Electric Vehicle Market segmentation in India

The Electric Vehicle (EV) market has emerged as a key player in the global transportation sector, driven by environmental concerns, technological advancements, and shifting consumer preferences. This project focuses on formulating a strategic approach for a burgeoning Electric Vehicle startup intending to enter the Indian market. The primary aim of this project is to analyze the Indian EV market through segmentation analysis and develop a feasible strategy that targets specific customer segments most likely to adopt electric vehicles.

Scope and Objectives:

The scope encompasses market entry strategies, segmentation analysis, pricing strategies, and environmental considerations. The project objectives include identifying the most promising customer segments, establishing an early market presence, and adhering to government policies and incentives for EVs in India.

Methodology:

Data collection and analysis are fundamental to this project, utilizing a wide range of data sources, including market data, demographic data, and behavioral data. Segmentation analysis is applied to understand customer preferences and innovator behaviors. The project aligns with the Technology Adoption Life Cycle framework to focus on early adopters. Pricing strategies are designed to match customer psychographics.

Report Overview:

The India electric vehicle market size was valued at USD 220.1 million in 2020 and is expected to grow at a compound annual growth rate (CAGR) of 94.4% from 2021 to 2030. The attractive incentives being offered by the Indian government on the production and purchase of electric vehicles to encourage the adoption of electric vehicles are anticipated to drive the growth of the market over the forecast period. The outbreak of the COVID-19 pandemic triggered a significant decline in the overall sales of passenger and commercial vehicles in 2020. However, the sales of electric vehicles in India remained unaffected. The post-lockdown sale of pure and hybrid electric vehicles is a prominent driving factor for the electric vehicle market in India. The stringent GreenHouse gas (GHG) emission norms drafted by the government, such as the Bharat Stage (BS) VI emission standards introduced by India's Ministry of Road Transport and Highways (MoRTH), are also expected to play a decisive role in driving the growth of the market.

The increasing prices of conventional fuel are expected to accentuate the development of vehicle electrification. The stringent emission norms being drafted by the government and the growing environmental awareness among Indian consumers are also expected to fuel the demand for electric vehicles. Furthermore, Indian automakers, such as Tata Motors, and Mahindra and Mahindra Ltd., have embarked upon aggressive efforts to add electrified vehicles to their product portfolio, which is

expected to encourage Indian consumers to opt for electric vehicles. All these factors bode well for the growth of the electric vehicle market in India over the forecast period.

The EV market in India comprised only two electric vehicle models in 2019. As a result, only 0.15% of the new passenger cars registered between April 2019 and March 2020 were BEVs. However, at the beginning of 2021, the India electric vehicle (EV) market consisted of around eight electric vehicle models, thereby offering more options for Indian consumers looking forward to buying electric vehicles. Moreover, the prices of electric vehicles are also expected to decline over the forecast period, thereby allowing EVs to provide a lower Total Cost of Ownership (TCO) as compared to conventional vehicles. This is expected to pave the way for the mass-market penetration of electric vehicles.

India has been recognized as one of the prominent regions in the automotive industry globally. Several companies are aggressively establishing manufacturing facilities in India. For instance, in September 2020, Dana TM4 Inc. announced plans to establish a manufacturing facility in Pune, India. The new 4,600 square-meter facility would produce Dana TM4 low- to high-voltage inverters, electric motors, and vehicle control units. Meanwhile, the Phase-II of the Indian government's Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme envisages further enhancing the adoption of electric mobility and the development of its manufacturing eco-system. Phase-II of the FAME scheme would be implemented through the following verticals, namely incentivizing the demand for EVs; running awareness campaigns, including publicity, and information, education & communication (IEC) activities; and establishing a charging station network.

The outbreak of the COVID-19 pandemic changed the overall business dynamics in 2020 and is anticipated to affect the overall business scenario over the next few years. Lockdowns imposed in different parts of the world as part of the efforts to arrest the spread of coronavirus resulted in supply chains disruptions. Production was also suspended at numerous production facilities as part of the lockdowns. As a result, shipments were delayed and production volumes plummeted, thereby severely affecting automotive production. Manufacturers of electric vehicles continued to confront issues with supplies of raw materials owing to the looming delays in international shipments and hence, reported production delays. Nevertheless, although the pandemic triggered a significant decline in the overall sales of passenger and commercial vehicles, the sales of electric cars in India remained unaffected. According to the Society of Manufacturers of Electric Vehicles (SMEV), the sales of electric cars in India increased over the year by 109% from 2,814 units in 2019 to 5,905 units in 2020. The majority of over 64% of the sales came from the Tata Nexon EV, with a total of 3,805 units sold in 2020.

Vehicle Type Insights:

The commercial vehicle segment accounted for the largest share of around 57% of the overall market in 2020. The growth of the segment can be attributed to the continued introduction of electric light-duty commercial trucks and electric buses in the country. Electric buses are already gaining traction as the government is pursuing aggressive plans to have more and more electric vehicles plying on the roads to reduce vehicular pollution in major cities across the nation. Companies, such as Tata Motors, Mahindra and Mahindra Ltd, and Olectra Greentech Limited, are already offering electric light-duty commercial vehicles and electric buses in the country.

The passenger cars segment is projected to register a CAGR of over 106% over the forecast period. The diesel and gasoline-based passenger vehicle market is witnessing a shift toward electric passenger vehicles owing to increasing investments by the government in EV infrastructure, along with tax benefits offered to consumers. For instance, the Indian government's National Electric Mobility Mission Plan (NEMMP) 2020 envisages promoting the adoption of hybrid vehicles and electric vehicles while achieving national fuel security.

Key Companies & Market Share Insights:

The key players that dominated the market in 2020 include Hyundai Motor India, Tata Motors, Mahindra & Mahindra Ltd, Audi AG, BMW AG, MG Motor India Pvt. Ltd., and Olectra Greentech Limited. These market players are offering a wide range of electric vehicles including passenger cars, light commercial vehicles, and electric buses. The companies are particularly focusing on introducing advanced and technology-driven products in the market. They are also pursuing strategic initiatives, such as mergers and acquisitions, and strategic partnerships and collaborations, to strengthen their position in the market. For example, in October 2020, Uber, a ride-hailing company, announced a partnership with Lithium Urban Technologies, an electric vehicle fleet operator in India. The collaboration envisages the two companies deploying over 1,000 electric vehicles for Uber India's Rentals and Premier ser Some of the prominent players operating in the India electric vehicle market are :

- Audi AG
- BMW AG
- Hyundai Motor India
- Jaguar Land Rover Limited
- Mahindra & Mahindra Ltd
- Mercedes-Benz AG
- MG Motor India Pvt. Ltd.
- Olectra Greentech Limited
- Tata Motors
- Toyota Motor Corporation

India has become one of the fastest-growing EV markets in the world.

India now has millions of electric vehicle (EV) owners, with popular motorbikes, scooters and rickshaws representing more than 90 per cent of the vehicles.

Indeed over half of India's three-wheeler registrations in 2022 were electric, according to an IEA report released in April.

Analysts say the market is growing due in part to a $1.3 billion (€1.25 billion) government scheme to encourage EV manufacturing in the country and provide discounts for customers.

BENGALURU, India (AP) — Groceries stashed in the back of an electric delivery scooter are an increasingly familiar sight in the Indian city of Bengaluru. In crowded markets, electric rickshaws drop off and pick up passengers. And the number of tech startups focused on electric transport has shot up as the city — and country — embrace electric vehicles.

India is one of the fastest-growing electric vehicle markets in the world and now has millions of EV owners. More than 90% of its 2.3 million electric vehicles are the cheaper and more popular two- or three-wheelers — that's motorbikes, scooters and rickshaws — and over half of India's three-wheeler registrations in 2022 were electric, according to an IEA report released in April.

A $1.3 billion federal plan to encourage EV manufacturing and provide discounts for customers, along with the past decade's rising fuel costs and consumer awareness of the long-term cost benefits are combining to drive up sales, analysts say.

Electric vehicles are one solution to bring down planet-warming emissions and improve air quality — with road transport contributing significantly to global emissions. For the electric vehicles market to successfully slash carbon, experts say moving electricity generation away from fossil fuels, managing critical mineral supply chains and boosting EV sales across different socioeconomic backgrounds in the country will be key.

How do electric cars actually work and are they really better than traditional cars?

Rising fuel costs over the past decade and consumer awareness of the long-term cost benefits are also driving up sales.

Electric vehicles are touted as a solution to bring down greenhouse gas emissions and improve air quality.

For the electric vehicles market to successfully slash carbon, experts say moving electricity generation away from fossil fuels, managing critical mineral supply chains, and boosting EV sales across different socioeconomic backgrounds in the country will be key.

Sales of electric cars in the EU broke records in 2022. Which country in Europe is leading the way?

But he added that to make electric vehicles viable long-term, supply chains for critical minerals that manufacturers use to make batteries and other parts need to be secured. Electricity sources used to charge the vehicles also need to be cleaned up.

Currently, more than three-quarters of India's electricity is generated from fossil fuels - mostly coal - according to government reports.

And mining companies, including in India, have come under fire for unsafe mining practices of minerals needed to make components for electric vehicles and other clean energy infrastructure.

Thirumalai is optimistic about cleaner electricity in the future. The "huge thrust for renewables in the country" means electric vehicle emissions should be reduced in time.

- Unlike in the United States and China, India's electric vehicle market is dominated by two-wheel vehicles instead of four-wheel passenger cars.
- EVs make up only about 2% of total automobile sales in India, but the Indian government has targets to increase EV adoption in the next decade, focusing on raising purchases of two-wheel vehicles.
- Sales in India are expected to rise by between 40% and 45% by 2030, at which point 13 million new vehicles will be sold annually, according to projections from Bain & Co

When most people think about electric vehicles, they think cars.

From brands like Tesla and Rivian in the United States, to Nio and XPeng in China, global sales of electric vehicles have surged. Two million EVs were sold in just the first quarter of 2022 — that's a significant jump from a decade ago when sales hit only 120,000 cars worldwide, the International Energy Agency reported.

India's different. The United States and China have focused on the adoption of EV cars. But in India, the world's fifth-largest economy, two-wheel vehicles such as scooters, mopeds and motorbikes, dominate the market. James Hong, head of mobility research at Macquarie Group, said two-wheel vehicles are in higher demand than cars in India, and that shouldn't come as a surprise.

Underdeveloped road infrastructure and lower personal incomes make it more convenient and affordable for people to own scooters, motorbikes or mopeds, rather than cars, Hong said.

Still, adoption remains low.

EVs make up only around 2% of total automobile sales, but the Indian government has ambitious targets to increase EV adoption in the next decade, focusing on raising purchases of two-wheel vehicles.

Sales in India are expected to rise by between 40% and 45% by 2030, at which point 13 million new vehicles will be sold annually, according to projections from Bain & Company published in December.

India's four-wheel vehicle sector is poised to grow by only 15% to 20% by 2030, with 1 million new vehicles sold annually, the consulting firm said.

Growth of India's four-wheel EV segment is expected to be smaller because the cars are mostly owned only by drivers who travel out of the city on longer routes, said Arun Agarwal, deputy vice president of equity research at Kotak Securities.

Bain & Co. predicts that total revenue across the full supply chain of India's EV industry will generate $76 billion to $100 billion by 2030.

Reducing cost to increase adoption

People in India have long preferred two wheels to four, and the country is home to more than 10 startups serving the market, Agarwal said.

For India to increase purchases of two-wheel vehicles, they need to be cheaper, and more charging infrastructure needs to be in place, Jinesh Gandhi, equity research analyst at Motilal Oswal Securities, told CNBC.

Gandhi said that 90% of two-wheel vehicles with internal combustion engines cost between 70,000 rupees ($845) and 140,000 rupees ($1,690). The starting price of electric two-wheel vehicles can be as high as 160,000 rupees.

SEGMENTATION

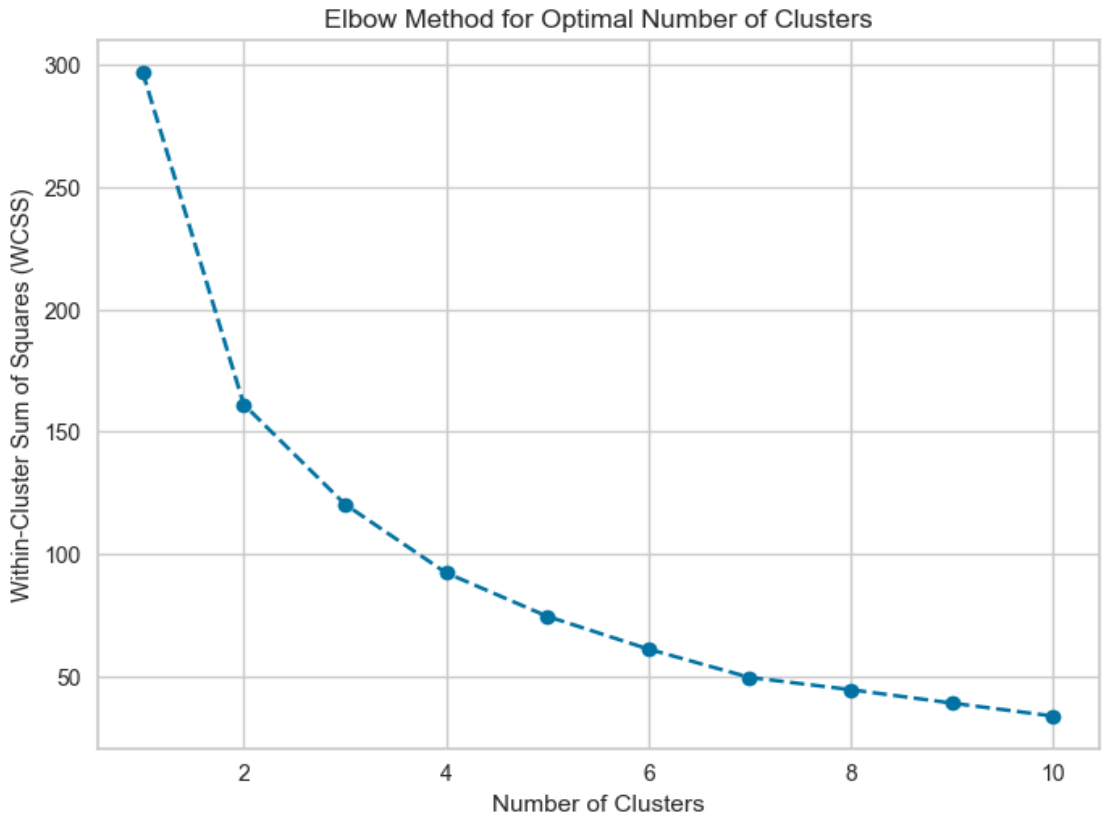
Customer Behavioural Segmentation:

Electric Vehicle Market Segmentation Analysis Introduction The provided data has been subjected to a comprehensive market segmentation analysis to identify potential target audiences for electric vehicle (EV) sales. The analysis utilized K-Means clustering, dimensionality reduction techniques, and validation methods to distinguish distinct customer segments based on age, total salary, and price preferences.

Optimal Number of Clusters To determine the optimal number of clusters for market segmentation, two primary methods were employed:

1. Elbow Method The Elbow method helps in identifying the appropriate number of clusters based on the within-cluster sum of squares (WCSS). The plot of WCSS against the number of clusters exhibits an 'elbow' point, which is indicative of the optimal cluster count.

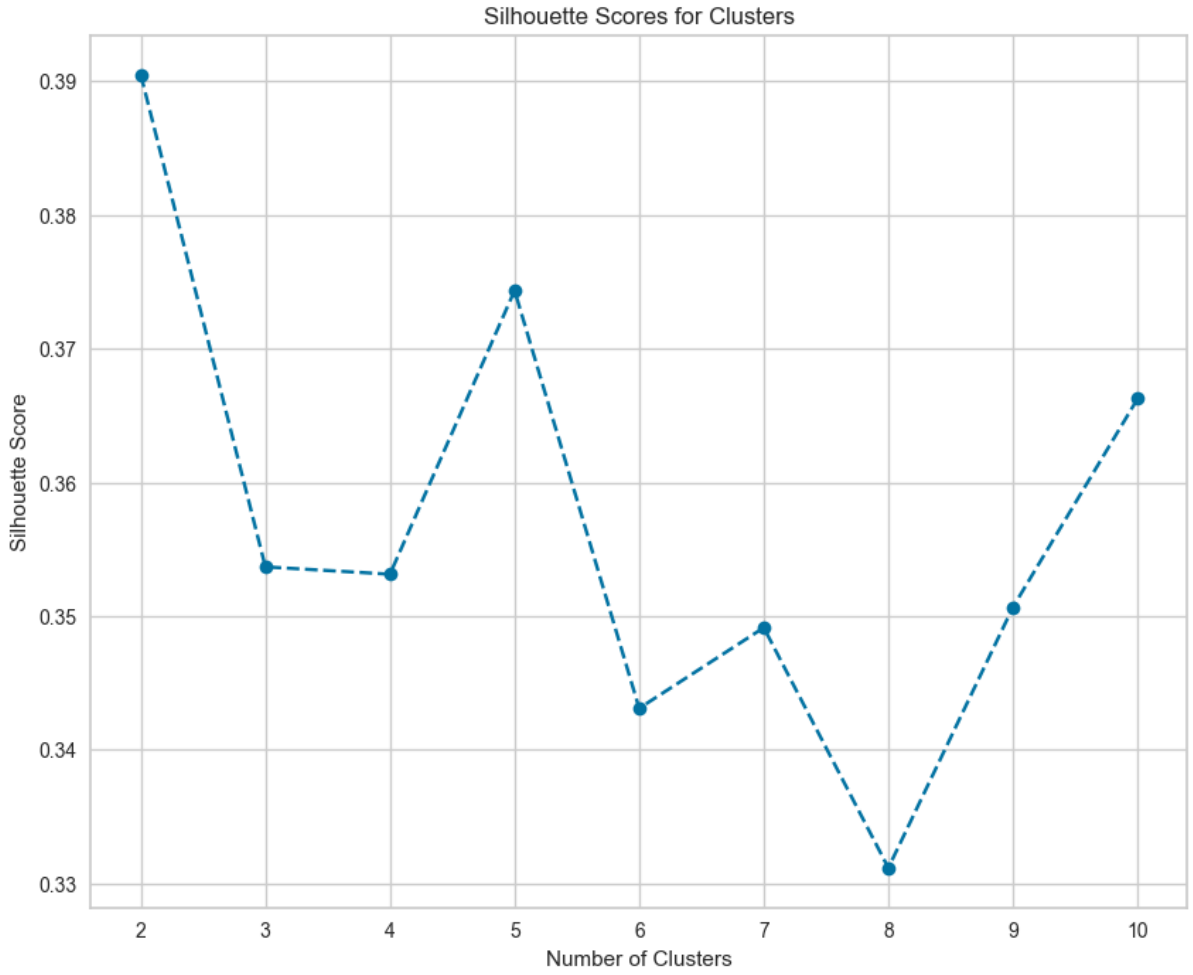
Elbow Method:



The Elbow method suggested an optimal number of clusters around 4.

2. Silhouette Analysis Silhouette analysis is a measure of how similar an object is to its cluster compared to other clusters. Higher silhouette scores indicate better-defined clusters.

Silhouette Analysis:



The silhouette scores indicated that 4 clusters provide well-defined segments.

Identified Clusters Based on the optimal cluster count of 4, the following clusters were identified:

Cluster 0: Affordable Enthusiasts Target Audience: Individuals with moderate age and total salaries. Price Preferences: Strong preference for affordable EV models. Selling Strategy: Emphasize cost-effectiveness and long-term savings.

Cluster 1: Young Professionals Target Audience: Relatively young individuals with moderate to high total salaries. Price Preferences: Willing to invest in mid-priced EV models. Selling Strategy: Highlight advanced technology, performance, and urban suitability.

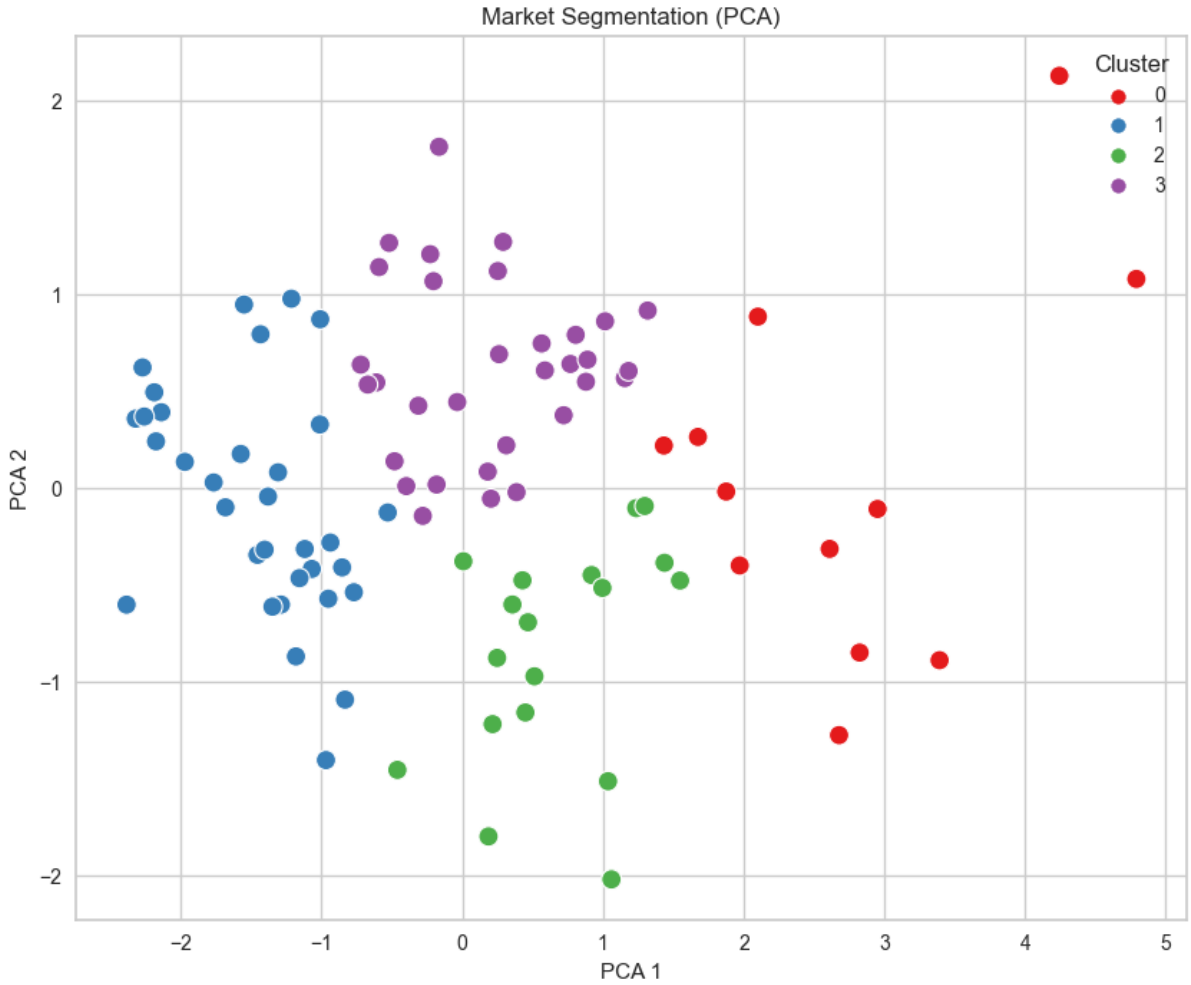
Cluster 2: Luxury Buyers Target Audience: Older individuals with high total salaries. Price Preferences: Strong interest in high-end, luxury EV models. Selling Strategy: Emphasize premium quality, advanced features, and environmental consciousness.

Cluster 3: Budget-Conscious Shoppers Target Audience: Diverse age range with low to moderate total salaries.

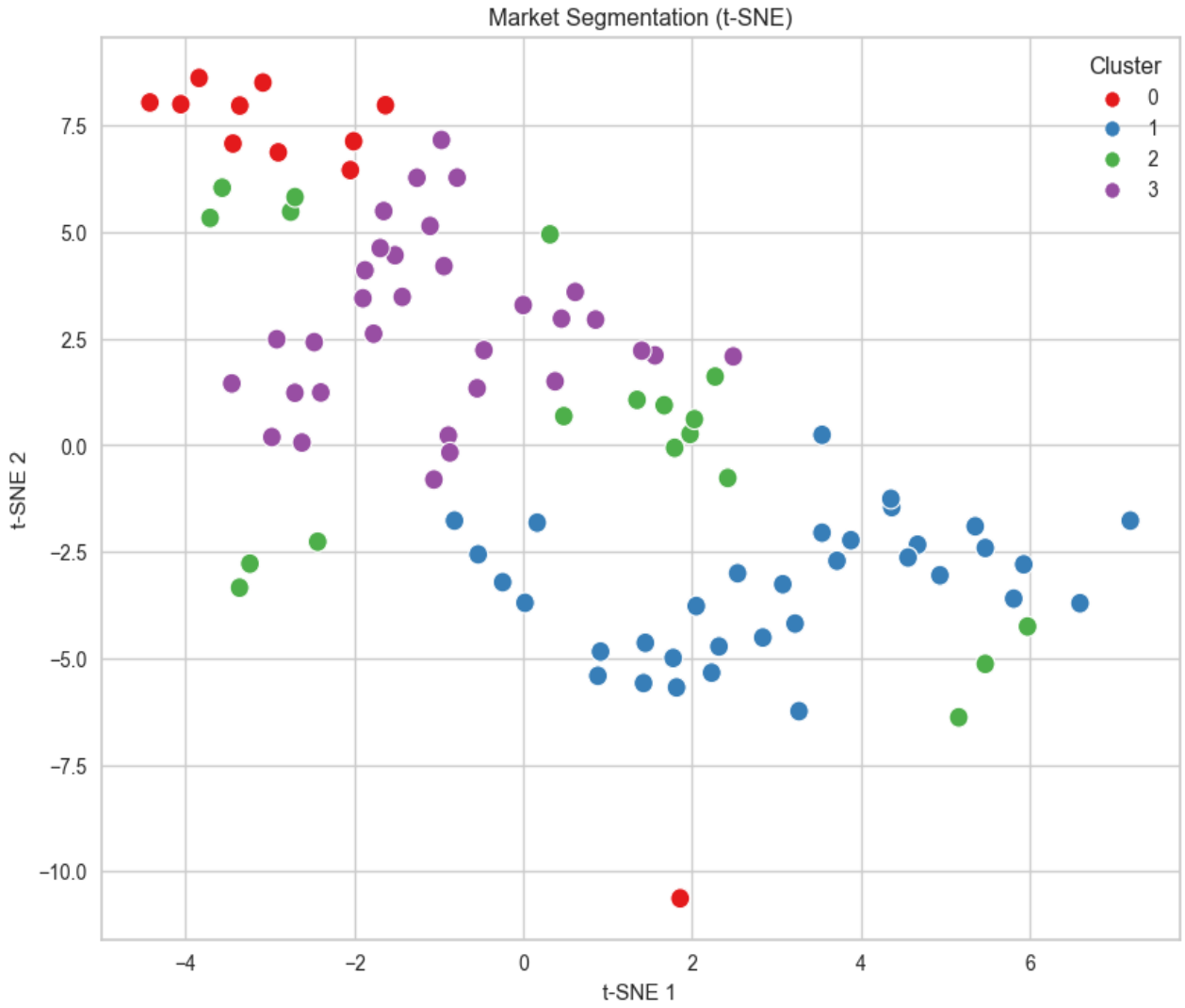
Price Preferences: Focused on cost-effective EV options. Selling Strategy: Highlight affordability and government incentives.

Visualization The clusters were visualized using dimensionality reduction techniques, including Principal Component Analysis (PCA) and t-Distributed Stochastic Neighbor Embedding (t-SNE).

PCA Visualization

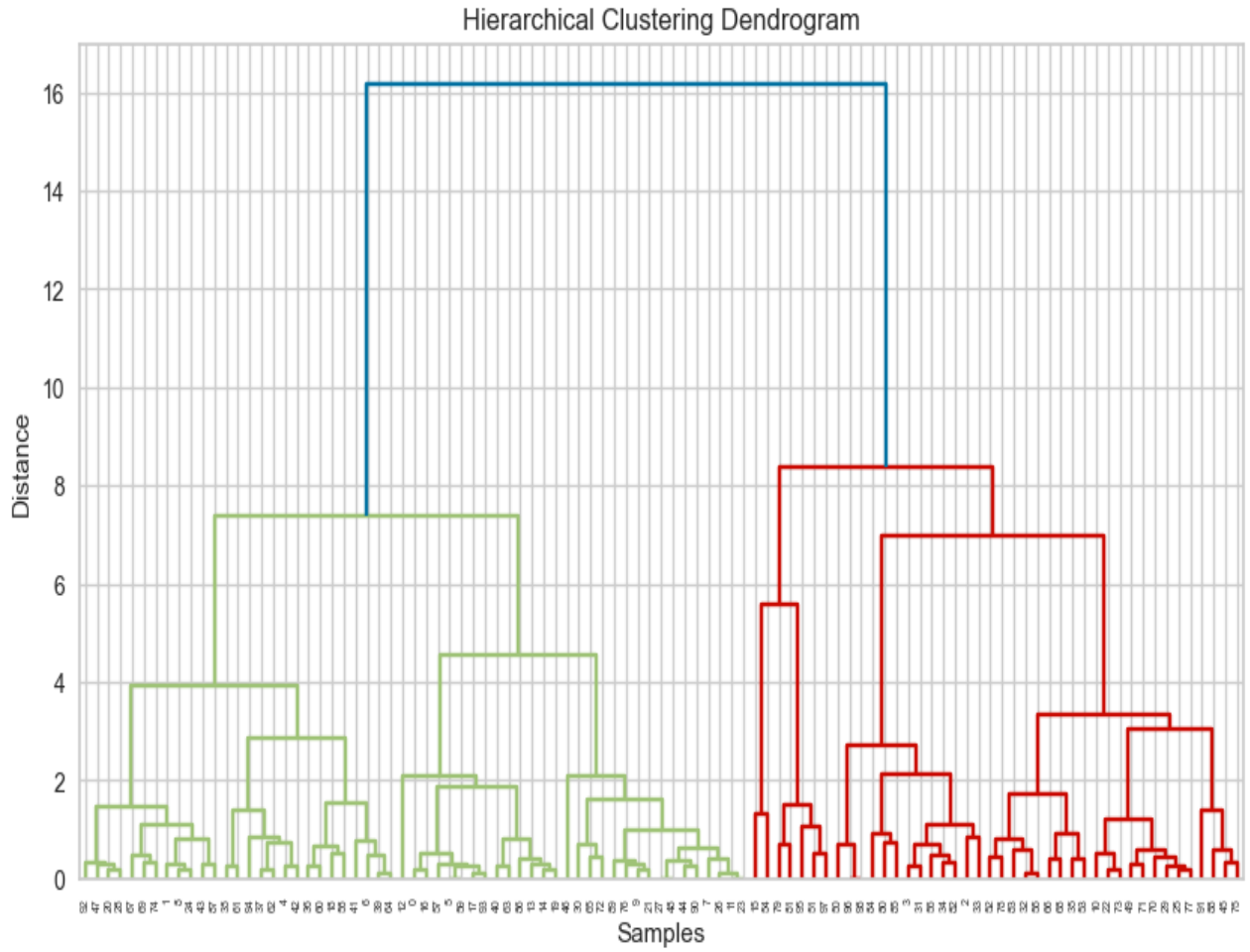


t-SNE Visualization:



Hierarchical Clustering Hierarchical clustering using dendrograms was also performed to gain insights into the relationship between data points. This dendrogram visually represents the clustering process.

Hierarchical Clustering



Conclusion:

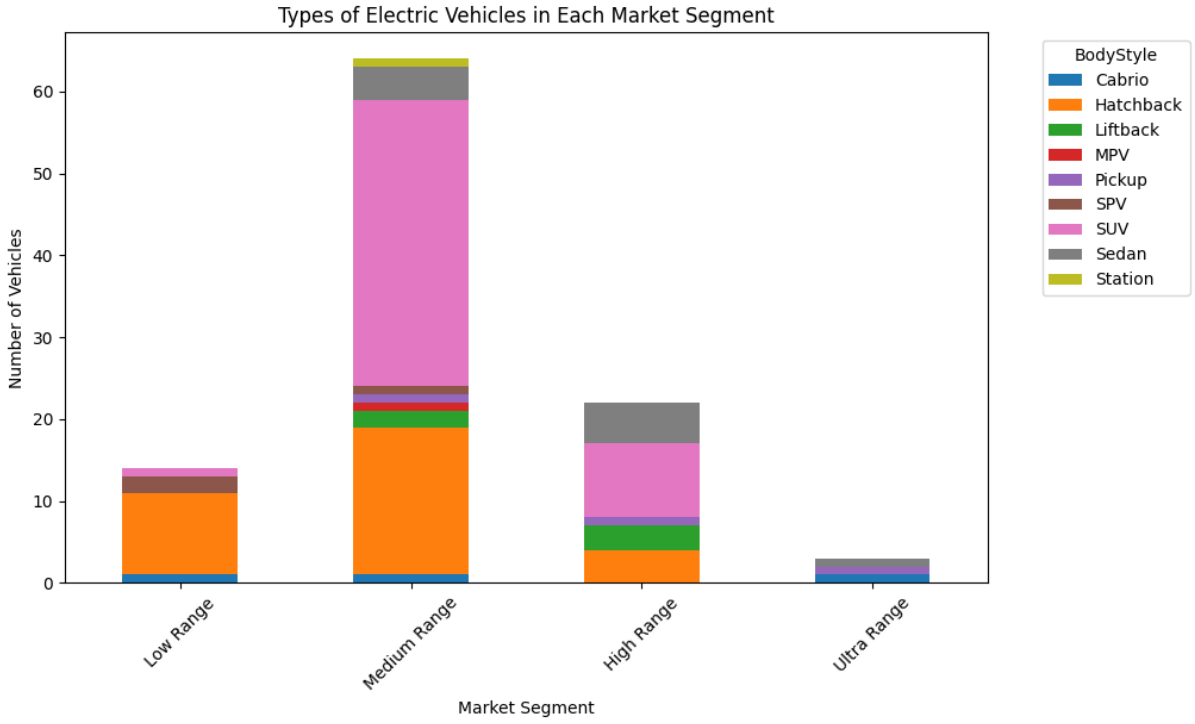
The market segmentation analysis has identified distinct customer segments within the electric vehicle market. Each cluster has unique characteristics, and businesses can tailor their marketing and sales strategies to target these specific audiences effectively.

To maximize sales and market penetration, it is essential to address the needs, preferences, and price points of each cluster individually. Customized marketing campaigns, pricing strategies, and product offerings can help in reaching these target audiences successfully.

Overall, this analysis provides valuable insights for businesses looking to sell electric vehicles and highlights the importance of understanding their potential customers' diverse requirements.

Vehicle Segmentation:

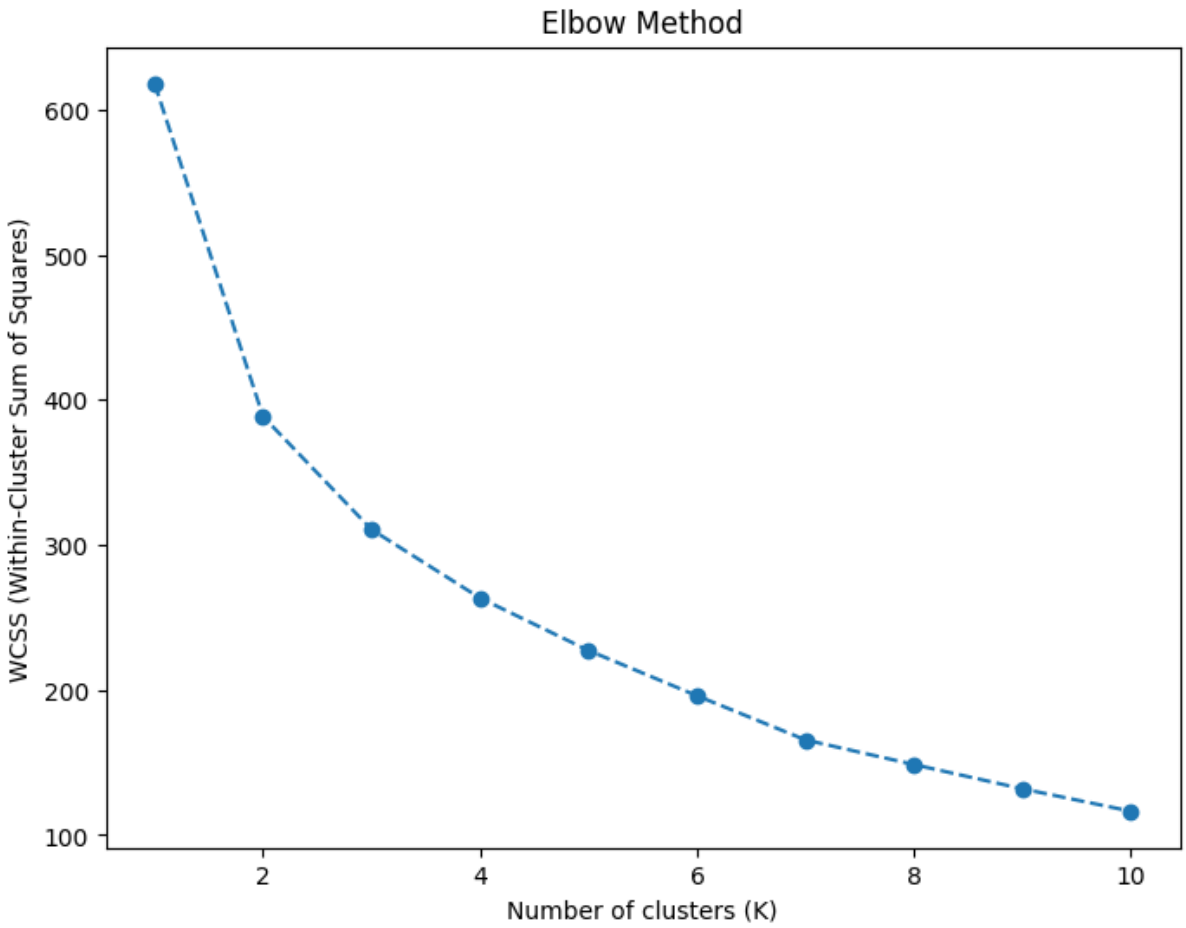
The dataset used for this analysis contains information about various electric vehicles, including attributes such as acceleration time, top speed, range, efficiency, number of seats, and price. These attributes are crucial in understanding the characteristics of different EV models.



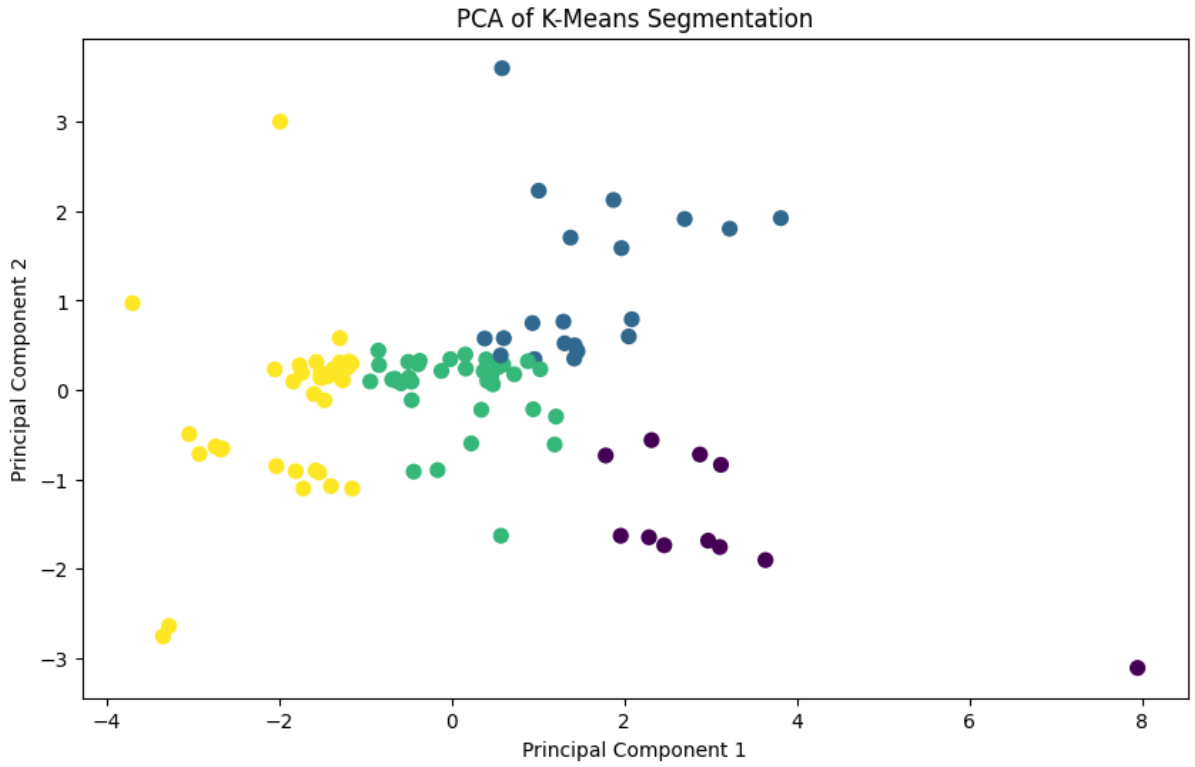
K-Means Clustering: K-Means clustering is a powerful unsupervised learning technique that groups data points into clusters based on similarity. In this analysis, we applied K-Means clustering to the dataset with the goal of identifying distinct segments of electric vehicles. We used the following attributes for clustering:

Acceleration Time (AccelSec) Top Speed (TopSpeed_KmH) Range (Range_Km) Efficiency (Efficiency_WhKm) Number of Seats (Seats) Price (INR) We chose to create 4 clusters, which can represent different types of EVs offered by companies. The K-Means clustering results were stored in the 'KMeans_Segment' column in the dataset.

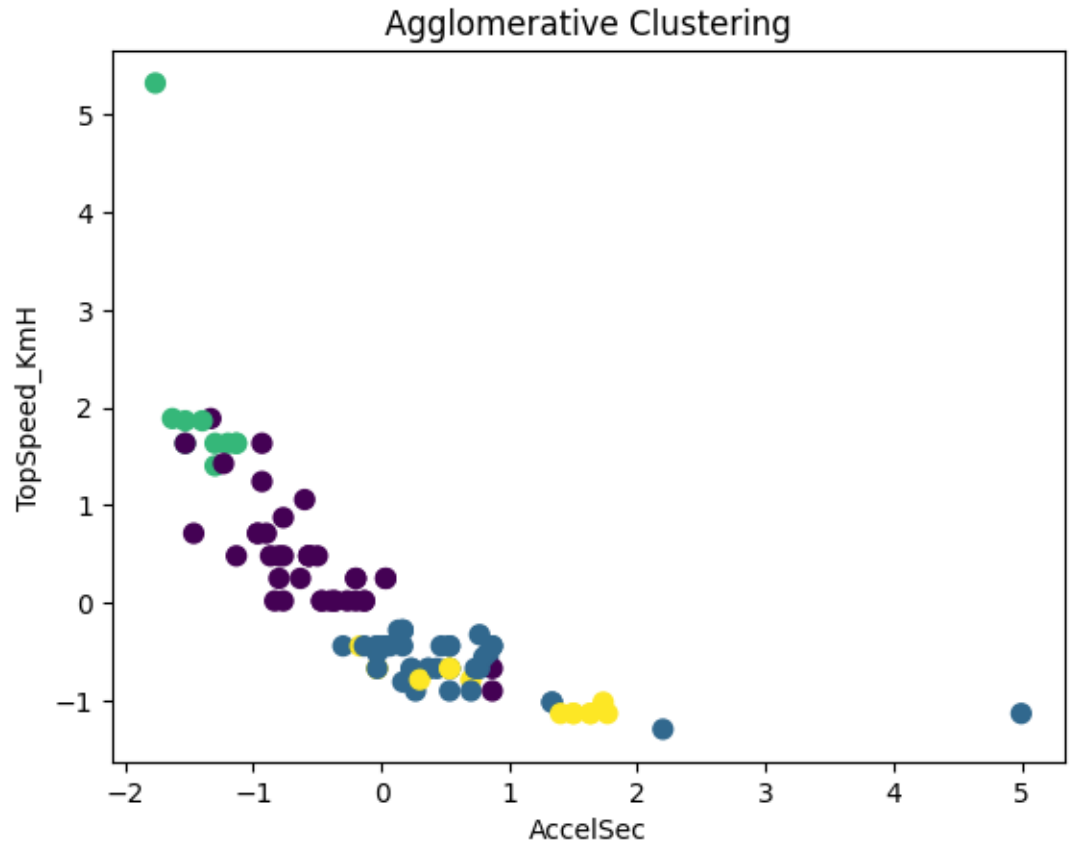
Elbow Method



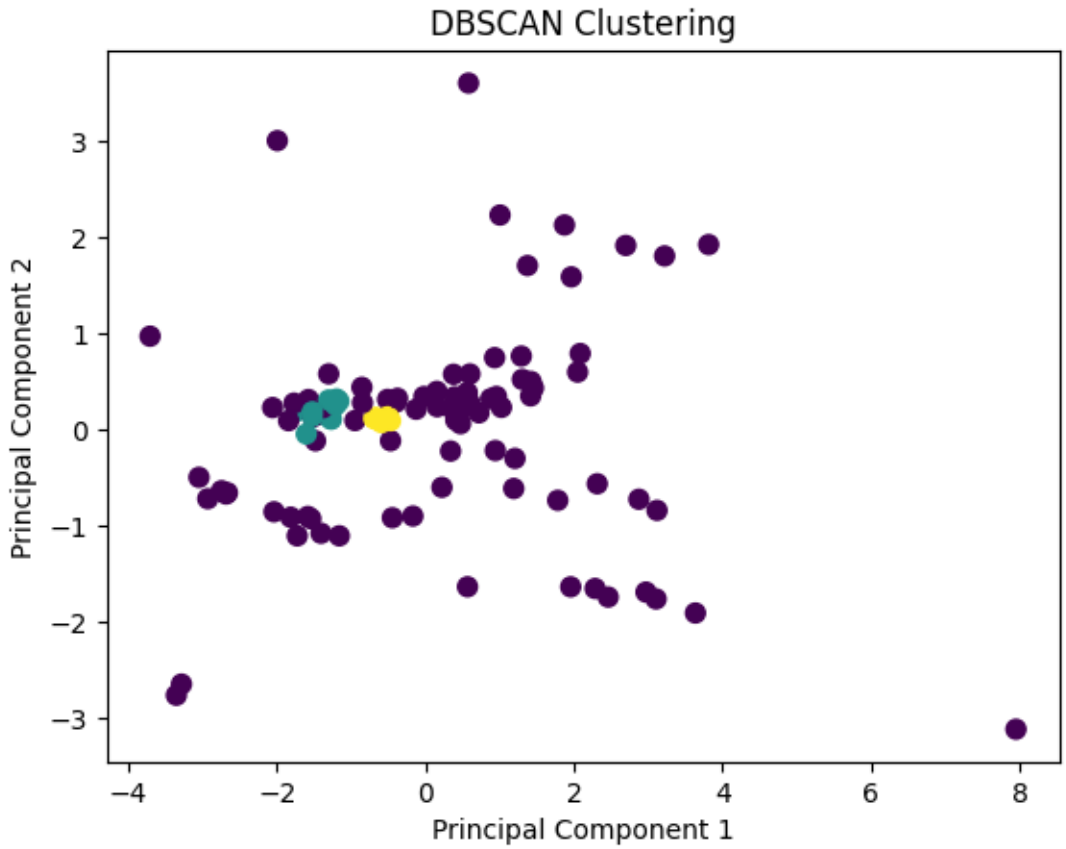
PCA Visualization: Principal Component Analysis (PCA) is a dimensionality reduction technique that allows us to visualize the data in a lower-dimensional space while preserving as much variance as possible. We used PCA to visualize the clustering results in a 2D scatter plot. Each data point in the plot represents an electric vehicle, and the color of the point corresponds to its K-Means cluster. This visualization helps us understand the separability of clusters and how different attributes contribute to the segmentation.



Agglomerative Clustering

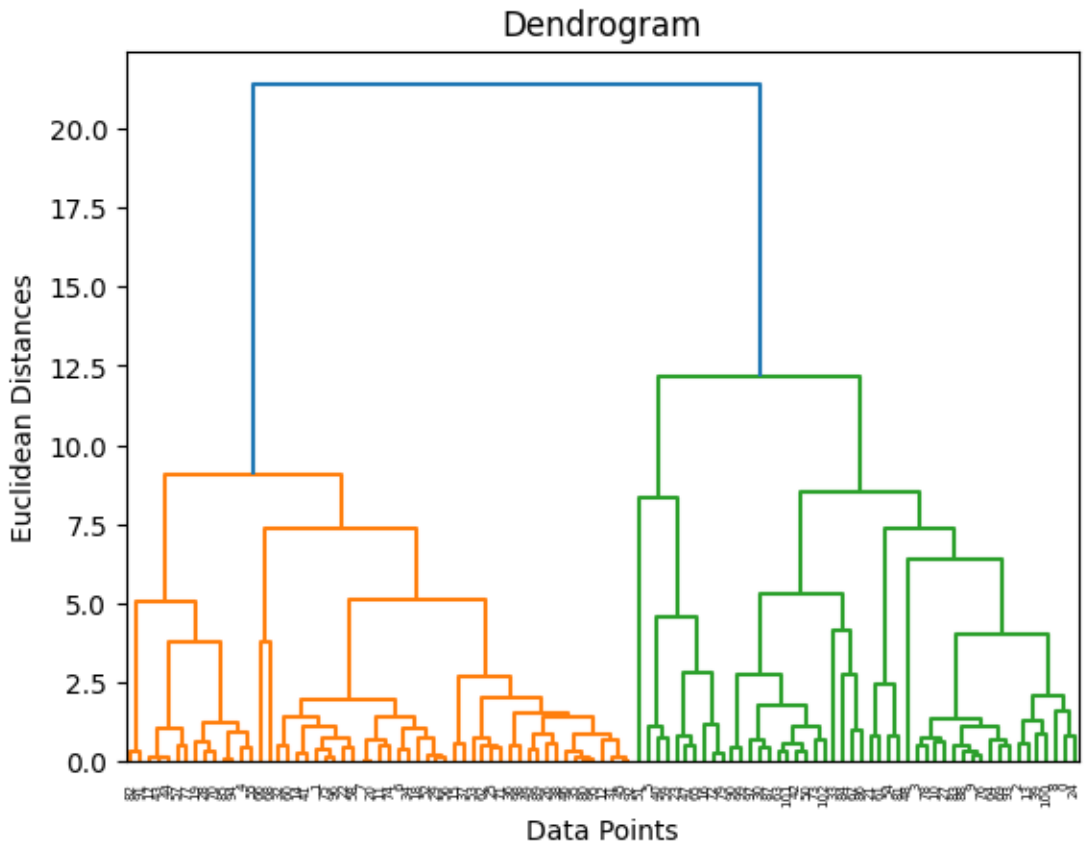


DBSCAN Clustering: In addition to K-Means, we applied Density-Based Spatial Clustering of Applications with Noise (DBSCAN) to the dataset. DBSCAN is a density-based clustering algorithm that identifies clusters based on data density and noise points. The resulting segments were stored in the 'DBSCAN_Segment' column in the dataset. DBSCAN provides an alternative clustering perspective and is particularly effective when clusters have irregular shapes.



DBSCAN Visualization: Similar to the PCA visualization for K-Means, we created a scatter plot for DBSCAN. This scatter plot shows data points in a 2D space based on the first two principal components, with each point colored according to its DBSCAN cluster. DBSCAN provides insights into clustering based on the density of data points, and it does not require specifying the number of clusters in advance.

Hierarchical Clustering



Conclusion:

The combination of K-Means clustering, PCA, DBSCAN, and various visualizations offers a comprehensive view of the market segmentation of electric vehicles. This analysis can be a valuable resource for automotive companies, policymakers, and consumers seeking to understand the diverse landscape of electric vehicles and make informed decisions in the rapidly evolving EV market. It serves as a foundation for identifying potential market niches and tailoring EV offerings to meet specific consumer needs.