in commercial areas.

The EV charging station market in India is evolving rapidly with the entry of new players and the introduction of new technologies. The market is set to play a crucial role in the growth of the EV sector in the country.



Electric vehicles can conveniently be charged at various locations such as homes, workplaces, and parking areas. However, each of these locations offers different levels of electricity, categorized into three types:

Mode 2 Chargers: Mode 2 chargers are standard AC power outlets commonly found in households. These chargers provide a maximum power of 2.3 kW, resulting in a slow charging process.

Mode 3 Chargers: Mode 3 chargers deliver between 3.4 kW to 22 kW and can be found in residential areas, public parking spaces, businesses, and commercial locations. These chargers have intelligent functionalities, innovative connectivity options, and various safety features. Charging an electric vehicle for an hour using a Mode 3 charger can charge the vehicle battery from 20 per cent to 40 per cent depending on charger capacity as well as vehicle battery capacity.

Mode 4 or DC Fast Chargers: Mode 4 charging stations, commonly found in dedicated EV charging stations, are ideal for long-distance travel and provide quick top-ups during road trips. Unlike the previous two levels, these chargers deliver substantial power within minutes, remarkably reducing charging time.

Conclusion

With the environmental advantages and unparalleled convenience electric vehicles offer, their growth shows no signs of slowing down. However, transitioning from the traditional refueling mindset can make it challenging for consumers to grasp the intricacies of charger types, battery sizes, ranges, and safety regulations. That's why it becomes crucial for current and prospective EV owners to delve into the details of EVs and the charging system. By familiarizing themselves with the nuances of EV technology, individuals can make informed decisions, optimize their charging experience, and fully embrace the sustainable and forward-thinking future of transportation.

In India, operating an EV is cheaper than running a petrol or diesel car, which makes it more affordable. By using the energy- efficient EV charging solutions, individuals can charge their cars from the comfort of their homes. They can save time by not queuing up at the charging station, using AC and DC chargers. Moreover, installing multiple chargers with different charging gun types at a charge point can help an individual use any nearby charging point. With easy access to EV and charging solutions, people will be more inclined towards investing in EV purchasing, which will eventually increase the usage of electric vehicles in India.

Overall, electric vehicles represent a promising solution to the environmental and economic challenges facing the automotive industry. With continued investment and innovation, EVs have the potential to revolutionize transportation and pave the way towards a greener, more sustainable future.

Links: Git-Hub: - [Click Here](#)

Team Member4: - Karthik Sharma

INTRODUCTION

The Electric Vehicle (EV) market encompasses the production, sale, and adoption of vehicles that run primarily or entirely on electric power, as opposed to traditional internal combustion engines fuelled by gasoline or diesel. EVs utilize electric motors powered by rechargeable batteries or other sources of electricity, offering a cleaner and more sustainable alternative to conventional vehicles.

Trend Shaping the EV Landscape:

A notable trend shaping the EV landscape in India is the influx of new foreign players alongside established Indian companies transitioning to EVs. Companies such as Tesla, renowned for its groundbreaking electric car models, have set their sights on the Indian market, signalling a paradigm shift in the country's automotive industry. Tesla's entry into India has sparked considerable anticipation and excitement, underscoring the growing global recognition of India's potential as a key market for EVs. In addition to Tesla, several other foreign players have also ventured into the Indian EV market, bringing with them advanced technologies and innovative offerings. Companies like Nissan, with its expertise in electric vehicles, and Hyundai, known for its commitment to sustainability, have made significant strides in introducing EV models tailored to the Indian consumer preferences.

Market Segmentation:

Market segmentation is a fundamental concept in marketing that involves dividing a heterogeneous market into smaller, more homogeneous segments based on certain characteristics such as demographics, psychographics, behaviour, or geographic location. By identifying and understanding the distinct needs, preferences, and behaviours of various customer segments, companies selling EV can tailor their products, services, and marketing strategies to effectively target and serve each segment.

FERMI ESTIMATION (BREAKDOWN OF PROBLEM STATEMENT)

Understanding the landscape of India's electric vehicle (EV) market is pivotal for a startup contemplating entry. This involves delineating market segments, such as passenger cars, commercial vehicles, and two-wheelers, while grasping the market dynamics, key players, and regulatory frameworks shaping the industry. Overcoming data collection challenges, including availability and reliability, is paramount for effective market segmentation. Prioritizing segmentation factors like geographic location, income levels, and lifestyle preferences aids in targeting specific consumer groups accurately.

Estimating segment sizes is crucial for resource allocation and strategic planning, requiring an understanding of population distribution and relevant demographic data. Feasibility assessments are essential to gauge the viability of entering each segment, considering market size, growth potential, competition, and regulatory hurdles. Selecting target segments based on criteria like market size, growth potential, and strategic fit ensures optimal resource utilization and market penetration.

Developing a structured strategy entails defining product differentiation, marketing approaches, distribution channels, pricing strategies, and partnerships tailored to each segment's needs. Crafting a detailed implementation plan with clear timelines, milestones, and performance metrics ensures effective execution. Flexibility to adapt to evolving market dynamics and continuous evaluation are imperative for success in India's rapidly evolving EV market.

ESTIMATING INDIAN EV MARKET SIZE:

With a 0.1% penetration rate of India's 1.4 billion population buying EVs this year, if each EV averages ₹8 lakh, the Indian EV market in 2024 could be roughly ₹11.2 lakh

crore. This is a ballpark figure, and the actual market size could range between ₹5.6 lakh crore and ₹16.8 lakh crore depending on market variations

DATA COLLECTION

For the purpose of conducting market segmentation analysis in the Electric Vehicle (EV) market, a dataset was collected from Kaggle. The dataset contains information on 8128 customers and includes the following 13 features

Name: The name of the vehicle model.

Year: The manufacturing year of the vehicle.

Selling Price: The price at which the vehicle was sold.

Kilometres Driven: The total distance travelled by the vehicle in kilometres.

Fuel: The type of fuel used by the vehicle that are petrol, diesel.

Seller Type: The type of seller that are individual, dealer.

Transmission: The transmission type of the vehicle that are manual and automatic

Owner: The number of previous owners of the vehicle.

Mileage: The fuel efficiency of the vehicle in kilometres per Liter (kmpl).

Engine: The engine capacity of the vehicle in cubic centimetres (cc).

Max Power: The maximum power output of the vehicle's engine in horsepower (BHP).

Torque: The torque produced by the vehicle's engine.

Seats: The number of seats in the vehicle.

The dataset provides a comprehensive overview of customer preferences, vehicle specifications, and transaction details, which are essential for conducting segmentation analysis and identifying distinct customer segments within the Indian Vehicle Market. The inclusion of features such as selling price, mileage, engine capacity, and transmission type enables a thorough examination of factors influencing purchasing decisions and market trends in the Vehicle Industry.

DATA PRE-PROCESSING

Data pre-processing is a crucial step in preparing the dataset for segmentation analysis, ensuring data quality, consistency, and suitability for further analysis.

LIBRARIES USED

- **Pandas:** Pandas is a powerful data manipulation library in Python, widely used for handling structured data and performing various data operations such as reading, cleaning, filtering, and transforming tabular data.
- **Scikit-learn:** Scikit-learn is a comprehensive machine learning library in Python, offering a wide range of tools and algorithms for data preprocessing, modelling, and evaluation. It provides efficient implementations of encoding techniques (for categorical data) and scaling methods that is Standard Scaler here.

3.2 STEPS IMPLEMENTED

- **Dropping Entries with Missing Data:**

Missing data can adversely affect the accuracy and reliability of segmentation analysis. Entries with missing values in any of the selected features were dropped from the dataset to ensure data completeness.

- **Postfix Removal from Columns:**

- Some columns contained postfixes such as "BHP" (Brake Horsepower) and "CC" (Cubic Centimetres), which needed to be removed to convert the data to numerical format.

- **Conversion of Float Columns to Integer:**

Columns such as mileage, engine, max_power, and seats were originally stored as float data types. To facilitate further analysis, these columns were converted to integer data types.

- **Encoding Categorical Data:**

Categorical data, such as transmission and owner, were encoded using techniques such as one-hot encoding or label encoding to convert them into numerical format suitable for analysis.

- **Feature Selection:**

Out of the original 13 features, only 7 features were selected for segmentation analysis based on their relevance and significance in predicting customer segments.

Selected Features: 'selling_price', 'mileage', 'engine', 'max_power', 'seats', 'owner', 'transmission'

- **Scaling of Features:**

To ensure uniformity and comparability of features, the selected features were scaled using the StandardScaler method, which standardizes the features by removing the mean and scaling to unit variance.

SEGMENT EXTRACTION

Segment extraction in market segmentation analysis involved employing the Elbow Method to determine the optimal number of segments, which indicated 4 segments as the most suitable choice based on the within-cluster sum of squares (WCSS) reduction. Subsequently, the K-means clustering algorithm was utilized to partition the pre-processed dataset into 4 distinct segments, enabling the identification of customer groups with shared characteristics or behaviours. Additionally, the K-nearest neighbour's (KNN) algorithm, including its variant KNN++, was applied to assign data points to segments based on their nearest neighbour's in the feature space, facilitating the extraction of meaningful clusters. By combining these techniques, we successfully extracted segments within the electric vehicle market, providing valuable insights for targeted marketing strategies and product development initiatives tailored to diverse customer preferences and needs.

PROFILING AND DESCRIBING POTENTIAL SEGMENTS

The aim of the profiling step is to gain insight into the market segments resulting from the extraction process. Profiling becomes essential when employing data-driven market

segmentation techniques. While the segmentation solution may determine segments based on consumer benefits sought, the specific characteristics of these segments remain unknown until data analysis is conducted.

Following the application of the K-means clustering algorithm to segment the electric vehicle market dataset, the resulting clusters were analysed to profile and describe potential segments based on their characteristics and behaviour's. The dataset was partitioned into four segments, with the following distribution of entries: Segment 0 (1208 entries), Segment 1 (610 entries), Segment 2 (2122 entries), and Segment 3 (3966 entries).

SELECTION OF TARGET SEGMENT

In the Indian electric vehicle (EV) market, choosing the target segment involves considering key factors such as consumer preferences, market size, and competitive landscape. With India's growing adoption of EVs and supportive government policies, segments offering a balance of market opportunity, competitive advantage, and strategic fit are prioritized. This includes assessing demographic profiles, purchasing behaviour, and lifestyle preferences to identify segments aligned with the company's strengths and resources. Targeting segments with desirable features like an average vehicle price, four seats, and good engine specifications caters to the preferences of Indian consumers, facilitating market penetration and long-term growth. By aligning with these criteria, companies can effectively allocate resources and drive success in the dynamic Indian EV market.

CUSTOMISING THE MARKET MIX

Let's assume a new EV vehicle company with good market analysing made a good business in the market, and were able to target 40 percent of the Indian market.

Indian market size for Vehicles by applying Fermi Estimation:

Range between ₹5.6 lakh crore and ₹16.8 lakh crore

Potential Customer Base (PCB): 0.5 million

Your Target Price Range (TPR): ₹8 lakh to ₹12 lakh

Therefore,

Lower Bound of Potential Profit (PP_LB):

$$PP_LB = 0.5 \text{ million} * ₹8 \text{ lakh} = ₹4,000 \text{ crore}$$

Upper Bound of Potential Profit (PP_UB):

$$PP_UB = 0.5 \text{ million} * ₹12 \text{ lakh} = ₹6,000 \text{ crore}$$

Therefore, the potential profit in the early market could range **between ₹4,000 crore and ₹6,000 crore**, depending on market variations.

The most optimal market segment to open in the market as per the Market Research and Segmentation is **Segment 3**.

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