Market Segmentation and Targeting Strategy for an Electric Vehicle Startup in India

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23Th March, 2025

Problem Statement:

An electric vehicle (EV) startup in India faces a crucial decision: who to target. The diverse Indian market offers numerous possibilities, but choosing the right segment is essential for success. This project tackles this challenge through market segmentation analysis. By understanding different customer groups (geographic, demographic, etc.), we will assess their needs and the competition. This will help us identify the "sweet spot": the segment most likely to embrace the startup's EVs. Considering data limitations and market dynamics, we will develop a targeted entry strategy, positioning the startup for long-term growth in the electrifying Indian market.

Data Collection:

To initialize the implementation of the market segmentation analysis for our EV startup's Indian launch, I started with the data acquisition efforts. Through meticulous research, I delved into various data sources available on the internet to gather appropriate and relevant data for the project. This comprehensive data collection exercise lays the groundwork for the next crucial step: identifying the most promising segment for our startup's successful entry into the electrifying Indian EV market.

Websites used for researching:

- https://www.kaggle.com/
- https://data.gov.in/
- https://datasetsearch.research.google.com/
- https://trends.google.com/trends/explore

The datasets I worked on for the project:
https://www.kaggle.com/datasets/prasenjitsharma/fuel-type-wise-vehicle-registration-india/data

The above dataset specifies the total no. of vehicles registered in India from January 2014- July, 2023. The has been categorized into fuel variant of the vehicle registered. Analyzing this data would give an idea about the purchasing trends in the Indian Market and how it has changed over the years.

https://pib.gov.in/Pressreleaseshare.aspx?PRID=1808115

This dataset specifies the sanctioned EV Charging Stations in India:
State-wise sanctioned EV Charging Stations
City-wise sanctioned EV Charging Stations
Sanctioned EV Charging Stations on Expressways and Highways

Analyzing this data would help in making proper decisions about which states/cities to target those have already established/planned supporting infrastructure for the electric vehicles.

Code Implementation:

Importing all the neccesarry libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
from sklearn.cluster import KMeans
import warnings
warnings.filterwarnings('ignore')
```

1. **Fuel Type wise vehicle registration in India**

1.1 Data Loading and Preprocessing

In [7]:
```
print(pd.isnull(datasetFuelType).sum())
```

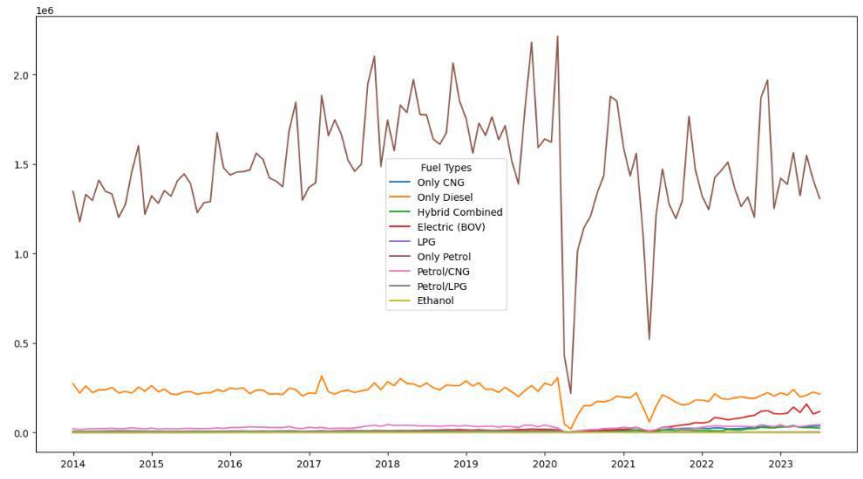
```
Month                0
CNG ONLY             0
DIESEL               0
DIESEL/HYBRID        0
DUAL DIESEL/CNG      0
ELECTRIC(BOV)        0
ETHANOL              0
LPG ONLY             0
NOT APPLICABLE       0
PETROL               0
PETROL/CNG           0
PETROL/ETHANOL       0
PETROL/HYBRID        0
PETROL/LPG           0
SOLAR                0
FUEL CELL HYDROGEN   0
LNG                  0
METHANOL             0
DUAL DIESEL/LNG      0
dtype: int64
```

In [8]:
```
datasetFuelType["Month"]=pd.to_datetime(datasetFuelType["Month"], format='%b-%y')
datasetFuelType["Month"].head()
```

Out[8]:
```
0   2014-01-01
1   2014-02-01
2   2014-03-01
3   2014-04-01
4   2014-05-01
Name: Month, dtype: datetime64[ns]
```

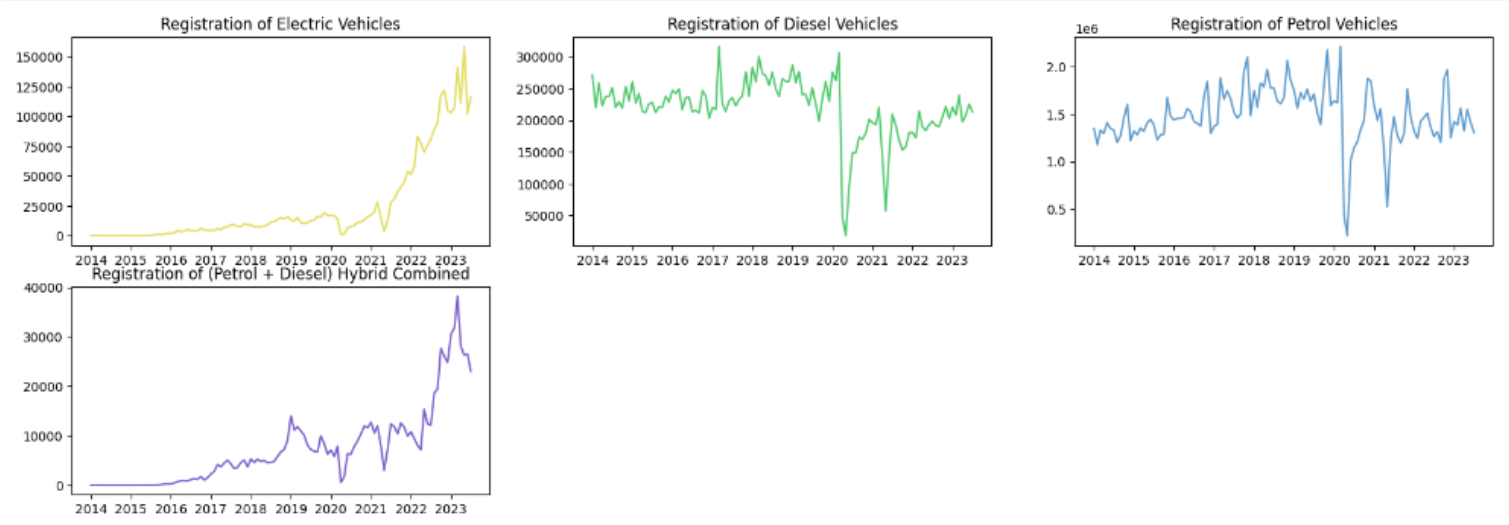
In [9]:
```
datasetFuelType['HYBRID COMBINED'] = datasetFuelType['PETROL/HYBRID'] + datasetFuelType['DIESEL/HYBRID']

# Dropping 'PETROL/HYBRID' and 'DIESEL/HYBRID' columns
datasetFuelType.drop(['PETROL/HYBRID', 'DIESEL/HYBRID'], axis=1, inplace=True)
```

1.2 Exploring the Data



Based upon the graph, we can see that:

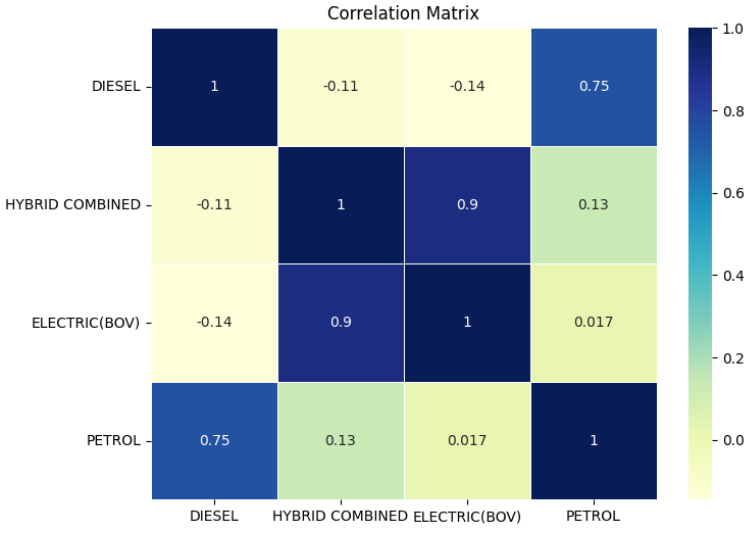
- Petrol vehicles consistently have the highest registrations throughout the time period, indicating their dominance in the market.
- Diesel vehicle registrations remain relatively stable over time, suggesting a consistent demand for diesel-powered vehicles.
- Electric vehicles show an increasing trend in registrations over time, indicating a growing interest or adoption of electric mobility, from late 2021 onwards.
- The increasing trend in EV registrations suggests a potential shift in the market toward cleaner and more sustainable transportation options.



Out of all the four variants of fuel type, the registrations of Electric Vehicles and Hybrid Vehicles show a noticeable increasing trend over the time period and seems to suggest a growing market in the near future.

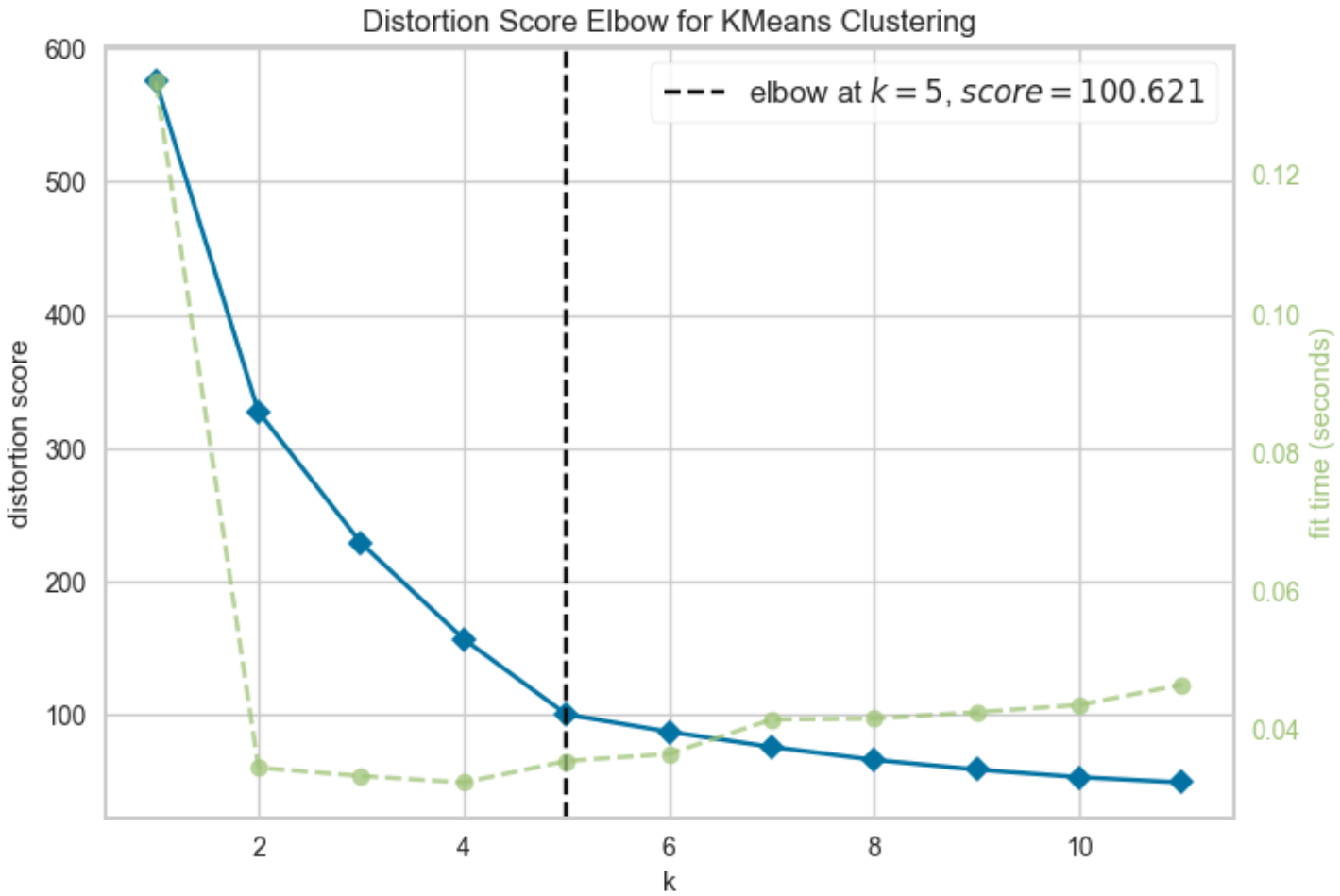
The upward trend may indicate a shift in consumer preferences towards more sustainable and environmentally friendly transportation options.

The consistent demand for the remaining vehicles suggests a stable market presence, possibly driven by specific industry requirements or consumer preferences.



- **Strong positive correlations** exist between "DIESEL" and "PETROL" (0.87), suggesting that these fuel types tend to move together in terms of their values.
- **Moderate positive correlation** exists between "HYBRID COMBINED" and "PETROL" (0.54) and "HYBRID COMBINED" and "ELECTRIC(BOV)" (0.44), indicating some degree of co-occurrence.

- **A weak positive correlation** exists between "Year" and "ELECTRIC(BOV)" (0.23), suggesting a possible increase in electric vehicles over time.
- **A strong negative correlation** exists between "ELECTRIC(BOV)" and "DIESEL" (-0.84), indicating that an increase in electric vehicles is associated with a decrease in diesel usage.

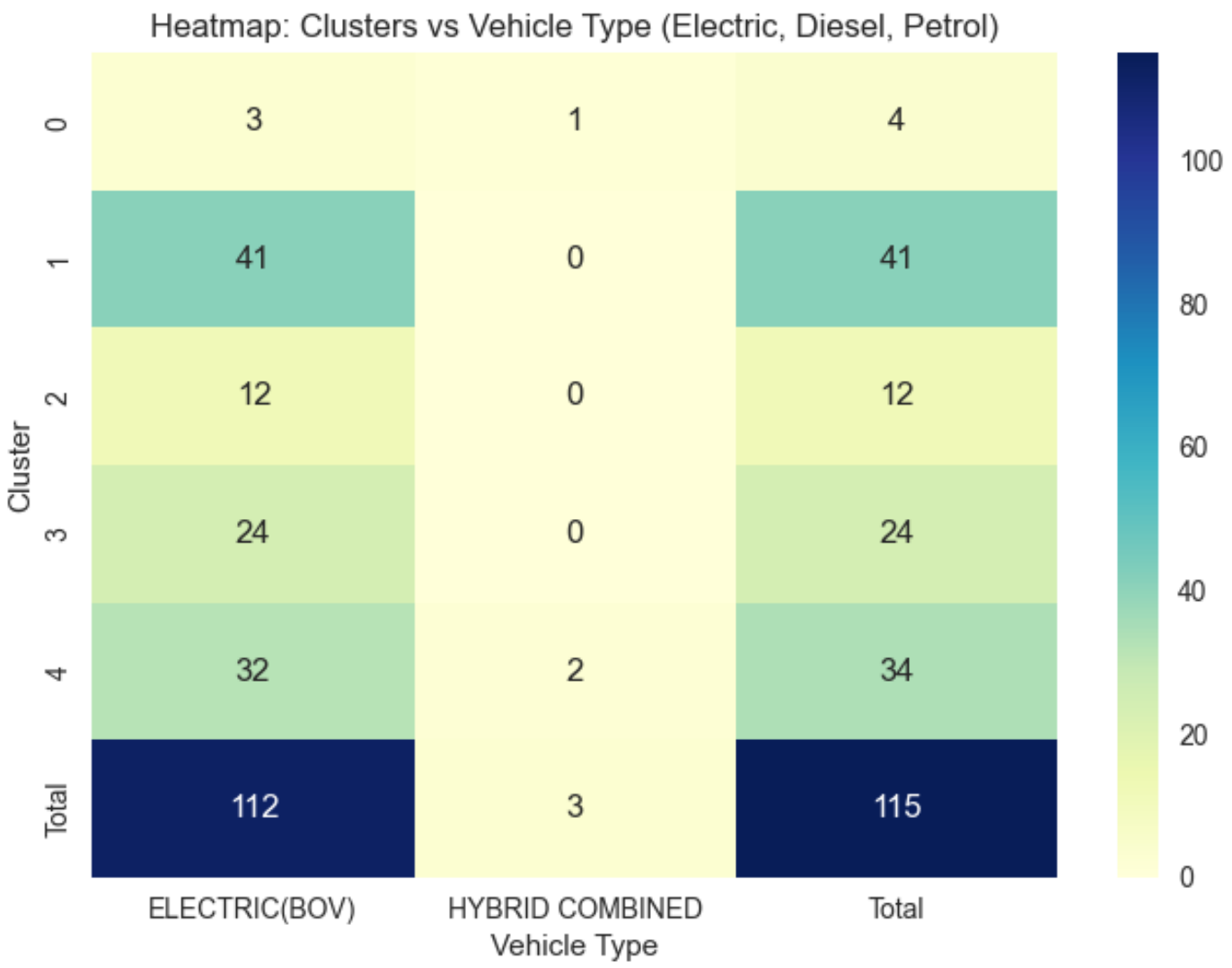


- There is a clear and sharp elbow around k=5, where the decrease in distortion score starts to slow down significantly. This suggests that adding more clusters beyond k=5 does not provide a substantial improvement in clustering quality.
- Based on the elbow method, the optimal number of clusters for the given data is likely **k=5.** This means that the KMeans algorithm can effectively group the data points into five distinct clusters with minimal distortion.

In [36]:
```
# Applying K-means clustering
kmeans = KMeans(n_clusters=5)
finalDatasetFuelType['Cluster'] = kmeans.fit_predict(scaledData)

# Visualize or analyze the clusters
print(finalDatasetFuelType['Cluster'].value_counts())
```

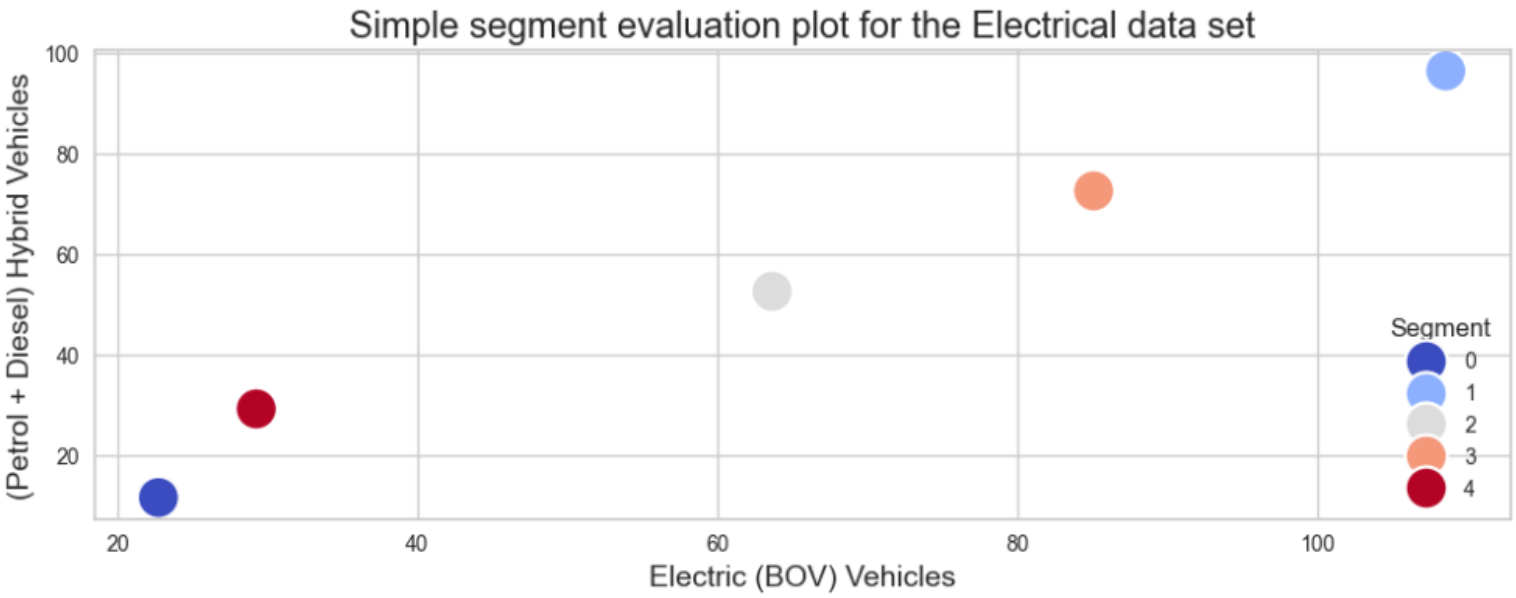
```
1    41
4    34
3    24
2    12
0     4
Name: Cluster, dtype: int64
```

More registerations belong to **Cluster 1 & 4**



Based on the above heatmap, here are some observations:

- Cluster 0: This cluster is dominated by Electric vehicles, with a significantly higher count compared to Diesel and Petrol vehicles.
- Cluster 1: This cluster has a more balanced distribution of vehicle types, with Petrol vehicles having the highest count, followed by Electric and Diesel vehicles.
- Cluster 2: This cluster is primarily composed of Diesel vehicles, with a very low count of Electric and Petrol vehicles.
- Cluster 3: This cluster has a moderate count of Electric vehicles, followed by Diesel and Petrol vehicles.



Electric (BOV) Vehicles:

This refers to Battery Operated Vehicles, which encompass pure electric cars and electric two-wheelers.

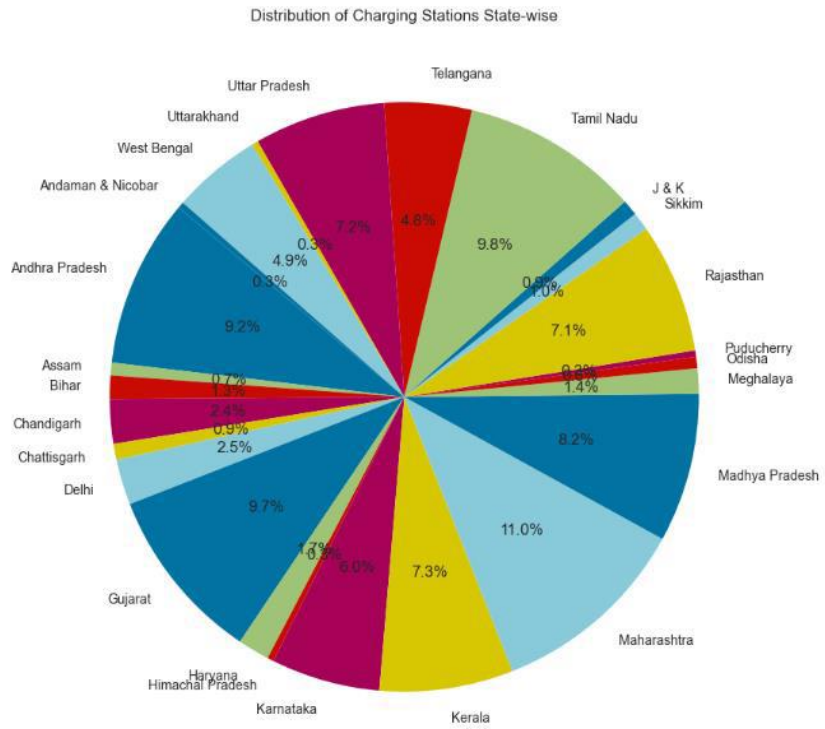
(Petrol + Diesel) Hybrid Vehicles:

These are vehicles that combine an electric motor with a traditional gasoline or diesel engine.

- The data points are spread across all four quadrants of the graph, suggesting that there is a diversity in terms of both electric and hybrid vehicle adoption across the identified segments.
- There seems to be a concentration of points in the lower left and upper right quadrants. This could imply that some segments have a preference for either electric or hybrid vehicles, while others have a more balanced mix.

Target Segments:
- Target Segment 0: Prioritize marketing EVs' environmental benefits and lower running costs. Ensure easy access to charging infrastructure information.
- Segment 4: Address price concerns and highlight the flexibility of having both hybrid and electric options.
- Segments 1 and 5: Offer a diverse range of EV and hybrid options cater to various needs and budgets. Emphasize fuel efficiency and the evolving charging infrastructure landscape.
- Segments 2 and 3: Focus on the practicality and reliability of hybrids while acknowledging the growing appeal of EVs. Address range anxiety concerns.

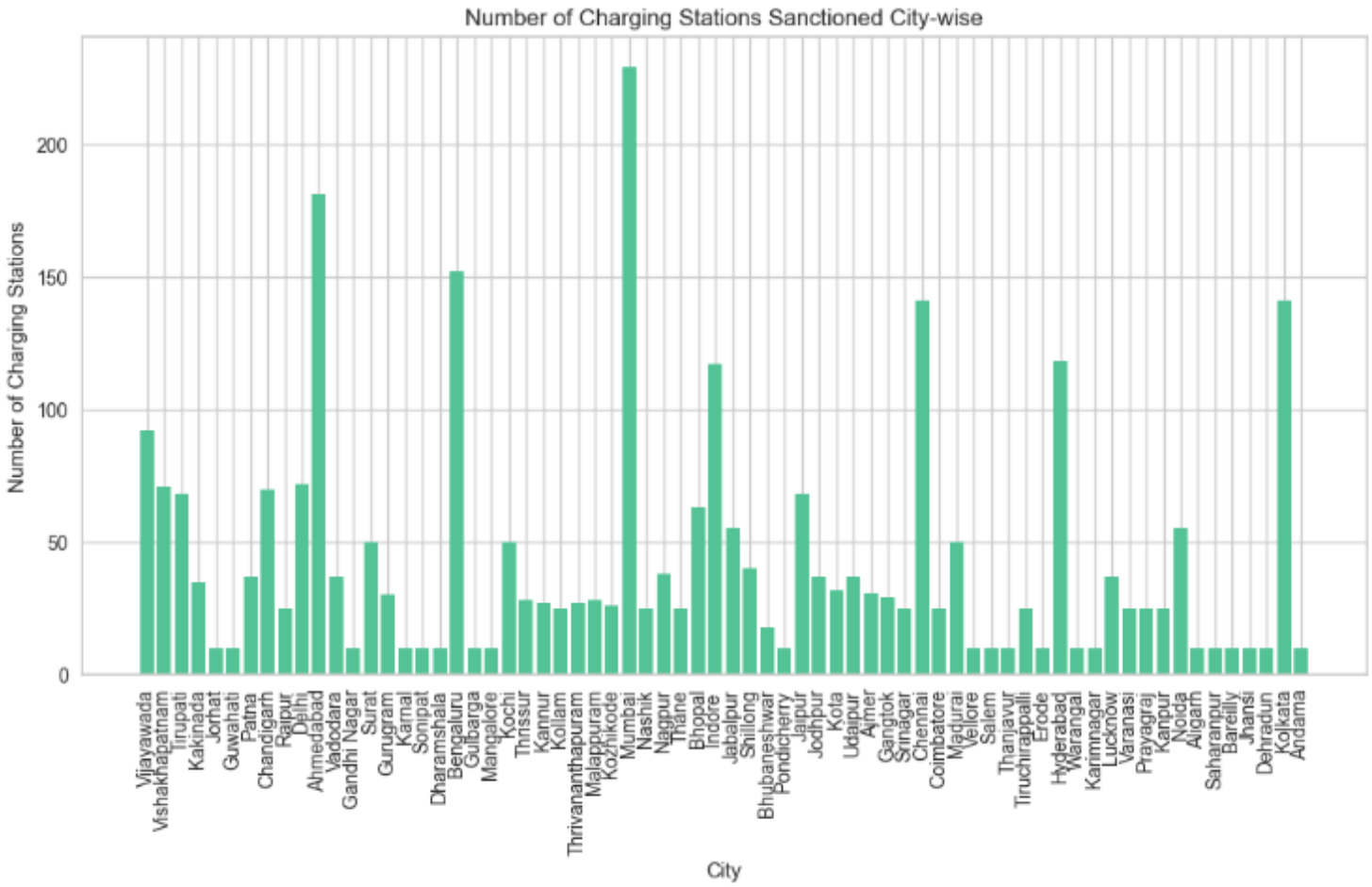
1. State-wise Charging Station Sanctioned



Based on the following graph we can see that the states with maximum number of sanctioned charging stations are:

1. Maharashtra
2. Tamil Nadu
3. Gujarat
4. Andhra Pradesh
5. Madhya Pradesh

City-wise Charging Station Sanctioned



Based on the following graph we can see that the cities with maximum number of sanctioned charging stations are:

1. Mumbai
2. Ahmedabad
3. Bengaluru
4. Kolkata
5. Chennai

Conclusion:

The Indian mobility landscape is undergoing a dynamic shift, fueled by rising environmental consciousness and evolving consumer preferences. While petrol retains dominance, electric vehicles (EVs) are experiencing a surge, particularly evident in states like Maharashtra, Tamil Nadu, and Gujarat, and major cities like Mumbai, Ahmedabad, and Bengaluru. This presents a lucrative opportunity for our EV startup to target two key segments:

1. **Environmentally Conscious Early Adopters**: Cluster 0, concentrated in these key regions, prioritizes sustainability and embraces EVs. Focus messaging on environmental benefits, address charging infrastructure concerns, and showcase innovative features.

2. Price-Conscious Hybrid-Open Consumers: Segment 4 represents potential converts open to both EVs and hybrids. Tailor messaging by emphasizing price competitiveness, flexibility, and fuel efficiency.
By focusing on these distinct segments and adapting marketing strategies accordingly, the startup can capitalize on the expanding Indian EV market, ensuring long-term success in this electrifying landscape.

The complete code along with the dataset is available at
https://github.com/antus964/Feynn-Labs-Internship-2025/tree/main/Task%202.1