



# **EV Product Analysis**

## **(Market Segmentation)**

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### **1.0 Introduction**

It is abundantly clear that India is completely focused on and committed to developing its EV ecosystem as soon as possible, as evidenced by the new budget's emphasis on the infrastructure for EV charging. In this blog, we'll look at how to take advantage of various business opportunities in the Indian EV market. Low-speed 2 W EVs currently dominate the Indian market.

Electric vehicles have taken the world by storm in recent years, led by Tesla, which now has \$11.8 billion in global revenue. By 2030, India is forecast to be the leader in the electric car market, accounting for 30% of all new vehicles sold. The government has proposed installing charging stations every 3 kilo-meters in major cities and every 50 kilo-meters on important national highways.

The EV industry will have a significant impact on the vehicle component manufacturing industry, which generates over 30 million jobs and employs over 8,000 micro, small, and medium-sized enterprises (MSMEs).

### **1.1 Problem Statement**

The Electric Vehicle Startup is in the process of determining which vehicle/customer segments to target for its EV offerings in India. The objective is to analyze the EV market using segmentation analysis to identify the most promising segments for market entry. This involves assessing various factors such as geographic location, demographic characteristics, psychographic profiles, and behavioral patterns of potential customers. The startup aims to develop a feasible strategy to effectively enter the market and target the segments most likely to adopt EVs.

## 1.2 Key factors influencing the EV market include:

- **Charging infrastructure:** Without charging infrastructure, it can be difficult for EV drivers to travel long distances or use their EVs as their primary mode of transportation.
- **EV affordability:** Affordability is a key driver of EV adoption, especially among cost-conscious consumers.
- **Battery production:** The performance and cost of EVs are significantly affected by the performance and life of battery packs.
- **Government :** The government is a vital stakeholder in the e-mobility ecosystem, establishing policies and regulations, and deploying authorities to enforce the law.
- **Car technology:** Factors related to car technology, such as the range and lifetime of batteries, influence EV purchase.
- **Test drive experience:** The test drive experience can be an important tipping point for potential EV purchasers.

## 2.0 Key Questions on the business domain

Here are the key questions we've answered that can help a client understand and make informed decisions when starting an EV business:

- Which EV models are similar in terms of features and specifications?
- What are the major market segments for EVs based on product features?
- Which features are most important for differentiating between EV models?
- What is the overall trend in the consumption of EV vehicles over the years?
- Which EV categories (e.g., E-2 Wheelers, E-4 Wheelers, E-Buses) are seeing the most growth?
- What is the market share of different EV categories?
- Are there any emerging trends in specific categories that indicate potential for new opportunities?
- Which electric two-wheelers are positioned in the market as premium models based on price and performance?
- Which models offer the highest riding range (km) on a full charge?
- What is the price range for electric two-wheelers in the current market?

## 3.0 Data Collection

The analysis of the Electric Vehicle (EV) product and market in India in this report is based on three datasets collected from Kaggle.

- Year wise trends in EV market : [kaggle/input/electric-vehicle-2023/smev\\_data.xlsx](https://www.kaggle.com/input/electric-vehicle-2023/smev_data.xlsx)
- EV4 Wheelers Dataset : <https://www.kaggle.com/datasets/kkhandekar/electric-vehicles-india/code>
- EV 2Wheelers Dataset: <https://www.kaggle.com/datasets/atom1991/electric-vehicle-2023>

### 3.1 Dataset Overview:

#### 3.1.1 EV 4 Wheelers Dataset

This dataset contains detailed information about various 4-wheeler electric vehicles (EVs) available in the market. Each row represents a different EV model, and the columns describe various features of these models. Here's a breakdown of the columns:

1. **Car:** The name of the EV model (e.g., Tata Nexon EV, Audi E-Tron GT).
  2. **Style:** The body style or segment of the vehicle (e.g., Compact SUV, Premium Midsize Sedan, Premium Coupe).
  3. **Range:** The distance the vehicle can travel on a full charge, usually measured in kilo-meters per full charge (e.g., 312 Km/Full Charge, 470 Km/Full Charge).
  4. **Transmission:** The type of transmission the vehicle uses, which in this case is consistently Automatic.
  5. **Vehicle Type:** The type of vehicle, which is Electric for all entries in this dataset.
  6. **Price Range:** The price range of the vehicle, likely in Indian Rupees (e.g., ₹ 13.99 - 17.4 L, ₹ 1.06 - 1.12 Cr). The "L" stands for lakhs (100,000), and "Cr" stands for crores (10 million).
  7. **Capacity:** The seating capacity of the vehicle (e.g., 5 Seater).
  8. **Boot Space:** The storage or trunk capacity of the vehicle, measured in litre (e.g., 350 L, 656 L). 'na' indicates data is not available.
  9. **Base Model:** The name of the base model variant (e.g., XM, XE).
  10. **Top Model:** The name of the top model variant (e.g., Dark XZ Plus LUX, Sportback 55).
- 'na' indicates data is not available.

#### 3.1.2 EV 2 Wheelers

The analysis indicates a clear positive correlation between the price of electric two-wheelers and their riding range. Higher-priced models generally offer a longer riding range, suggesting that manufacturers position models with superior battery technology and extended range as premium offerings. This is critical for potential investors and businesses as it highlights the importance of range in justifying higher price points. In a market where consumers are increasingly concerned with the convenience and reliability of electric vehicles, the range becomes a crucial selling point. It consists of 39 rows and 7 columns.

1. **Model Name:** The name of the electric two-wheeler model.
2. **Price (INR):** The cost of the vehicle in Indian Rupees
3. **Riding Range (km):** The distance the vehicle can travel on a single charge, measured in kilo meters.
4. **Top Speed (kmph):** The maximum speed the vehicle can achieve, measured in kilometers per hour.
5. **Weight (kg):** The weight of the vehicle in kilograms.
6. **Battery Charging Time (hrs):** The time it takes to fully charge the vehicle's battery, measured in hours.
7. **Rated Power (W):** The power rating of the vehicle's motor, measured in watts.

### 3.1.3 Year Wise Trends

This dataset tracks the rise in the number of electric vehicles (EVs) across different categories over several financial years. It provides insights into the trends and growth rates within the EV market. Here's a breakdown of the features:

1. **Category:** The type of EV being tracked, which could include categories like:
  - **E-2 Wheelers:** Electric two-wheelers, such as scooters and motorcycles.
  - **E-3 Wheelers:** Electric three-wheelers, often used for commercial purposes or as autorickshaws.
  - **E-4 Wheelers:** Electric four-wheelers, which include personal cars and commercial vehicles.
  - **E-Buses:** Electric buses used for public transportation.
2. **Financial Year:** The fiscal year during which the data was recorded, usually formatted as YYYY-YY (e.g., 2017-18, 2018-19).
3. **Num\_Vehicles:** The number of vehicles sold or registered in the given category during the financial year. This metric is used to analyse the growth trend of different EV categories over time.

## 4.0 Exploratory Data Analysis (EDA)

Exploratory Data Analysis (EDA) is a crucial step in understanding the structure, patterns, and insights within the dataset. A comprehensive analysis of the three datasets was performed to understand the trends and extract answers of the domain for business.

### 4.1 EV 4 Wheelers

**Data Overview:** This dataset includes information on 'Automatic' and 'Electric' cars of different companies and their models along with their prices and range. It is important to know the technology, shape and size of the car model to be able to decide which vehicle should be chosen for marking market entry. The dataset contains 12 entries and 10 columns.

#### Key Observations:

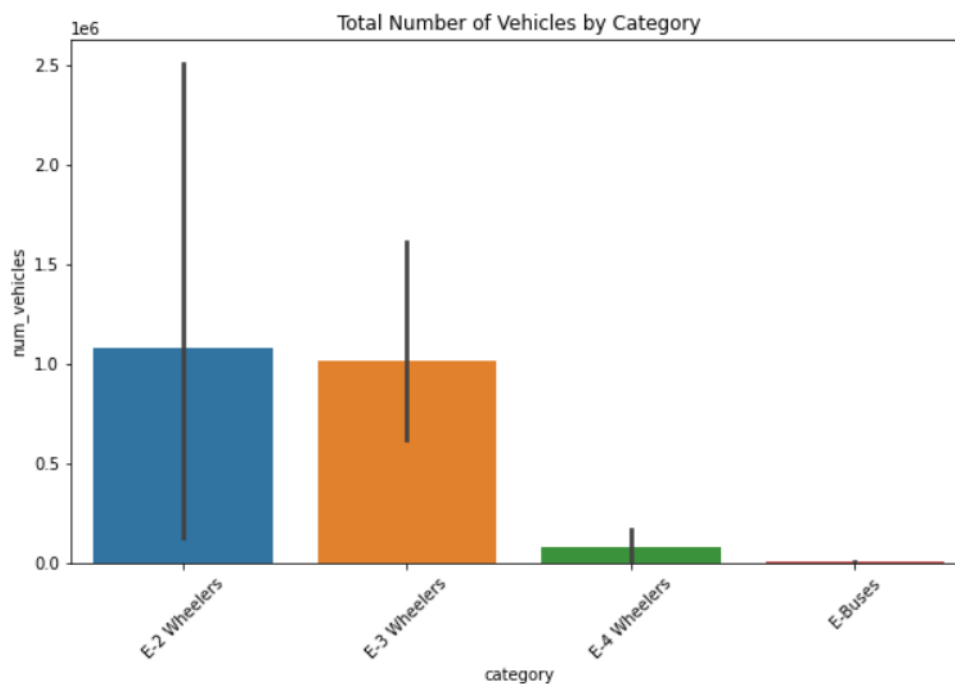
- **Cars:** There are 12 unique car models
- **Price Range:** There are both high value cars such as Audi, BMW and Porche as well as balanced budget models like Tata Tigor Ev.
- **Range:** Range of cars is an important feature to estimate their performance. Through the analysis, it was found that there was no correlation between Range and Price in the dataset. Yet both are crucial independent features in the process of clustering.

## 4.2 Year Wise Trends

**Data Overview:** This contains the market production and purchasing information of different vehicles in the years 2017 to 2023. It covers the broader categories of vehicles without diving deep into particular model information.

### Key Observations:

- **Manufacturing of each category vehicle:** The E-3 and E-2 vehicles were the most manufactured categories of vehicles. There is barely any difference in their numbers over these years. However, E-4 vehicles seem to have not made a popular entry as of yet.



## 4.3 E2 Wheelers:

### Key Observations

- **Price vs. Riding Range:** There is a positive correlation between the price of an electric two-wheeler and its riding range. Generally, models that offer a longer range are more expensive. This suggests that the riding range is a significant factor contributing to the pricing of these vehicles, likely due to the cost of more advanced battery technology.
- **Top Speed and Rated Power:** Higher top speeds and rated power are associated with higher prices. This indicates that performance features such as speed and power are positioned as premium attributes in the market. Models that are both powerful and fast tend to be in the higher price bracket, appealing to consumers looking for high-performance vehicles.
- **Market Segmentation:** The data reveals distinct market segments:
  - **Budget Models:** These typically have lower prices, moderate riding ranges, and lower top speeds. They are likely designed for cost-conscious consumers or those who need a basic, reliable vehicle for short commutes.

- **Premium Models:** These feature higher prices, extended riding ranges, faster speeds, and more powerful motors. They target consumers who prioritize performance and are willing to pay a premium for advanced features.

## 5.0 Product Analysis

Our first dataset provided a detailed overview of various EV models available in the market, including features such as vehicle style, range, transmission type, price range, seating capacity, and boot space. This data is critical for understanding the diversity within the EV market, allowing us to segment vehicles based on these characteristics.

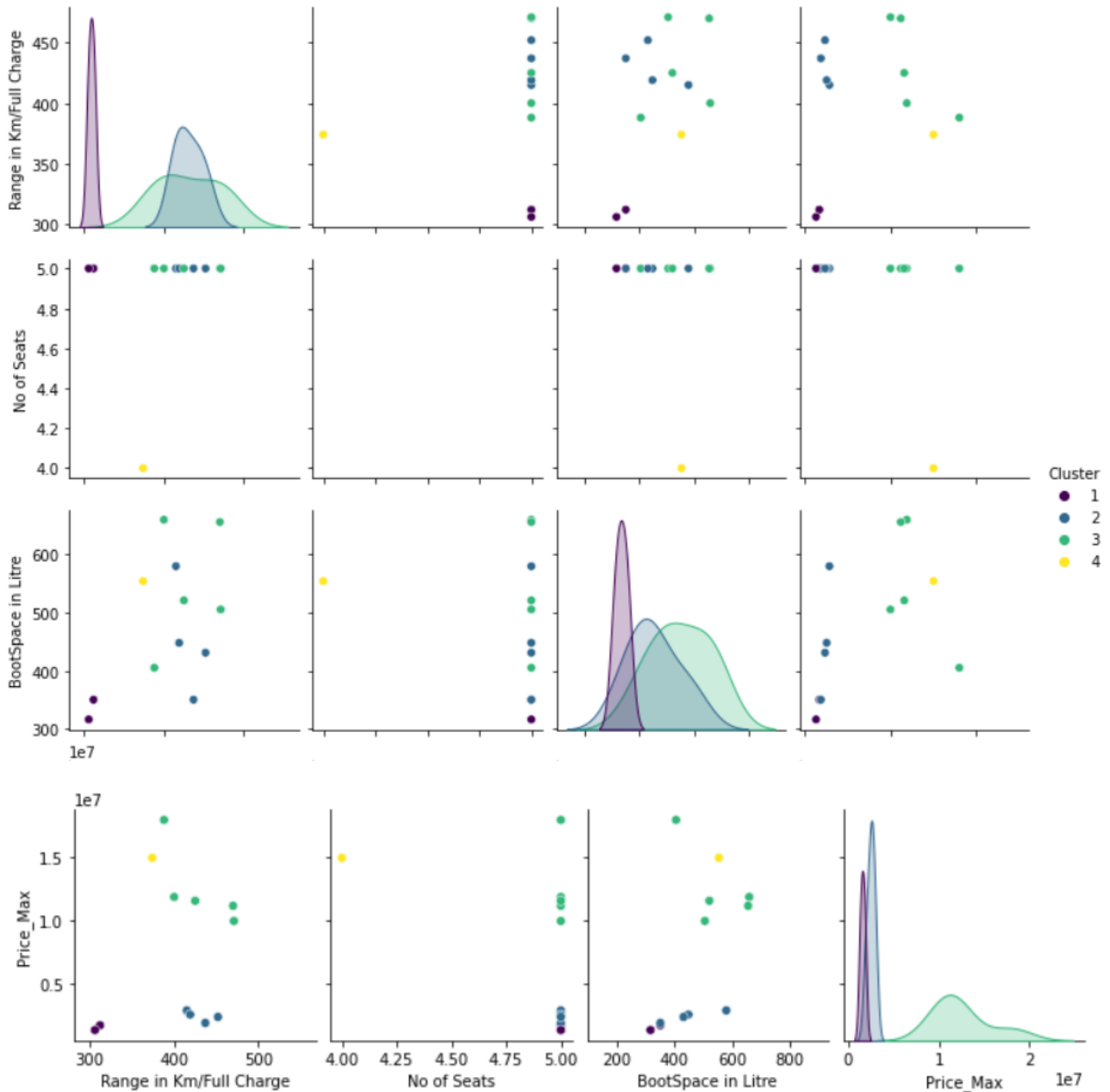
By analysing this data, we identified clusters of vehicles that cater to different market segments. For instance, compact SUVs like the Tata Nexon EV and MG ZS EV are positioned as mid-range options, balancing price with range and utility, appealing to urban commuters. On the other hand, premium models like the Jaguar I-Pace and Porsche Taycan target the luxury segment, offering higher ranges and advanced features.

The second dataset tracked the rise in EV consumption across various categories, including two-wheelers, three-wheelers, four-wheelers, and buses, over recent financial years. Our analysis revealed a significant upward trend in the adoption of EVs, particularly in the four-wheeler and two-wheeler segments, reflecting the growing consumer acceptance and demand for electric mobility.

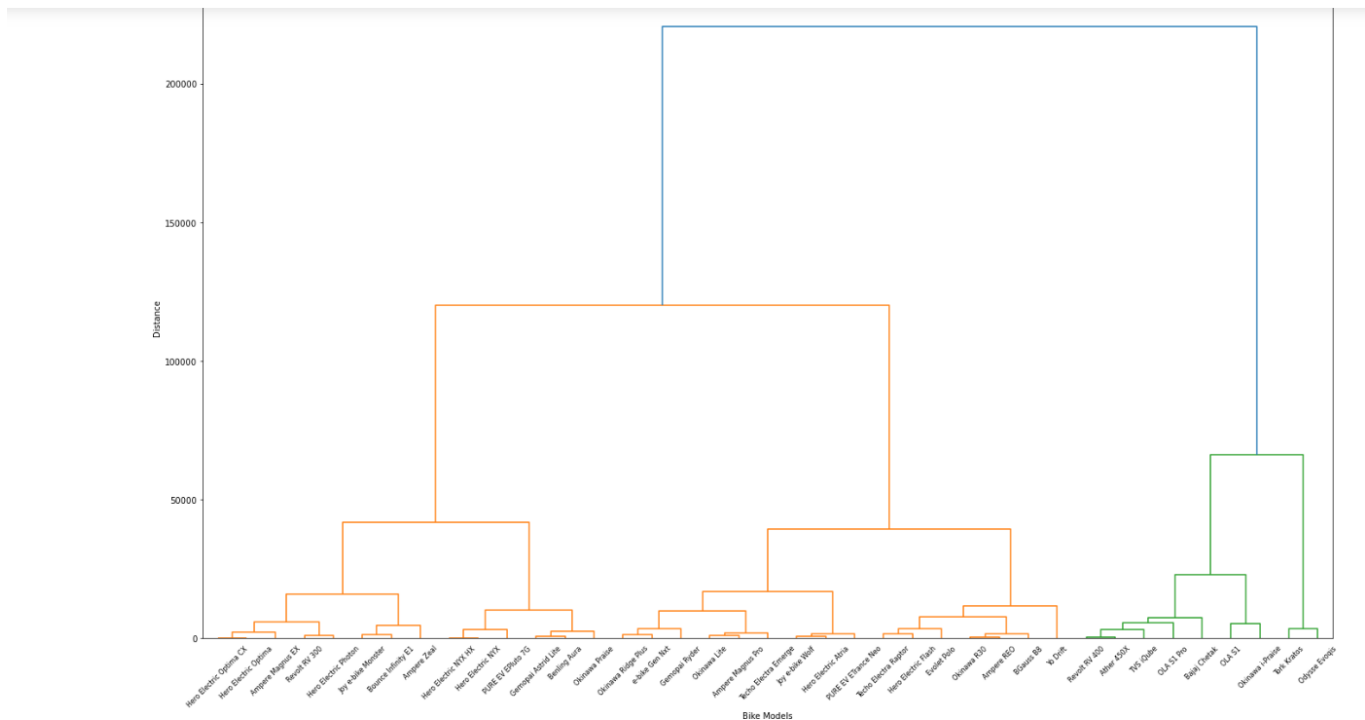
We observed that financial incentives, policy support, and technological advancements have played a crucial role in this growth. The data showed a dramatic increase in the number of electric two-wheelers and four-wheelers, with a notable spike in the most recent financial years, indicating a rapidly maturing market.

## 5.1 Which EV models are similar in terms of features and specifications?

**4 Wheelers:** From the dataset of 4 Wheelers, it was found that the high-end, long ranged EVs and compact ones with unique features show considerable familiarity.



- 2 **Wheelers:** All models within a specific low-level branch or cluster can be considered similar to each other. These groups represent EV two-wheelers with closely related features such as price, riding range, top speed, battery charging time, and rated power.



## 5.2 Which features are most important for differentiating between EV models?

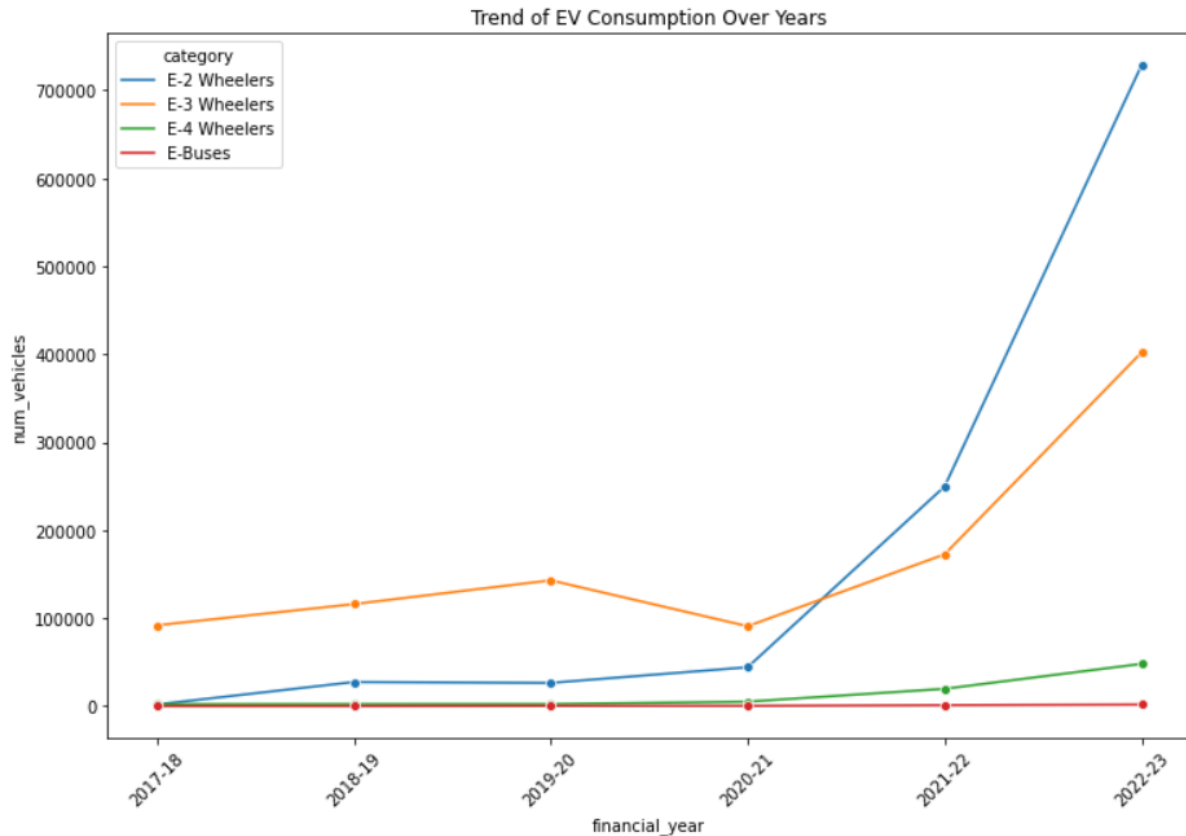
**4 Wheelers:** Range is the most important feature in our 4 wheeler dataset because it is the model with a short range that stands out of clustered data points.

**2 Wheelers:** All the listed features are important as they create clusters with minimum overlaps.

- **Model Name:** The name of the electric two-wheeler model.
- **Price (INR):** The cost of the vehicle in Indian Rupees.
- **Riding Range (km):** The distance the vehicle can travel on a single charge, measured in kilo-meters.
- **Top Speed (kmph):** The maximum speed the vehicle can achieve, measured in kilo-meters per hour.
- **Weight (kg):** The weight of the vehicle in kilograms.
- **Battery Charging Time (hrs):** The time it takes to fully charge the vehicle's battery, measured in hours.
- **Rated Power (W):** The power rating of the vehicle's motor, measured in watts.



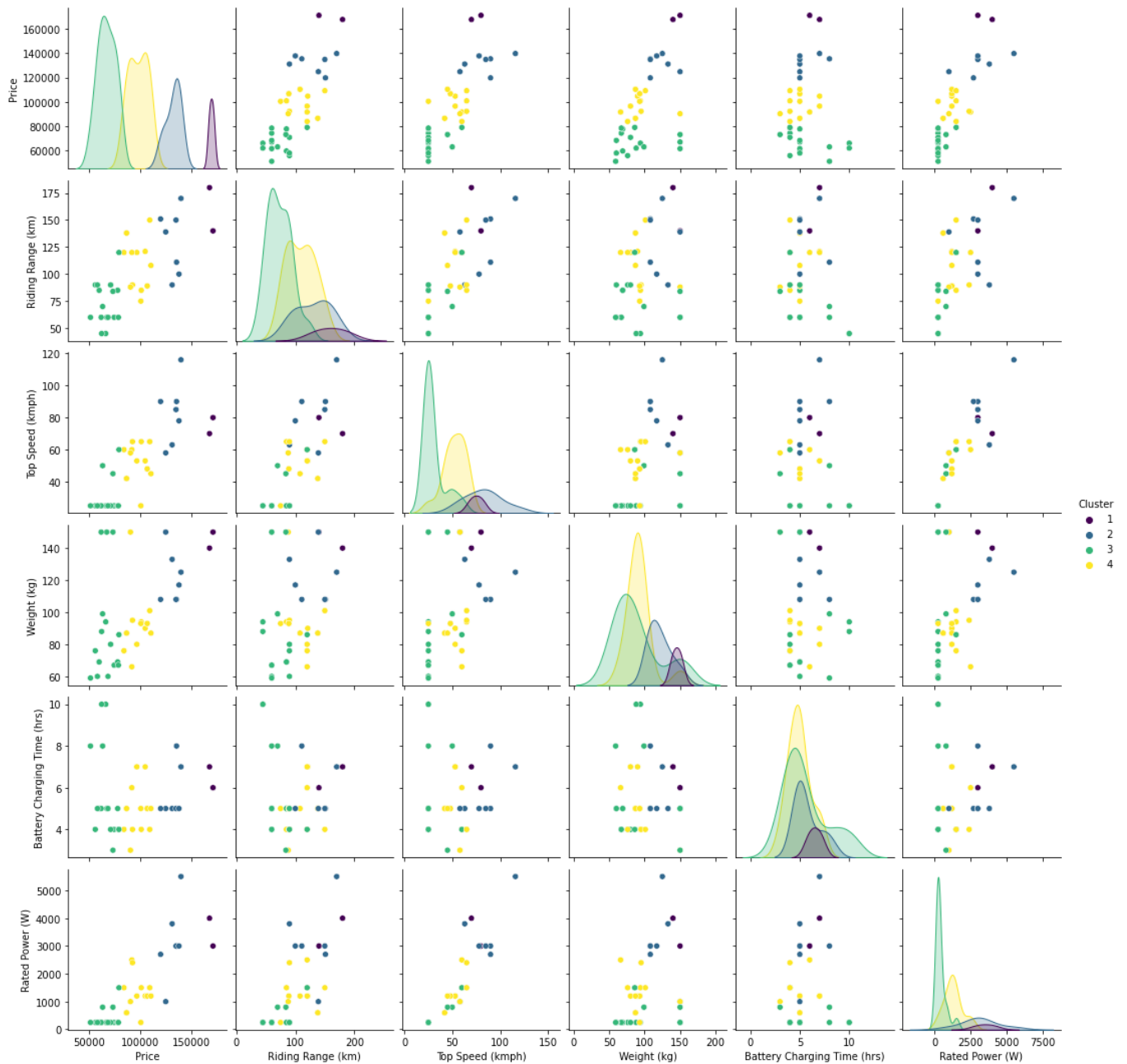
### 5.3 What is the overall trend in the consumption of EV vehicles over the years?



### 5.4 Which electric two-wheelers are positioned in the market as premium models based on price and performance?

	Price	Riding Range (km)	Top Speed (kmph)	Weight (kg)	Battery Charging Time (hrs)	Rated Power (W)	Score	Model Name
29	0.738490	0.925926	1.000000	0.725275	0.571429	1.000000	0.518437	OLA S1 Pro
28	0.572031	0.785185	0.714286	0.538462	0.285714	0.466667	0.378339	OLA S1
33	0.698101	0.777778	0.659341	0.538462	0.285714	0.523810	0.371062	Revolt RV 400
36	0.971654	1.000000	0.494505	0.890110	0.571429	0.714286	0.298901	Tork Kratos
32	0.483938	0.777778	0.439560	0.461538	0.142857	0.238095	0.291941	Revolt RV 300

These are the top 5 premium two wheeler EV models based on the scores of their performance.



We can see how data points are beautifully segmented by almost every feature.

## 6.0 Conclusion

After our analysis, here are the models that outperform others and would be best to make an entry in the EV market

### Two Wheelers Products:

- OLA S1
- REVOLT RV

### **Key Features:**

- **High budget**
- **Long Range**
- **Moderate Speed**
- **Maximum Battery Charging Time**

### **Three Wheelers Product:**

- **TATA NEXON**
- **BMW**
- **AUDI**

### **Key Features:**

- **High budget**
- **Moderate Range**

Our analysis of the electric vehicle (EV) market, grounded in detailed datasets of EV models and consumption trends, reveals a dynamic and rapidly growing industry with significant opportunities for new entrants. The data underscores the accelerating adoption of EVs, driven by advancements in technology, favourable government policies, and increasing consumer awareness of environmental issues. Key insights from the analysis indicate that the mid-range segment, particularly compact SUVs, is thriving, offering a balanced mix of affordability, range, and utility that appeals to urban consumers. Meanwhile, the luxury segment continues to expand, with high-end models capturing a niche but lucrative market. The exponential growth in the number of EVs sold over recent years, particularly in the two-wheeler and four-wheeler categories, highlights the burgeoning demand and the market's maturity.

For businesses looking to enter the EV market, the analysis provides clear strategies for positioning and targeting. By identifying popular segments, understanding consumer preferences, and tracking adoption trends, companies can make informed decisions on product offerings, pricing strategies, and marketing approaches.

In conclusion, the EV market presents a promising landscape with diverse opportunities across various segments. Success in this industry will depend on aligning business strategies with the evolving needs of consumers, leveraging technological innovations, and staying attuned to market trends. As the transition to electric mobility gains momentum, businesses that are agile, forward-thinking, and customer-focused will be well-positioned to thrive.