Market Segmentation Analysis of Electric Vehicles Market in India

(By Nikhil Singh-(Team2 - SB-23-11-2))

Problem Statement: The objective is to analyze the Electric Vehicle (EV) Market in India.

Overview:

An electric vehicle (EV) is a mode of transportation propelled by one or more electric motors. These vehicles can derive power from an external collector system, drawing electricity from external sources, or operate independently with a battery, which may be charged through solar panels or by converting fuel to electricity using fuel cells or a generator.[1] The scope of EVs encompasses road and rail vehicles, surface and underwater vessels, electric aircraft, and electric spacecraft.

The inception of EVs dates back to the mid-19th century when electricity emerged as a preferred means of motor vehicle propulsion. During this period, EVs offered a level of comfort and operational ease that surpassed the capabilities of gasoline-powered cars. Although internal combustion engines dominated the automotive landscape for approximately a century, electric power continued to be prevalent in other vehicle categories such as trains and smaller modes of transportation.

In the 21st century, EVs have experienced a resurgence, driven by technological advancements and an increased emphasis on renewable energy sources. This renewed interest is fueled by the growing awareness of transportation's impact on climate change and other environmental concerns. Recognizing electric vehicles as one of the top 100 contemporary solutions for addressing climate change, Project Drawdown underscores the pivotal role of EVs in mitigating environmental challenges.

Data Collection :

Data is extracted from various websites .

- https://drive.google.com/drive/folders/1pF1KZYXMvCwstSYHJNRPBuRXMNOtFjwR
- https://www.sciencedirect.com/science/article/pii/S2352340922002062
- https://kilthub.cmu.edu/articles/dataset/eVTOL_Battery_Dataset/14226830?file=26855063
- https://drive.google.com/drive/folders/137KIMhwpB1bx5zx0hTaa486bEKe3kXaB
- https://drive.google.com/drive/folders/1Yn_0KpPUvPjdNjJe8emy-QsKzqt7aexb

Exploratory Data Analysis:

Exploratory Data Analysis (EDA) is a critical step in the data analysis process where the main objective is to summarize the main characteristics of a dataset, gain insights into its structure, detect patterns, and identify potential relationships among variables. EDA involves visualizing and exploring data to understand its distribution, central tendencies, spread, and potential outliers before applying more advanced statistical methods or machine learning algorithms.

In the context of market segmentation, EDA can be a powerful tool for uncovering patterns and trends within the data that can inform the segmentation strategy. Here's how EDA can be used for market segmentation:

Understanding Data Distribution:

EDA helps in understanding the distribution of key variables related to the market, such as customer demographics, purchase behavior, or product preferences. By visualizing these distributions, analysts can identify potential groups or clusters within the data.

Identifying Patterns and Trends:

Through exploratory data analysis, analysts can identify patterns and trends that may exist within the dataset. This can include identifying common characteristics among certain customer segments, such as age groups, geographic locations, or specific product preferences.

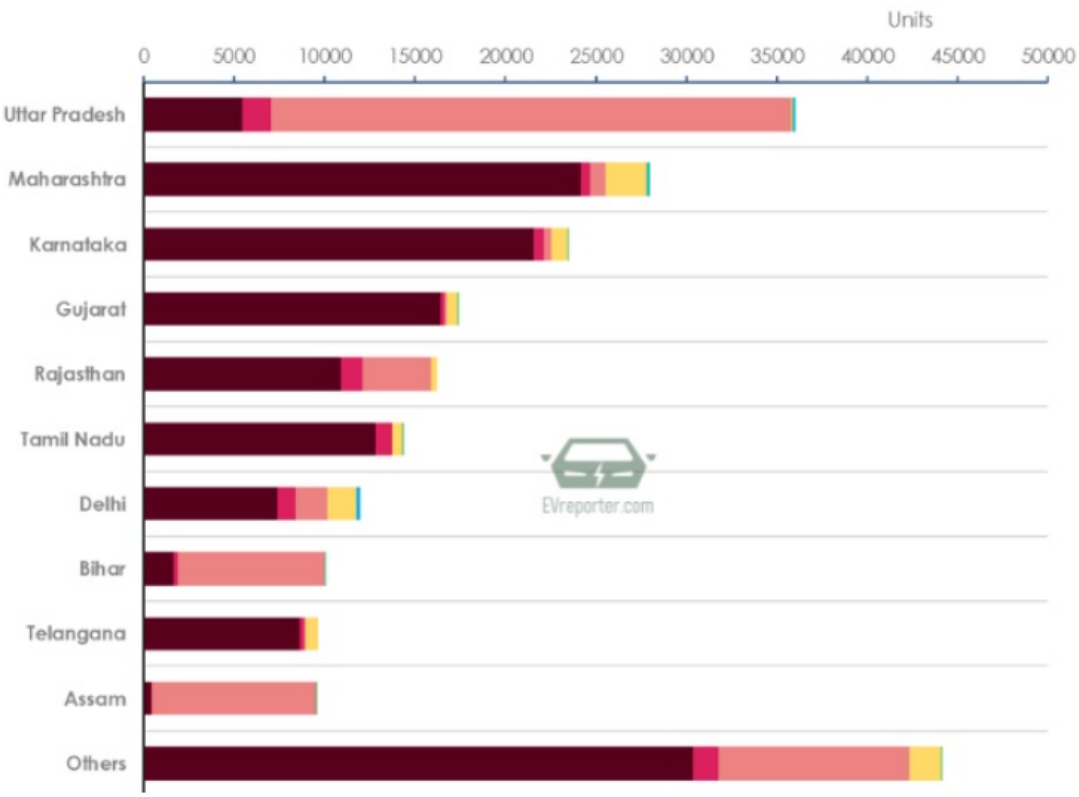
Detecting Outliers:
EDA allows the identification of outliers or unusual data points that may represent unique segments or anomalies in the market. Outliers could be indicative of niche markets or areas where a specific marketing strategy might be required.

Feature Engineering:
EDA can guide the process of feature engineering by identifying which variables are most influential in distinguishing different market segments. Understanding the key features that contribute to segmentation helps in designing effective marketing strategies.

Visualization for Insights:
Visual representations of data, such as scatter plots, histograms, and box plots, can provide insights into the relationships between variables. Visualization helps in interpreting complex patterns and understanding the structure of the data, aiding in segmentation decisions.

Customer Profiling:
EDA can assist in creating customer profiles by analyzing the distribution of characteristics and behaviors. This information is valuable for defining distinct market segments based on common traits or preferences.

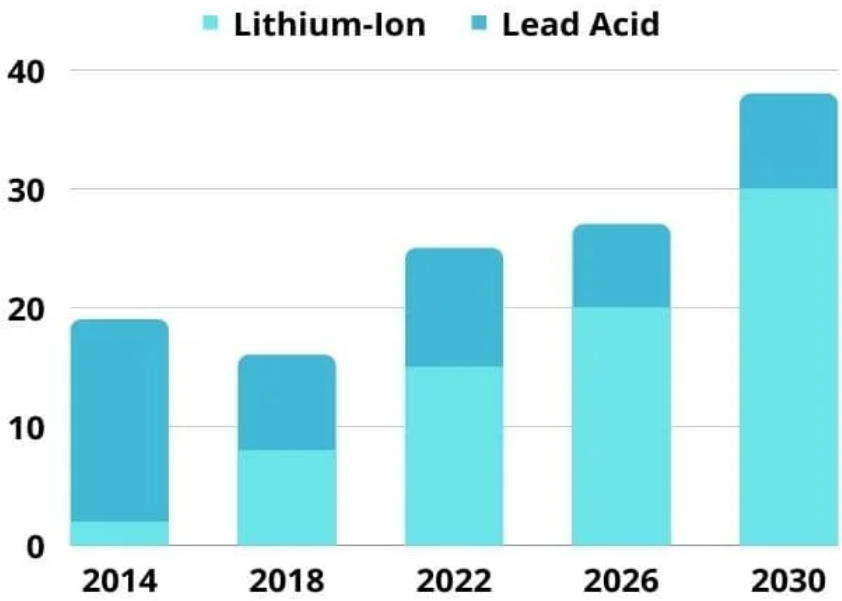
Data-driven Decision Making:
EDA facilitates informed decision-making by providing a solid foundation for subsequent steps in the segmentation process. It helps marketers and analysts make decisions based on a deeper understanding of the data.



EV Cars sales trend in India

STATE	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	YTD	RANK	CONT%
MAHARASHTRA	43,528	38,555	47,852	40,460	40,460	42,170	2,53,025	1	14%
UTTAR PRADESH	38,499	33,169	35,600	38,499	35,748	32,805	2,14,320	2	12%
GUJARAT	25,344	27,254	30,143	30,521	26,472	29,586	1,69,320	3	9%
KARNATAKA	25,502	20,592	26,054	28,185	24,046	26,507	1,50,886	4	8%
TAMIL NADU	23,883	19,897	24,472	20,997	22,539	24,081	1,35,869	5	7%
HARYANA	20,612	19,006	22,067	20,312	21,397	20,270	1,23,664	6	7%
RAJASTHAN	18,004	19,032	18,662	20,021	21,771	17,445	1,14,935	7	6%
KERALA	18,634	15,644	18,135	17,595	16,897	17,767	1,04,672	8	6%
DELHI	15,509	14,366	15,624	18,165	16,879	16,688	97,231	9	5%
PUNJAB	11,144	10,779	12,339	11,913	11,318	10,638	68,131	10	4%
WEST BENGAL	10,752	10,134	11,940	12,115	11,344	11,348	67,633	11	4%
ASSAM	7,352	8,645	10,422	8,734	9,073	7,964	52,190	12	3%
BIHAR	7,278	7,147	8,994	7,781	8,348	7,598	47,146	13	3%
ODISHA	7,620	6,500	7,961	7,310	7,356	7,580	44,327	14	2%
CHHATTISGARH	5,322	4,800	6,153	6,542	5,323	4,860	33,000	15	2%
JAMMU & KASHMIR	4,791	5,576	6,020	5,571	5,727	5,045	32,730	16	2%
JHARKHAND	5,124	5,251	6,318	5,712	5,177	5,033	32,615	17	2%
UTTARAKHAND	4,719	4,217	4,482	4,610	4,371	4,453	26,852	18	1%
HIMACHAL PRADESH	3,513	4,240	4,047	3,875	4,446	4,074	24,195	19	1%
CHANDIGARH	1,504	1,799	2,345	2,230	2,354	1,914	12,146	20	1%
GOA	1,346	1,269	1,625	1,537	1,476	1,472	8,725	21	0%
MEGHALAYA	1,375	1,262	1,570	1,216	1,423	1,438	8,284	22	0%
NAGALAND	1,208	1,162	1,165	1,487	1,104	1,192	7,318	23	0%
ARUNACHAL PRADESH	858	778	826	981	1,125	1,183	5,751	24	0%
MANIPUR	829	1,004	892	995	815	1,135	5,670	25	0%
PUDUCHERRY	785	657	855	740	765	842	4,644	26	0%
TRIPURA	621	576	768	680	545	553	3,743	27	0%
DNH&DD	695	560	540	629	498	490	3,412	28	0%
MIZORAM	548	558	620	513	533	518	3,290	29	0%
SIKKIM	318	446	456	436	486	528	2,670	30	0%
LADAKH	220	80	87	194	478	456	1,515	31	0%
ANDHRA PRADESH	0	0	0	0	37	1,085	1,122	32	0%
ANDAMAN & NICOBAR	116	125	134	182	147	143	847	33	0%
	3,07,553	**2,85,080**	**3,29,168**	**3,20,738**	**3,10,478**	**3,08,861**	**18,61,878**		**100%**

EV BATTERY MARKET GROWTH IN INDIA



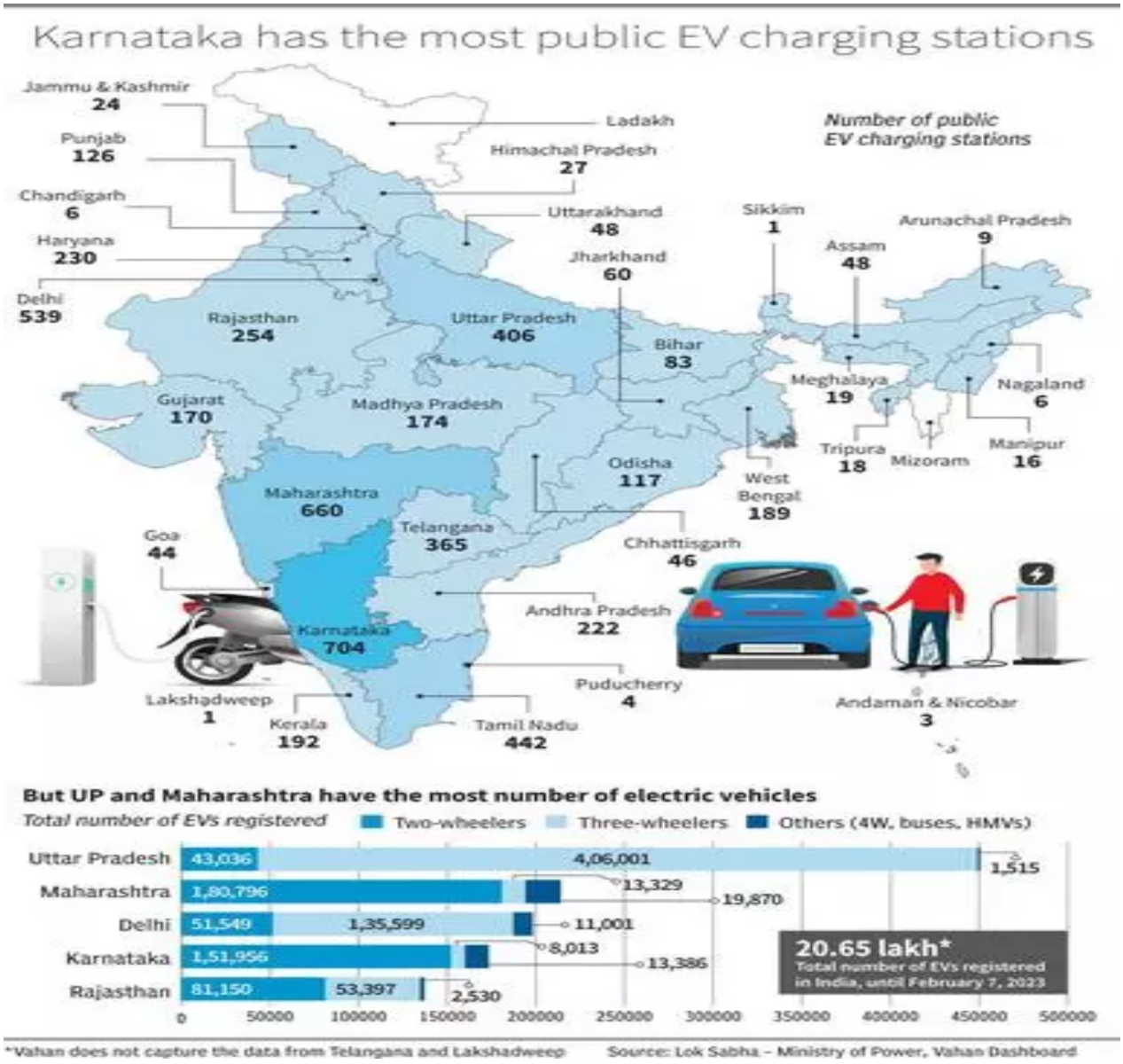
Goal 2030

Power

175 GWh

Market

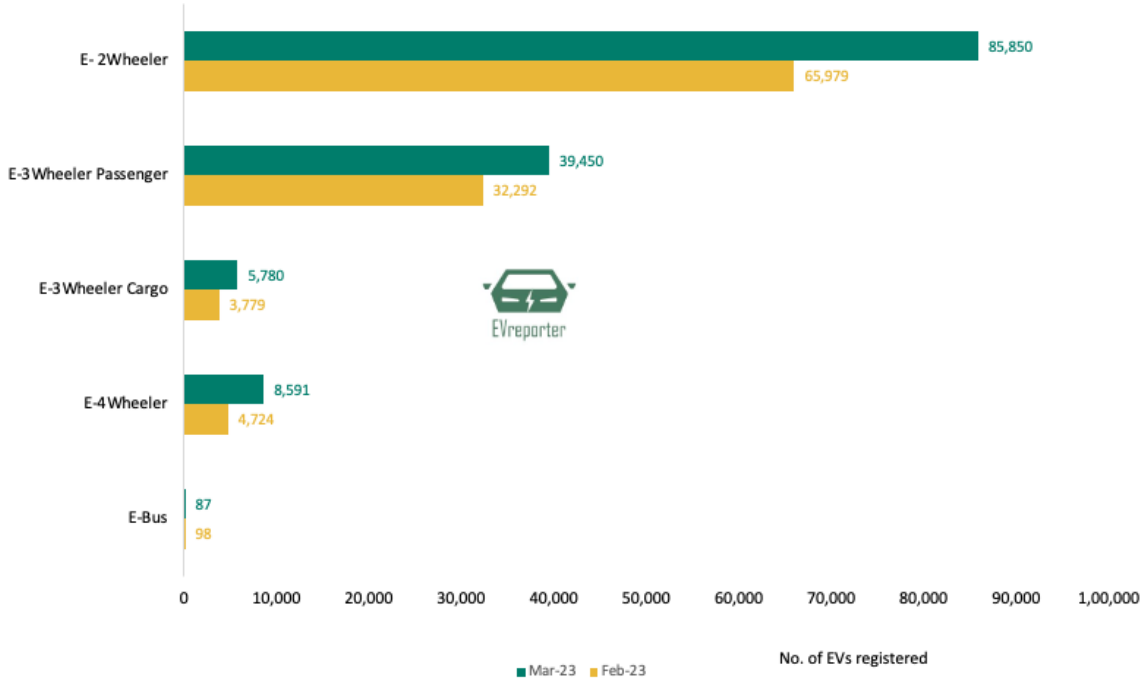
USD 17 Billion



EV Charging Stations in India State Wise

RETAIL SALES OF THE INDIAN EV INDUSTRY IN FIRST 7 MONTHS OF CY2023								
EV segment	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Total**
2-wheelers	64,683	66,075	86,324	66,841	1,05,452	45,993	54,272	4,89,640
3-wheelers	34,332	36,034	45,283	38,051	44,635	48,028	53,736	3,00,099
PVs	3,441	4,769	8,840	6,024	7,693	7,921	7,475	46,163
Goods vehicles	137	163	340	304	223	217	219	1603
Buses	96	87	74	84	271	200	133	945
Others	172	81	25	8	26	3	1	316
Total	**1,02,861**	**1,07,209**	**1,40,886**	**1,11,312**	**1,58,300**	**1,02,362**	**1,15,836**	**8,38,766**
Data: Vahan (as of August 2, 2023)								

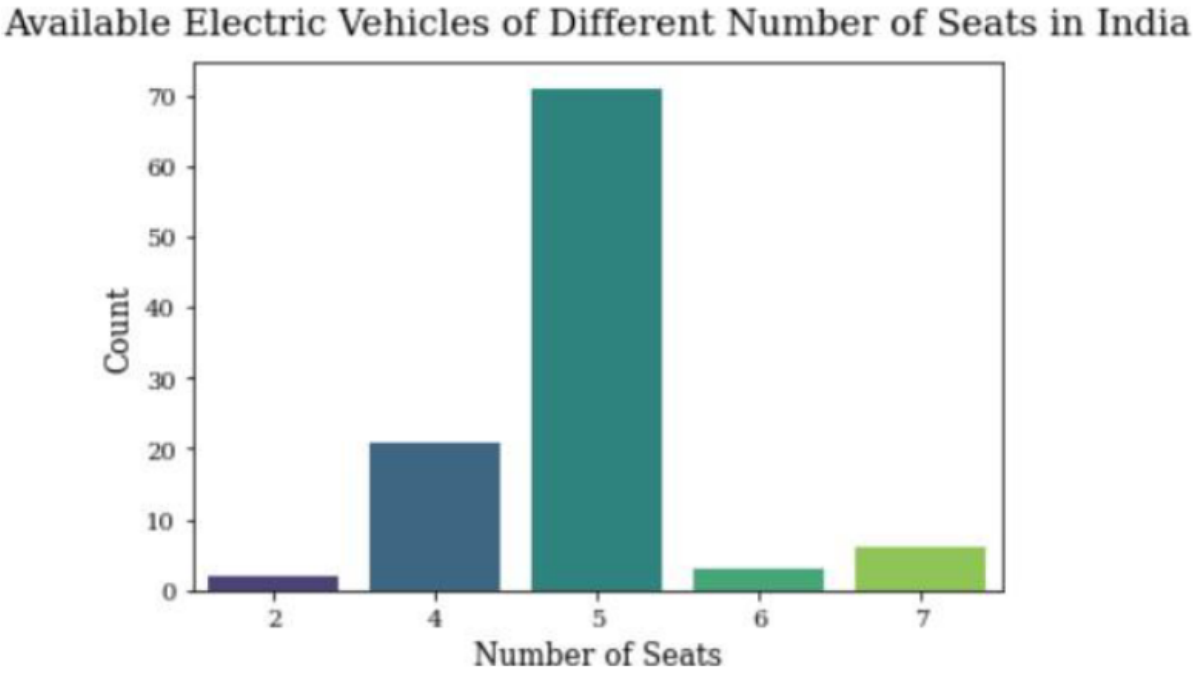
EV Sales in India of 2023

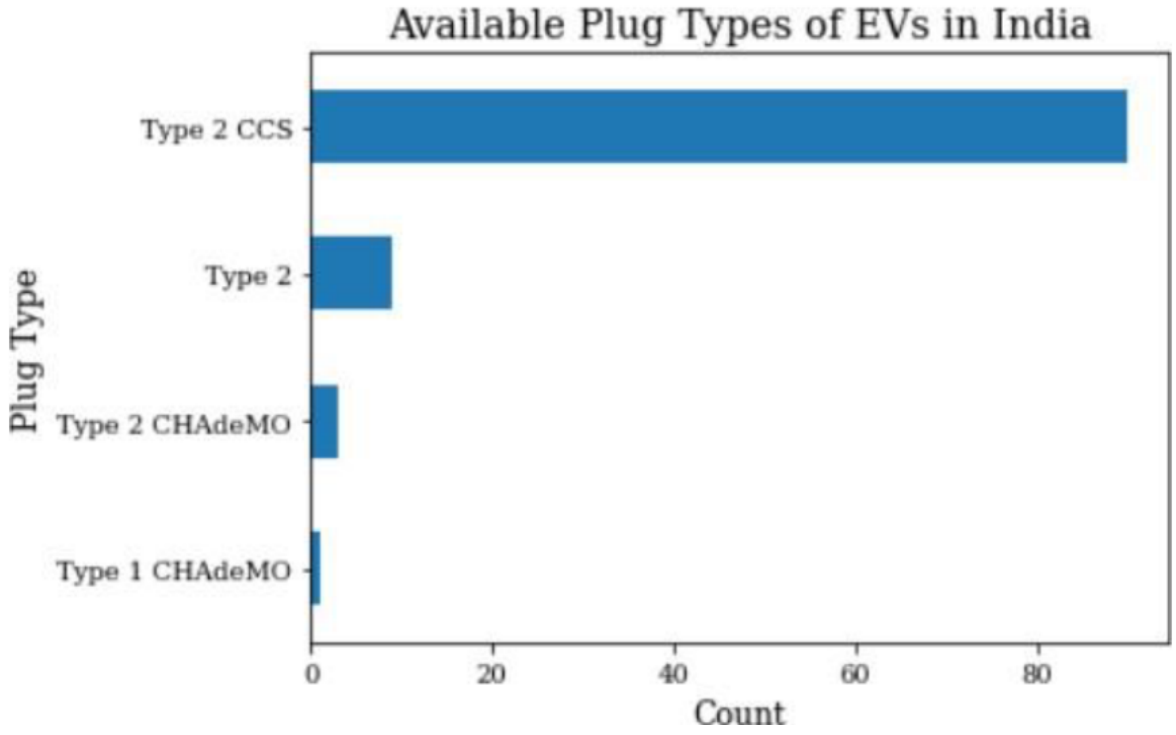


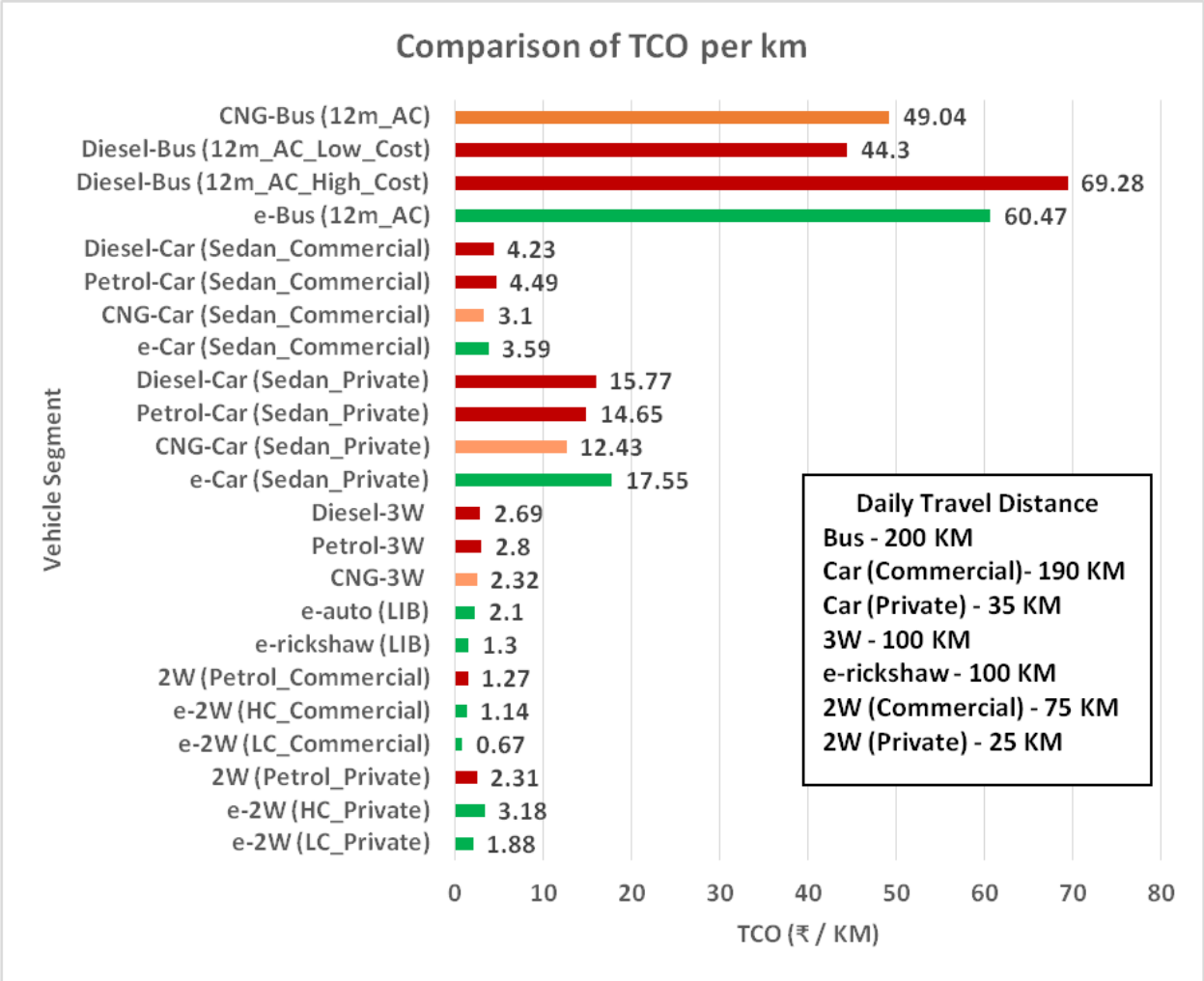
EV Sales Trend of India

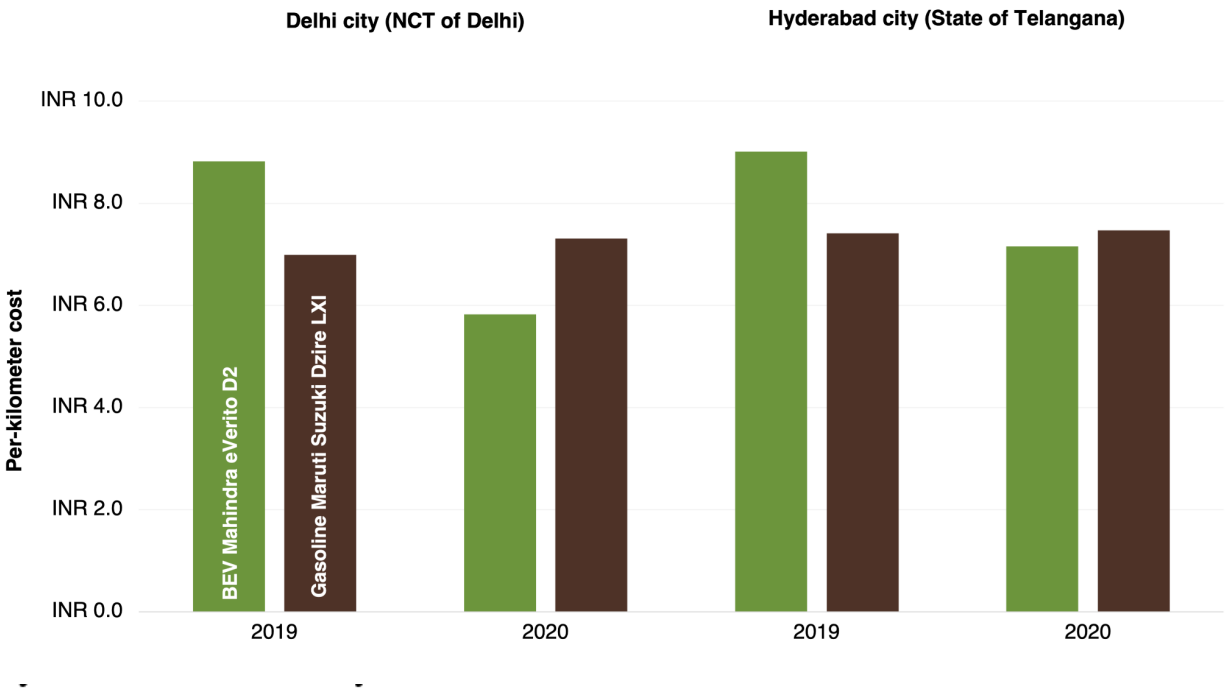
Product	Market type	Body Type	Production type	FY 2021-22 Volume	Market share
Tata Nexon EV	Mass-market	SUV	Local	13,879	63%
Tata Tigor EV	Mass-market	Sedan	Local	5,227	24%
MG EZS	Mass-market	SUV	CKD	2,525	11.5%
Hyundai Kona	Mass-market	SUV	CKD	131	0.59%
Mahindra E-Verito	Mass-market	Sedan	Local	79	0.36%
Audi e-Tron	Luxury	SUV	CBU	73	0.33%
Jaguar I-Pace	Luxury	SUV	CBU	69	0.31%
Mercedes EQC	Luxury	SUV	CBU	30	0.14%
Audi e-Tron Sportback	Luxury	SUV	CBU	23	0.10%
BMW iX	Luxury	SUV	CBU	3	0.01%
				22,039	100%

Electric Vehicles Sales By Category


Available Electric Vehicles of Different Number of Seats in India
Count
0
10
20
30
40
50
60
70
2
4
5
6
7
Number of Seats


Available Plug Types of EVs in India
Plug Type
Type 2 CCS
Type 2
Type 2 CHAdeMO
Type 1 CHAdeMO
0
20
40
60
80
Count


Comparison of TCO per km
CNG-Bus (12m_AC) 49.04
Diesel-Bus (12m_AC_Low_Cost) 44.3
Diesel-Bus (12m_AC_High_Cost) 69.28
e-Bus (12m_AC) 60.47
Diesel-Car (Sedan_Commercial) 4.23
Petrol-Car (Sedan_Commercial) 4.49
CNG-Car (Sedan_Commercial) 3.1
e-Car (Sedan_Commercial) 3.59
Diesel-Car (Sedan_Private) 15.77
Petrol-Car (Sedan_Private) 14.65
CNG-Car (Sedan_Private) 12.43
e-Car (Sedan_Private) 17.55
Diesel-3W 2.69
Petrol-3W 2.8
CNG-3W 2.32
e-auto (LIB) 2.1
e-rickshaw (LIB) 1.3
2W (Petrol_Commercial) 1.27
e-2W (HC_Commercial) 1.14
e-2W (LC_Commercial) 0.67
2W (Petrol_Private) 2.31
e-2W (HC_Private) 3.18
e-2W (LC_Private) 1.88
Vehicle Segment
0 10 20 30 40 50 60 70 80
TCO (₹ / KM)
Daily Travel Distance
Bus - 200 KM
Car (Commercial)- 190 KM
Car (Private) - 35 KM
3W - 100 KM
e-rickshaw - 100 KM
2W (Commercial) - 75 KM
2W (Private) - 25 KM



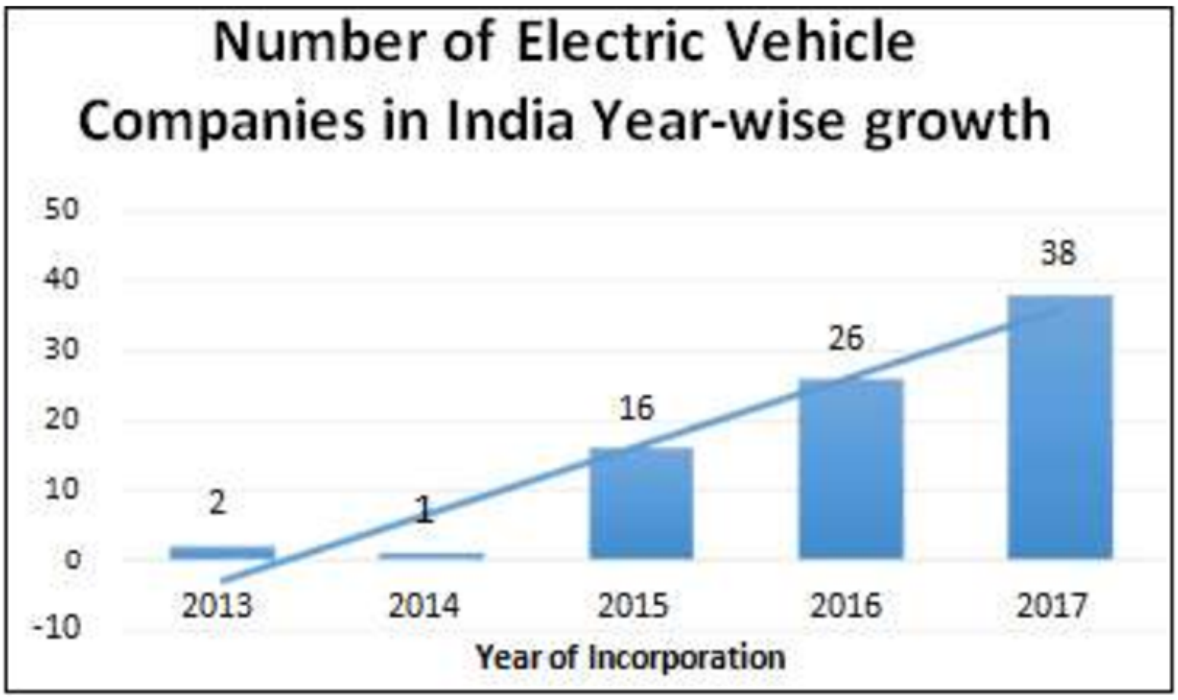


Figure 3: Number of Electric Vehicle Companies in India Year-wise growth

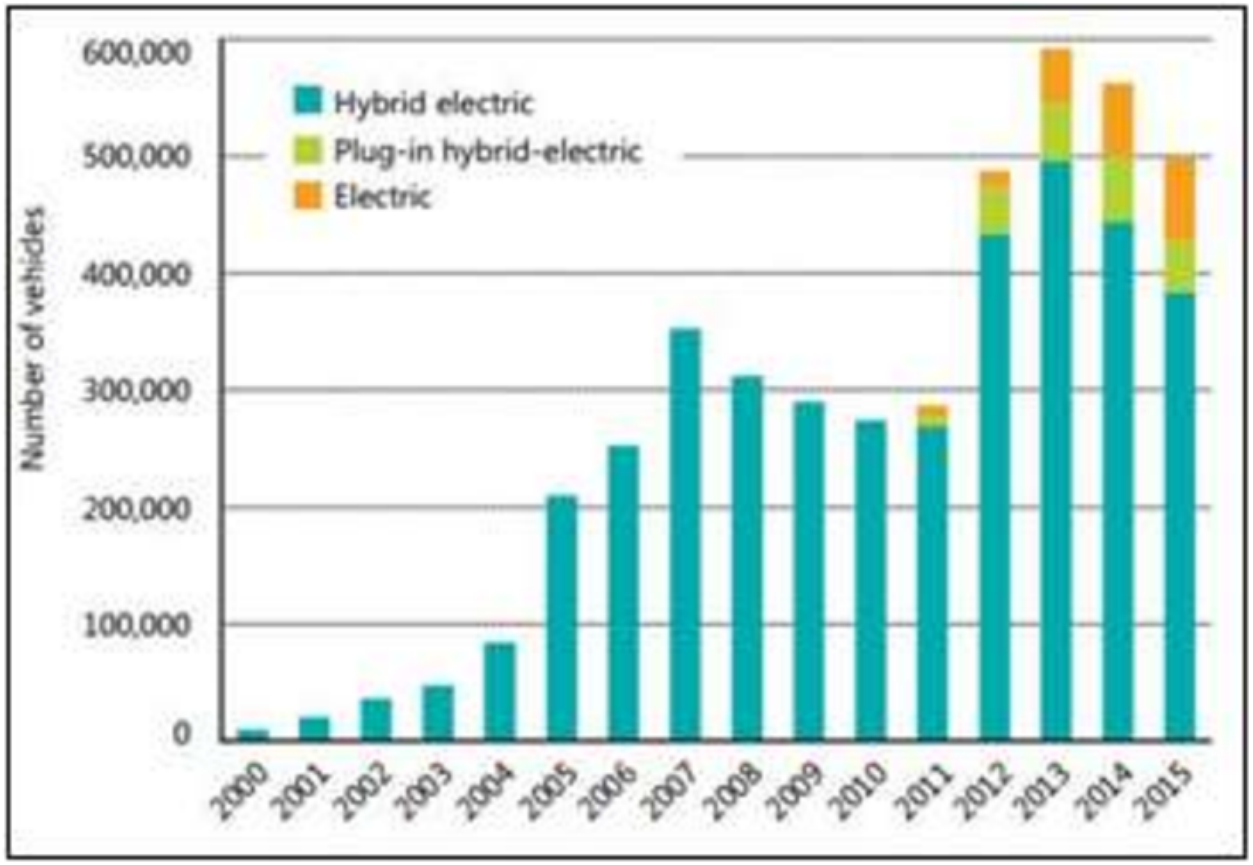


Figure 1: Increase in number of EV sold globally since 2000

Segment Extraction

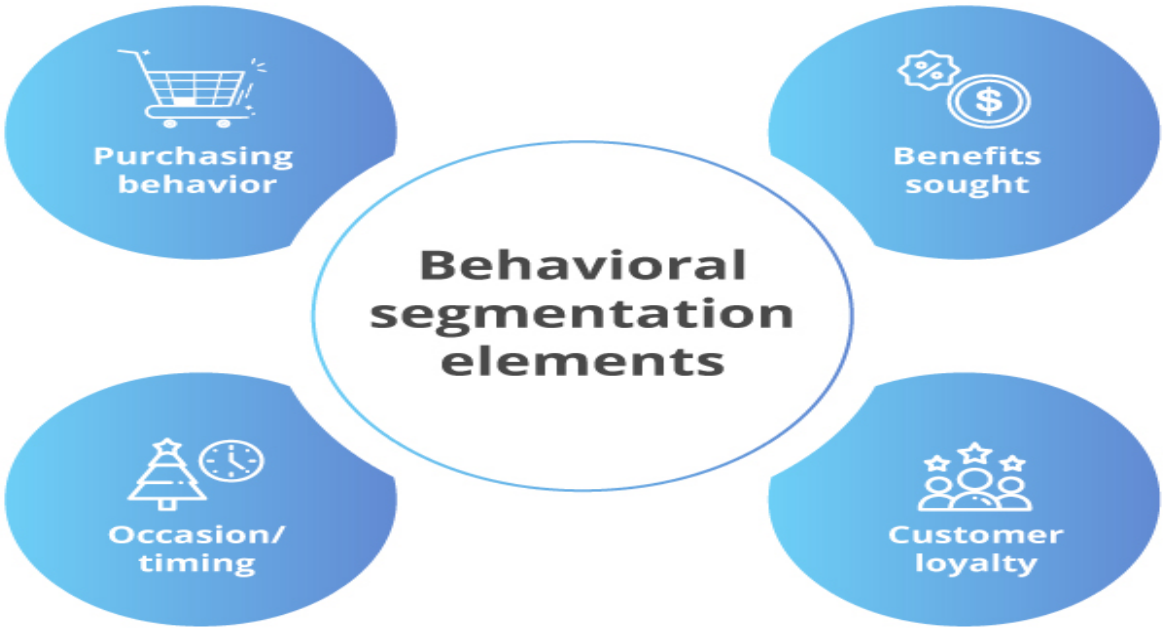
K-Means Clustering is one of the most popular Unsupervised Machine Learning Algorithms Usedfor Solving Classification Problems. K Means segregates the unlabeled data into various groups, called clusters, based on having similar features, common patterns.lustering is a machine learning technique that can be used for segment extraction. The goal of clustering is to group similar data points together based on certain features or characteristics. By applying clustering algorithms, you can identify natural groupings within a dataset, and each cluster can be considered as a segment. Here's a general approach to segment extraction using clustering methods.

1. **Data Preparation:**Collect and preprocess your data, ensuring that it is in a format suitable for clustering. This may involve feature scaling, handling missing values, or encoding categorical variables.
2. **Feature Selection:** Identify the relevant features for clustering. The choice of features will depend on the nature of your data and the specific segments you are trying to extract.

3. **Choose a Clustering Algorithm:** Select an appropriate clustering algorithm based on your data and requirements. Common clustering algorithms include K-means, hierarchical clustering.
4. **Determine the Number of Clusters:** If using algorithms like K-means, you need to specify the number of clusters beforehand. Techniques such as the elbow method or silhouette analysis can help you determine the optimal number of clusters.
5. **Apply the Clustering Algorithm:** Use the chosen clustering algorithm to cluster the data based on the selected features.
6. **Identify and Extract Segments:** Once the clustering is done, each cluster represents a segment of your data. You can extract the data points belonging to each cluster as the segments of interest.

Profiling Potential Segments:

Behavioral Segmentation:
Behavioral segmentation is a marketing strategy that categorizes consumers based on their behaviors, attitudes, and usage patterns. When applied to car customers in India, behavioral segmentation involves grouping consumers based on their actions, preferences, and decision-making processes related to purchasing and using cars.

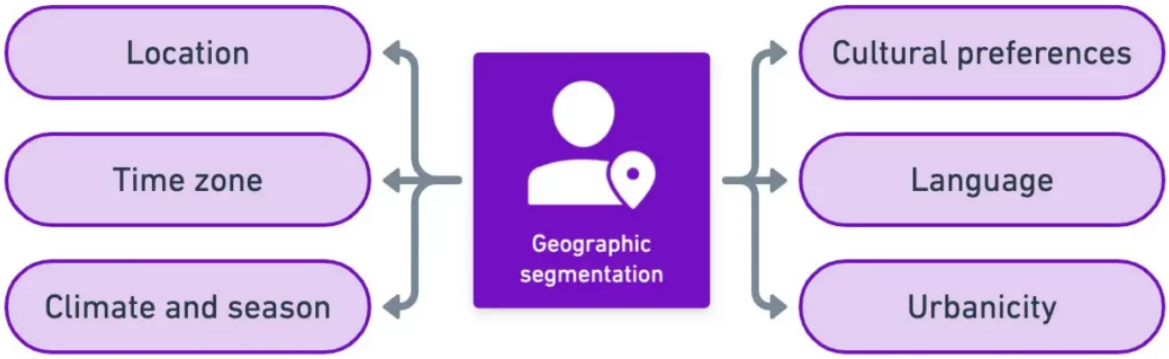


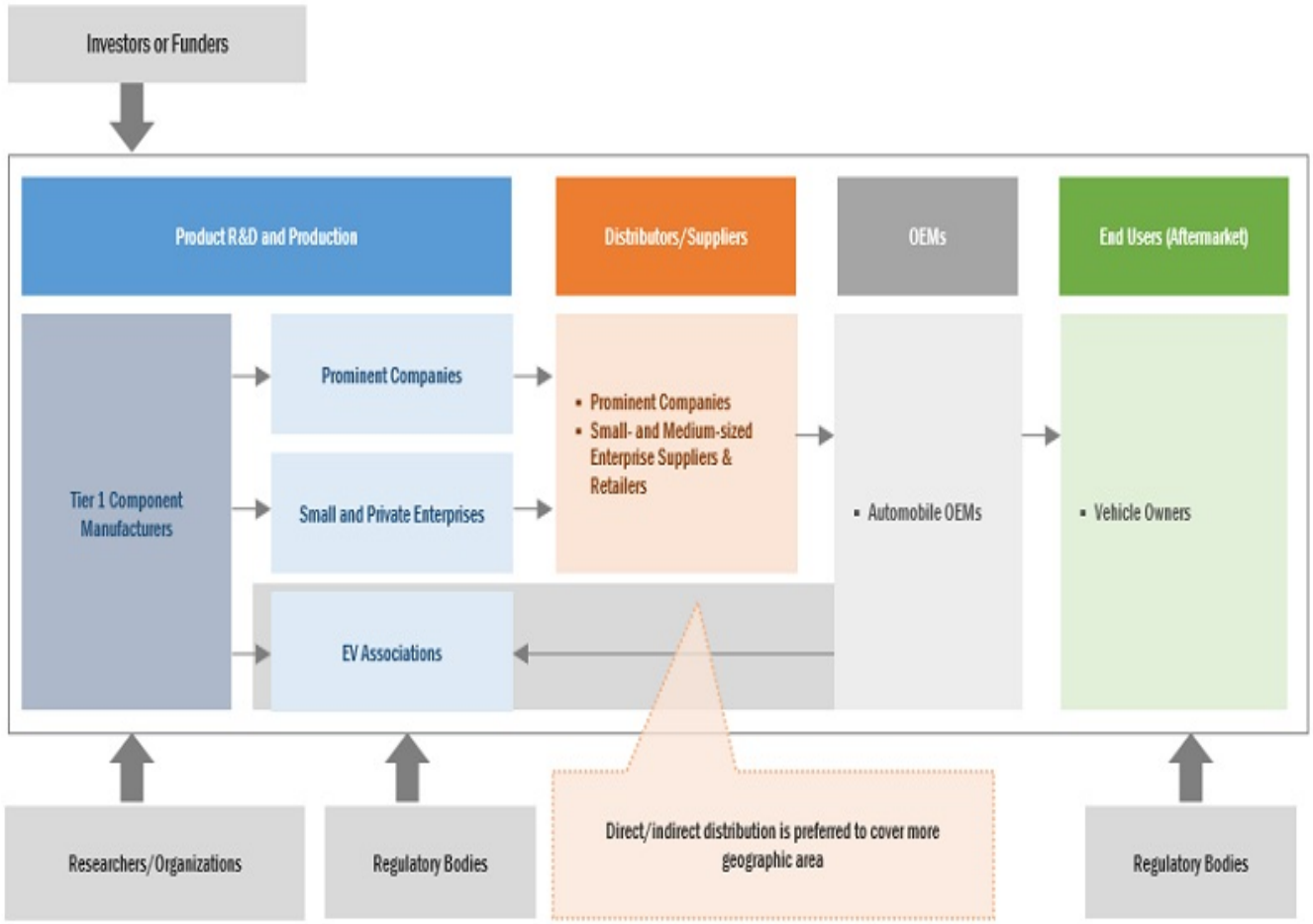
Psychographic Segmentation :

Psychographic segmentation is a marketing strategy that categorizes consumers based on their psychological characteristics, including their values, beliefs, interests, lifestyles, and personality traits. This segmentation approach goes beyond demographic factors such as age, gender, and income to understand the deeper motivations and attitudes that drive consumer behavior. Psychographic segmentation aims to create more personalized and targeted marketing messages to connect with specific consumer segments.

Geographic Segmentation :

Geographic segmentation is a marketing strategy that involves dividing a market into different geographical units based on various factors such as location, region, climate, population density, and other physical or cultural characteristics. The goal of geographic segmentation is to better target and tailor marketing efforts to the specific needs and preferences of consumers in different geographic areas.





Target Segments :
Based on the analysis, the target segment can be narrowed down to EVs having:
Psychographic factors - Comfort,Luxury,Futuristic,Value for Money
Behavioral factors - Mileage , Pocket Friendly , Less Maintenance Cost
Geographic factors - Easily Available of charging Stations

In conclusion, the target segment should comprise of EVs having Acceleration of 7.5-10 sec,High in Comfort and Value for Money ratings, have a Price range of 20-30 Lakhs, and be focused mainly on States such as Maharashtra, Karnataka, Tamil Nadu and Rajasthan.

Customizing the market mix: Customizing the marketing mix for electric vehicles (EVs) involves adapting the traditional 4Ps framework (Product, Price, Place, and Promotion) to address the unique characteristics and challenges of the electric vehicle market.

Price:
Incentives and Rebates: Leverage government incentives and rebates for EV buyers, and clearly communicate the cost savings associated with owning an EV.
Total Cost of Ownership (TCO): Highlight the long-term cost advantages of owning an EV, including lower fueling and maintenance costs over the vehicle's lifespan.
Flexible Financing Options: Introduce flexible financing options or partnerships with financial institutions to make EVs more affordable for a broader range of consumers.

Place:
Charging Infrastructure: Address concerns about charging infrastructure by partnering with charging station providers and promoting the growth of charging networks.
Urban Centers and Eco-Friendly Zones: Focus marketing efforts in urban areas where environmental concerns are higher, and emphasize the suitability of EVs in eco-friendly zones.
Online Platforms: Leverage online channels for sales and information dissemination, as tech-savvy consumers are more likely to research and purchase EVs online.

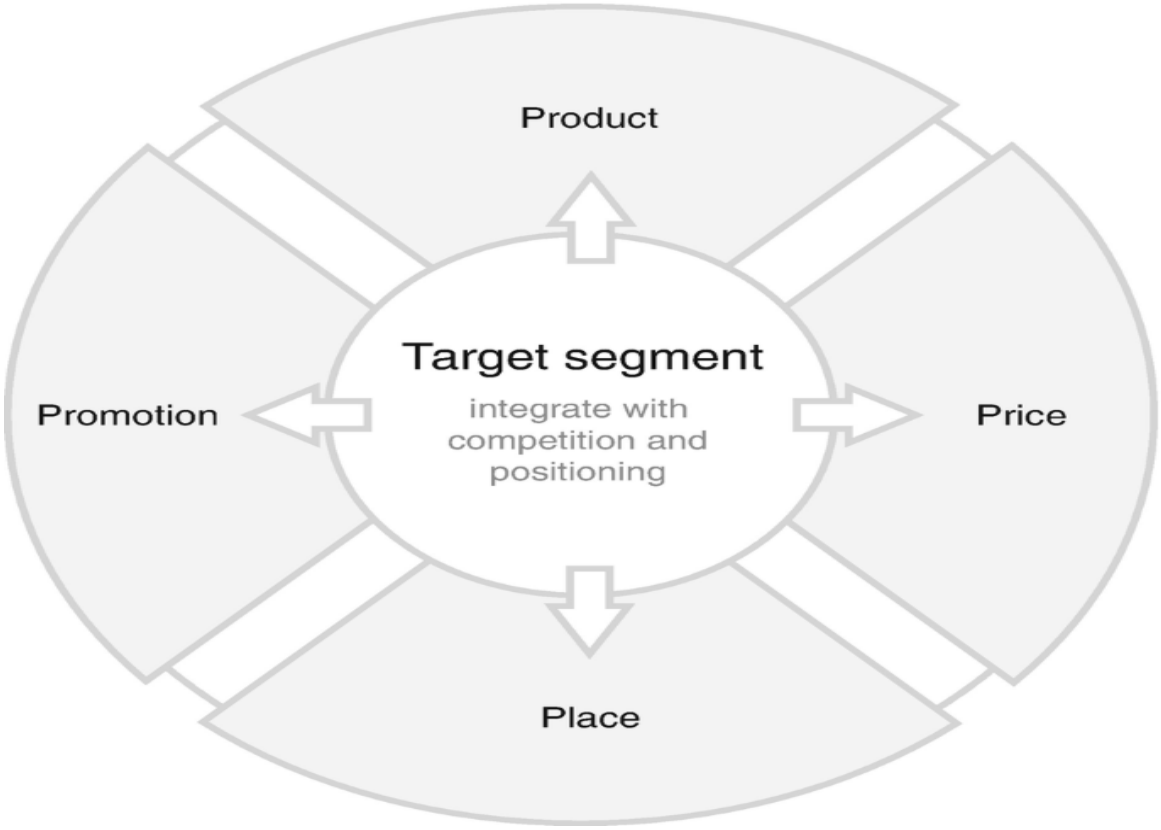
Promotion:
Environmental Messaging: Emphasize the environmental benefits of EVs in promotional campaigns, highlighting reduced emissions and their contribution to a sustainable future.

Educational Campaigns: Conduct educational campaigns to dispel myths and misconceptions about EVs, addressing concerns such as range anxiety and battery life.
Partnerships and Collaborations: Collaborate with environmental organizations, government agencies, and other stakeholders to build credibility and increase awareness of the benefits of EV adoption.

People:
Training and Education: Train sales staff to be knowledgeable about EV technology, charging infrastructure, and government incentives, enabling them to educate potential buyers effectively.
Customer Support: Provide excellent customer support, especially regarding EV-specific concerns and queries, to build trust and confidence in the brand.

Processes:
Seamless Purchasing Process: Streamline the purchasing process for EVs, ensuring that it is as convenient as possible, including online options, home test drives, and transparent pricing.
After-Sales Services: Develop after-sales services that cater to the unique needs of EV owners, such as maintenance programs, software updates, and battery warranty information.

Physical Evidence:
Showrooms and Test Drive Experiences: Create engaging showrooms and test drive experiences that showcase the advantages of EVs and allow potential buyers to experience the technology firsthand.
Branding and Packaging: Develop a brand image that aligns with environmental consciousness and sustainability, reflecting these values in the packaging and overall presentation of the EVs.



Potential Sales in Early Market: Refers to the anticipated market demand and sales opportunities during the early stages of the adoption curve for EV technology. The electric vehicle market is still evolving, and the early market phase typically involves a smaller group of innovative and early-adopter consumers. Understanding and tapping into the potential sales in this early market is crucial for the successful introduction and growth of EVs.

- **Early Adopters:**
  Profile: Early adopters are typically individuals who embrace new technologies and innovations eagerly. They are willing to take risks and try new products, often serving as influencers within their social circles.
  Motivations: Early adopters of EVs may be motivated by environmental concerns, a desire to embrace cutting-edge technology, or the potential for cost savings over the long term.
- Product Features and Innovation:
  Advanced Technology: Highlight the advanced features and technology embedded in EVs, such as longer battery life, regenerative braking, smart connectivity, and autonomous driving capabilities if applicable.

Performance: Emphasize the superior performance characteristics of electric vehicles, including instant torque, quiet operation, and a smooth driving experience.

- **Education and Awareness:**
  Educational Campaigns: Conduct targeted marketing campaigns to educate potential early adopters about the benefits of EVs, addressing any misconceptions or concerns they may have, such as range anxiety or charging infrastructure.
  Demonstrations and Test Drives: Offer opportunities for potential buyers to experience EVs through test drives, demonstrations, and interactive events.

- **Incentives and Rebates:**
  Government Incentives: Communicate available government incentives and rebates that make EVs more attractive from a financial perspective. Early adopters may be more responsive to these incentives.
  Special Offers: Consider offering special promotions or discounts for early adopters to incentivize initial purchases and build momentum in the market.

- **Charging Infrastructure:**
  Addressing Concerns: Early adopters may be more forgiving of limitations in charging infrastructure, but addressing these concerns through partnerships with charging station providers and highlighting planned infrastructure developments can enhance market appeal.

- **Community Engagement:**
  Building Communities: Foster a sense of community among early adopters through forums, social media groups, and events. This helps create a network of enthusiasts who can share experiences and information, contributing to the positive perception of EVs.

- **Market Positioning:**
  Differentiation: Clearly communicate the unique selling propositions of your EV models compared to traditional vehicles. This could include environmental benefits, lower operating costs, and cutting-edge technology.
  Brand Image: Develop a brand image that resonates with early adopters, aligning with values such as sustainability, innovation, and forward-thinking.

Improving a Market Segmentation Project with additional time and budget for data purchase involves refining the dataset, enhancing feature selection, and experimenting with more advanced machine learning models. Here's how you can approach it:

1. Dataset Collection:

Demographic Data:
Acquire more granular demographic data such as age, income, education level, and occupation.
Include geographic data for a more detailed understanding of regional preferences.

Behavioral Data:
Purchase data on consumer behavior, such as purchase history, frequency, and preferred channels.
Include data on online behavior and interactions, especially for e-commerce segmentation.

Psychographic Data:
Obtain data related to consumer attitudes, interests, and lifestyles.
Include data on values, hobbies, and social activities.

Customer Feedback:
Invest in customer feedback data from surveys or online reviews.
Include sentiment analysis data for a qualitative understanding of customer perceptions.

Competitor Data:
Acquire data on competitors' market share, pricing strategies, and product offerings.
Include customer reviews and feedback on competitor products.

2. Additional Columns:

Purchase Intent:
Incorporate a column indicating the likelihood of a customer making a purchase in the near future.

Brand Loyalty:

Include a metric or survey response indicating the level of brand loyalty among customers.

Customer Satisfaction:

Integrate data on customer satisfaction scores or Net Promoter Scores (NPS).

Social Media Engagement:
Include metrics on social media engagement, such as likes, shares, and comments.

Preferred Communication Channels:
Identify the preferred communication channels for different segments (email, social media, in-person).

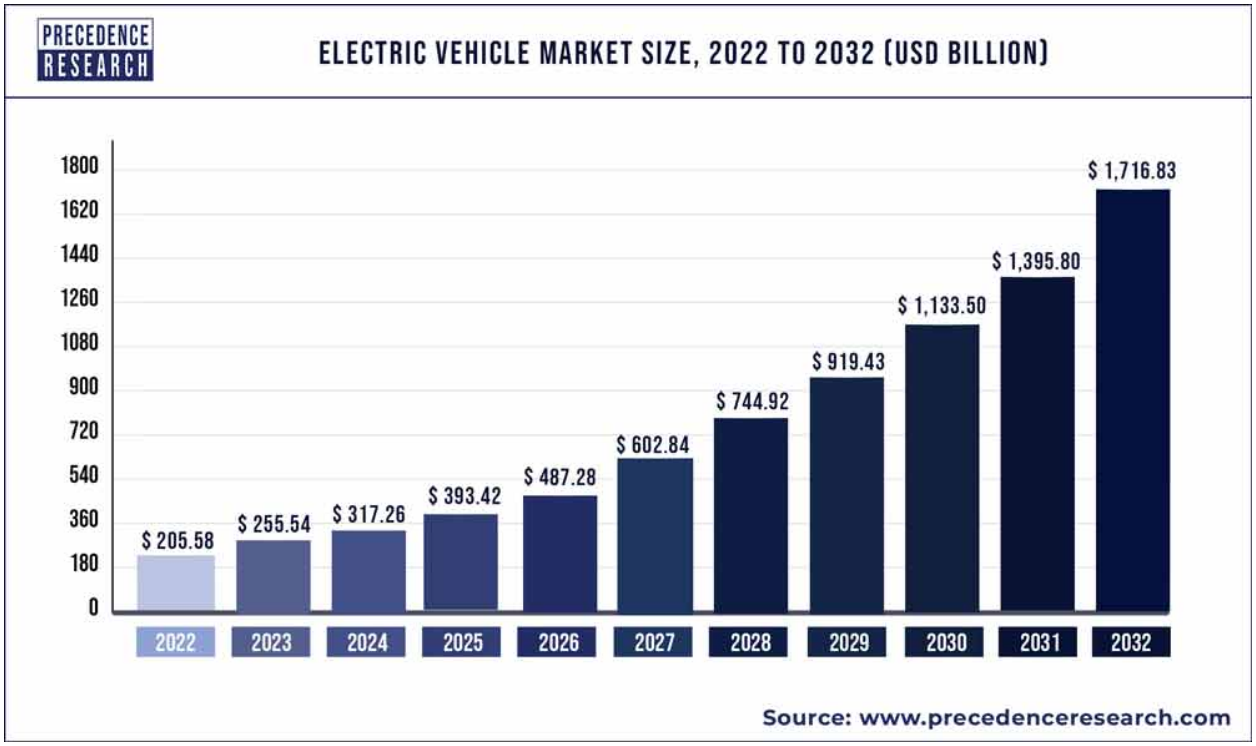
3. Advanced ML Models:

Ensemble Methods:
Implement ensemble methods like Random Forest or Gradient Boosting to improve predictive accuracy.

Clustering Algorithms:
Experiment with hierarchical clustering or DBSCAN to discover natural groupings within the data.
Implement k-means clustering for customer segmentation.

Deep Learning Models:
Explore neural network models, such as multi-layer perceptrons, for complex pattern recognition.
Use embeddings for categorical variables to capture nuanced relationships.

Time-Series Analysis:
If time-series data is available, apply models like ARIMA or LSTM to understand trends over time.



Conclusion: In conclusion, the electric vehicle (EV) market stands at the forefront of a transformative shift in the automotive industry. As the world gravitates towards sustainable and eco-friendly transportation solutions, EVs emerge as a pivotal force driving change. This report has explored various facets of the EV landscape, encompassing technological advancements, market trends, challenges, and strategic considerations for stakeholders.The future of EVs holds immense promise. As technology advances, costs decrease, and infrastructure expands, EVs are poised to become mainstream. Industry players should remain agile, adapt to changing consumer needs, and collaborate to build a sustainable and robust EV ecosystem.

“Go Electric Go Green”.