EV Market Segmentation Analysis

1. Breakdown of the problem statement:

The problem is to analyze the Electric Vehicle (EV) market in India and develop a feasible strategy for an Electric Vehicle Startup to enter the market.

The objective is to identify and analyze the different segments of the EV market in India and determine which segments are most likely to use electric vehicles. The goal is to target these segments for the startup's EV development and market penetration.

Segmentation analysis is a process of dividing a market into distinct groups or segments based on certain characteristics or criteria. In this case, apart from the traditional segmentation factors like geography, demographics, psychographics, and behaviour, different categories of segments based on the availability of data specific to the EV market are considered.

By conducting a comprehensive segmentation analysis and considering the various factors that influence EV adoption, the startup can make informed decisions about the target market segments, product features, pricing, marketing strategies, and distribution channels. This will increase the chances of success in entering the EV market and capturing the interest of potential customers.

2. Data Sources:

The data used in the report is obtained from the following source:

https://www.kaggle.com/datasets/divyanshusingh18/ev-cars-india-2023

A	B	C	D	E	F	G	H	I
Car_name	Car_price	Batter_cap	Drive_range	Power	Charge_time	transmission	Boot_space	Top_speed
MG Comet EV	7.98 lakh	17.3 kWh	230 km/full charge	41.42 Bhp	7 Hours	Automatic		
Tata Tiago EV	8.69 - 11.99 lakh	19.2 KWh	250 km/full charge	60.34 - 73.75 Bhp	58 Min(10-80%)	240 L (Liters)	Automatic	
Tata Tigor EV	12.49 - 13.75 lakh	26 kWh	315 km/full charge	73.75 Bhp	7.5h	316 L (Liters)	Automatic	
MG ZS EV	23.38 - 27.40 lakh	50.3 kWh	461 km/full charge	174.33 Bhp	8.5 to 9 Hours	Automatic		
BYD Atto 3	33.99 - 34.49 lakh	60.48 kWh	521 km/full charge	201.15 Bhp	9.5-10 Hours	440L L (Liters)	Automatic	
Hyundai Kona Electr	23.84 - 24.03 lakh	39.2kWh	452 km/full charge	134.1 Bhp	6.16 Hours	Automatic		
Mahindra XUV400 E	15.99 - 18.99 lakh	34.5 kWh	375 s km/full charge	50min	Automatic			
Tata Nexon EV Max	16.49 - 19.54 lakh	40.5 kWh	453 km/full charge	141.04 Bhp	15 Hours	350 L (Liters)	Automatic	
Mercedes-Benz EQS	1.59 - 2.4 lakh	17.3 kWh	230 km/full charge	41.42 Bhp	7 Hours	Automatic		
Audi e-tron GT	1.7 cr	19.2 KWh	250 km/full charge	60.34 - 73.75 Bhp	58 Min(10-80%)	240 L (Liters)	Automatic	
BMW i4	73.90 - 77.50 lakh	26 kWh	315 km/full charge	73.75 Bhp	7.5h	316 L (Liters)	Automatic	
BYD E6	29.15 lakh	50.3 kWh	461 km/full charge	174.33 Bhp	8.5 to 9 Hours	Automatic		
Porsche Taycan	1.53 - 2.3 lakh	60.48 kWh	521 km/full charge	201.15 Bhp	9.5-10 Hours	440L L (Liters)	Automatic	
Audi RS e-tron GT	1.9 cr	39.2kWh	452 km/full charge	134.1 Bhp	6.16 Hours	Automatic		
Mahindra E Verito	9.13 - 9.46 lakh	34.5 kWh	375 s km/full charge	50min	Automatic			
Strom Motors R3	4.50 lakh	40.5 kWh	453 km/full charge	141.04 Bhp	15 Hours	350 L (Liters)	Automatic	
Tata Nexon EV Prim	14.49 - 17.19 lakh	71.7 kWh	415 km/full charge	93.87 Bhp	1.5H	580 L (Liters)	Automatic	
Hyundai IONIQ 5	44.95 lakh	29.2 kWh	320 km/full charge	56.22 Bhp	10.5 Hours	315 L (Liters)	Automatic	
Kia EV6	60.95 - 65.95 lakh	77.4 kWh	708 km/full charge	225.86 - 320.55 Bhp	18 Min (0-80%)	Automatic		
BMW iX	1.2 cr	200kmph	372-425 km/full char	321.84 Bhp	7.25h(AC 0-100%)	Automatic	71kWh	200kmph
BMW i7	1.9 cr		590-625 km/full char	536.4 Bhp	Automatic	101.7kWh		
Mini Cooper SE	52.50 lakh	32.6KwH	270 km/full charge	181.03 Bhp	2.5 Hours	Automatic		

Fig 1. Glimpse of data

3. Data Preprocessing:

Libraries Used:

```
import pandas as pd
import numpy as np
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
from google.colab import drive
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
import re
drive.mount('/content/drive')
data = pd.read_csv("/content/drive/MyDrive/EV_cars_India_2023.csv")
```

Fig.2 Libraries used

To preprocess the uncleaned dataset, load the dataset and followed by these steps:

1. Car_name column is split into Brand and model. Splitting the car_name allows for more focused brand-level analysis and detailed comparisons between different car models.
2. Convert units: Convert the car price from lakh and crores to the appropriate currency unit (e.g., Indian Rupees). Remove any extra

characters such as commas, dashes, and "lakh" from the car price column.

3. Convert all Battery capacity values to KWH units.
4. Clean Drive Range of vehicles to KM and Power to bhp, remove any non-numeric characters from the power column.
5. Convert charge time values to a standardized format, such as hours to make them more comparable.
6. Handle missing values: Check for missing values in each column and gave their respective previous row values.
7. Handle inconsistent data: Look for any inconsistencies or errors in the dataset, such as conflicting information or incorrect values. Correct or remove such data points if necessary.
8. Remove duplicates: Check for and remove any duplicate rows in the dataset.

Following these preprocessing steps, the data is cleaned and prepared for further analysis.

Car_price	Batter_cap	Drive_range	Power	Charge_time	Brand	Model
798000	17.3	230	41.42	7	MG	EV
1034000	19.2	250	60.34	7	Tata	EV
1312000	26	315	73.75	7.5	Tata	EV
2539000	50.3	461	174.33	8.5	MG	EV
3424000	60.48	521	201.15	9.5	BYD	3
2393500	39.2	452	134.1	6.16	Hyundai	Electric
1749000	34.5	375	50	6.16	Mahindra	EV
1801500	40.5	453	141.04	15	Tata	Max
199500	17.3	230	41.42	7	Mercedes	EQS
17000000	19.2	250	60.34	7	Audi	GT
7570000	26	315	73.75	7.5	BMW	i4
2915000	50.3	461	174.33	8.5	BYD	E6
191500	60.48	521	201.15	9.5	Porsche	Taycan
19000000	39.2	452	134.1	6.16	Audi	GT
929500	34.5	375	50	6.16	Mahindra	Verito
450000	40.5	453	141.04	15	Strom	R3
1584000	71.7	415	93.87	1.5	Tata	Prime
4495000	29.2	320	56.22	10.5	Hyundai	5
6345000	77.4	708	225.86	10.5	Kia	EV6
12000000	200	398.5	321.84	7.25	BMW	iX
19000000	200	607.5	536.4	7.25	BMW	i7
5250000	32.6	270	181.03	2.5	Mini	SE

Fig 3. Data after preprocessing

4. Segment Extraction:

- Select Features: Choose the relevant features from the dataset that will be used for segment extraction. These features should provide meaningful information for clustering. Here Car_price ,Batter_cap Drive_range , Power, Charge_time, Brand are the selected features.

- Data Normalization: Normalize the selected features to bring them to a similar scale, ensuring that no single feature dominates the clustering process.
- Performing K-means clustering for segmentation:

Step 1: Perform Elbow Method for Finding Number of Clusters:

To determine the optimal number of clusters for segmentation, we can use the elbow method. This method plots the within-cluster sum of squares (WCSS) against the number of clusters and identifies the point where the rate of decrease in WCSS begins to level off. This point indicates a good balance between the number of clusters and the compactness of each cluster.

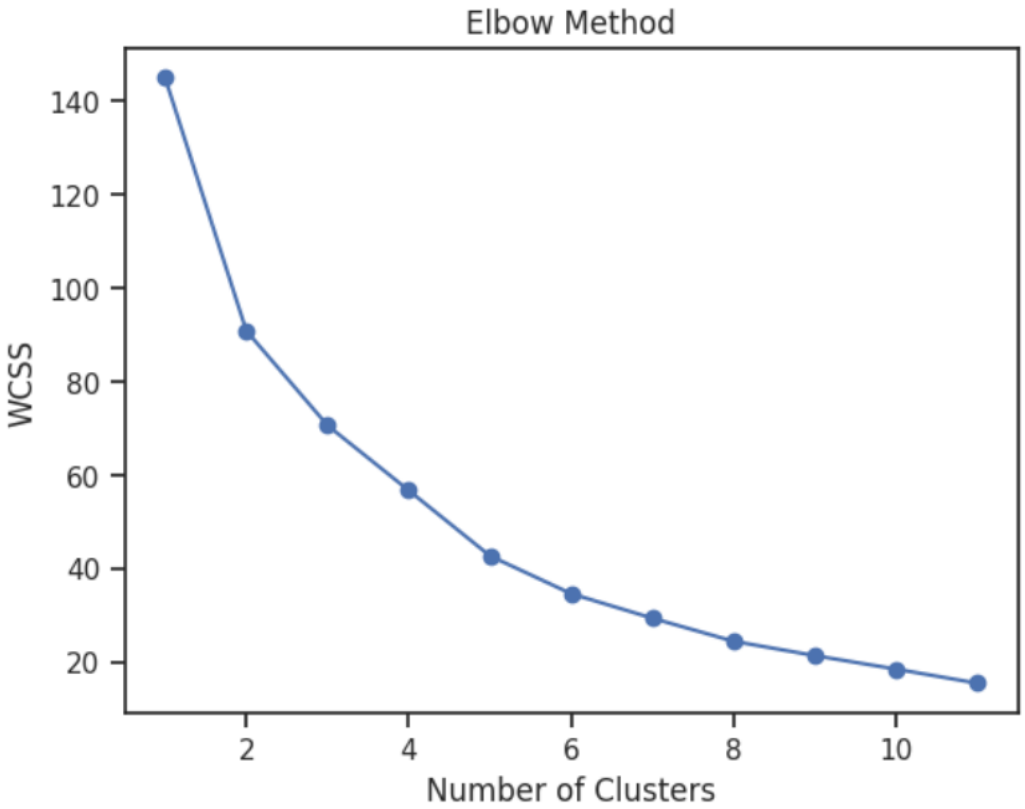


Fig4. Elbow method

Step 2: Perform K-means Clustering with 4 Number of Clusters:

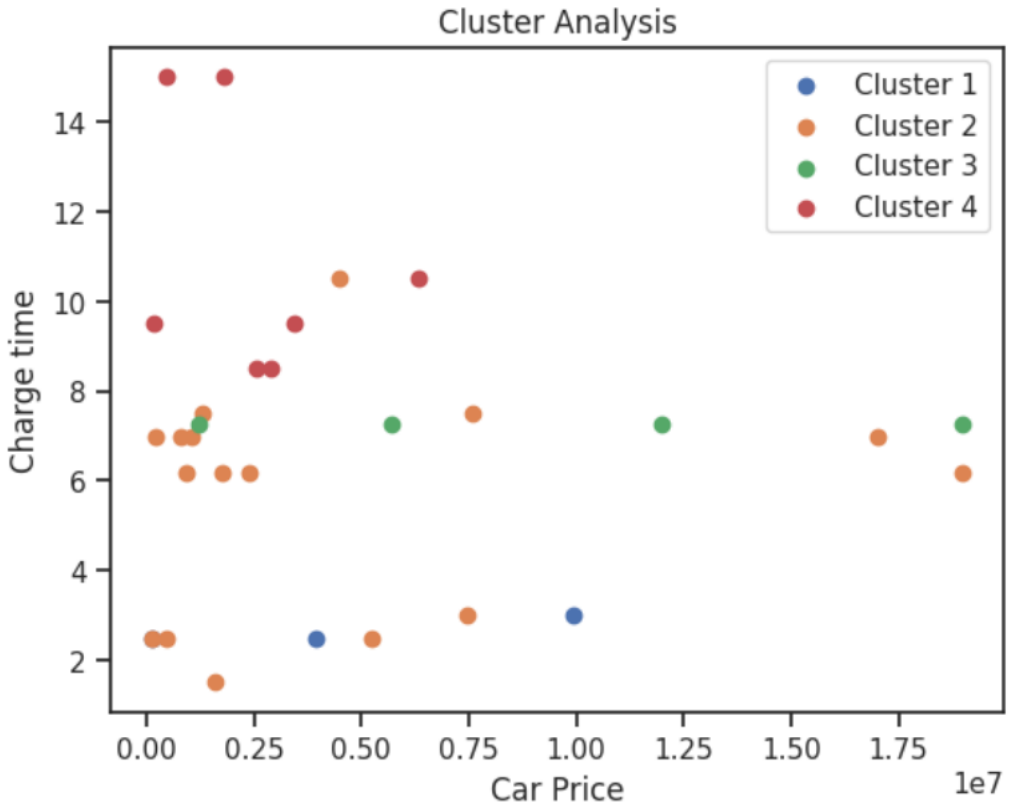
we have determined the optimal number of clusters as 4 from the elbow method, we can perform K-means clustering using that number of clusters.

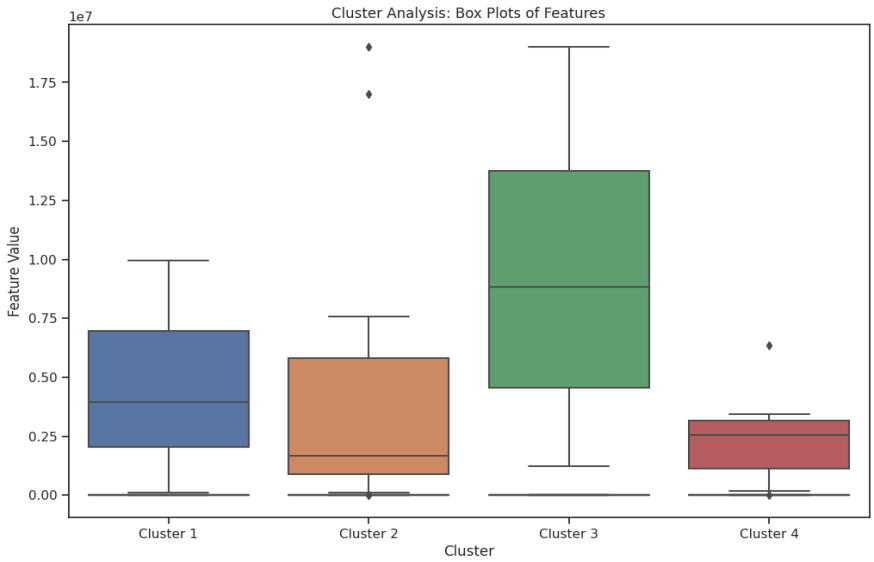
```
Number of samples in each cluster:
0     3
1    16
2     4
3     7
Name: Cluster, dtype: int64
```

	Brand	Model	Car_price	Cluster
0	MG	EV	798000.0	1
1	Tata	EV	1034000.0	1
2	Tata	EV	1312000.0	1
3	MG	EV	2539000.0	3
4	BYD	3	3424000.0	3
5	Hyundai	Electric	2393500.0	1
6	Mahindra	EV	1749000.0	1
7	Tata	Max	1801500.0	3
8	Mercedes	EQS	199500.0	1
9	Audi	GT	17000000.0	1
10	BMW	i4	7570000.0	1
11	BYD	E6	2915000.0	3
12	Porsche	Taycan	191500.0	3
13	Audi	GT	19000000.0	1
14	Mahindra	Verito	929500.0	1
15	Strom	R3	450000.0	3
16	Tata	Prime	1584000.0	1
17	Hyundai	5	4495000.0	1
18	Kia	EV6	6345000.0	3
19	BMW	iX	12000000.0	2
20	BMW	i7	19000000.0	2

Step 3: Display Cluster, Their Features, Properties, and Feature Importance:

Each cluster is individually analysed and examined their features, properties.





5. Profiling and describing potential segments:

Based on the feature values and patterns within each cluster, we can interpret the segments as follows:

Segment 1: High-end Performance

- Car price: Moderate around 4.67 million

• Battery capacity: Moderate approx 89.7 kWh
• Drive range: High approx. 702 km
• Power: High 359 kW
• Charge time: Low 2.67 hours

This segment represents high-performance electric vehicles with moderate prices, battery capacities, long drive ranges, and high power. These vehicles are suitable for customers who prioritize performance and are willing to pay a premium for advanced features and capabilities

Segment 2: Affordable and Compact

- Car price: Moderate
- Battery capacity: Low
- Drive range: Moderate
- Power: low
- Charge time: Moderate

This segment represents affordable and compact electric vehicles with moderate prices, lower battery capacities, and moderate performance. These vehicles are suitable for customers looking for more budget-friendly options and practical city driving.

Segment 3: Luxury and Premium

- Car price: Very High
- Battery cap: Very High
- Drive range: High
- Power: very High
- Charge time: Moderate

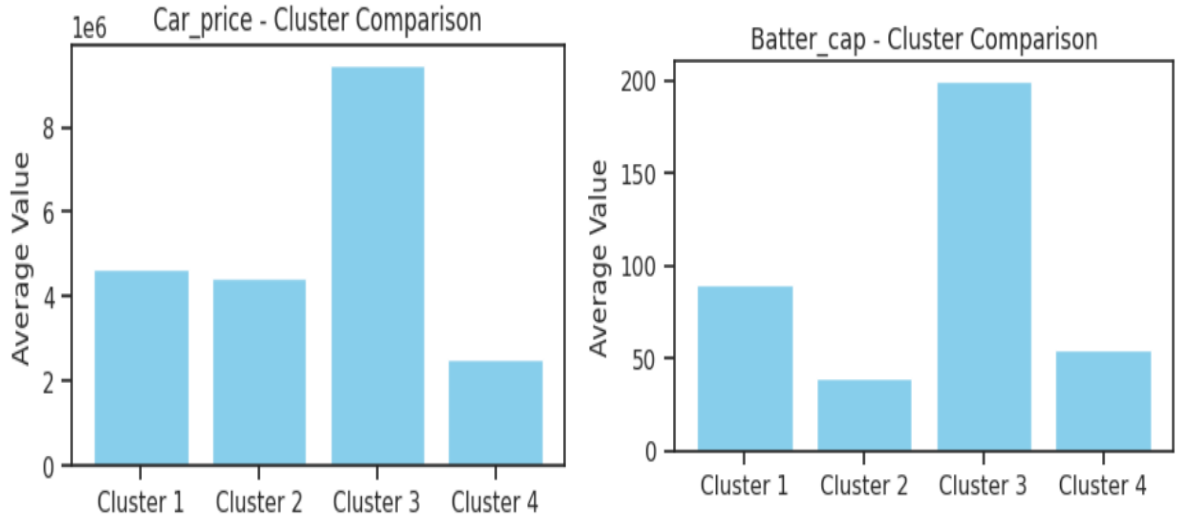
This segment represents luxury and premium electric vehicles with very high prices, high battery capacities, and high performance. These vehicles offer a combination of luxury features, advanced technology, and long drive ranges. They are targeted towards customers who value luxury, prestige, and the latest innovations in electric vehicle technology.

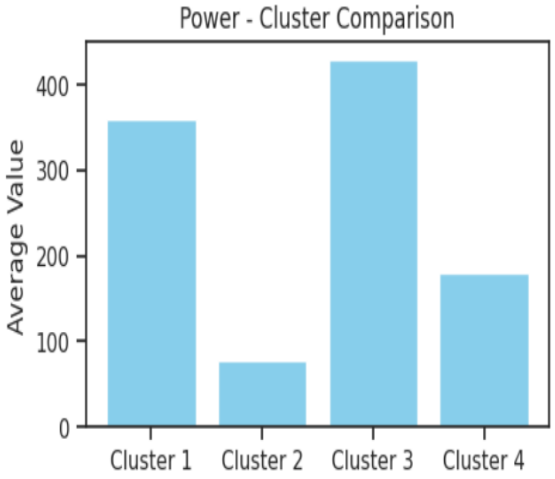
Segment 4: low-range and Balanced

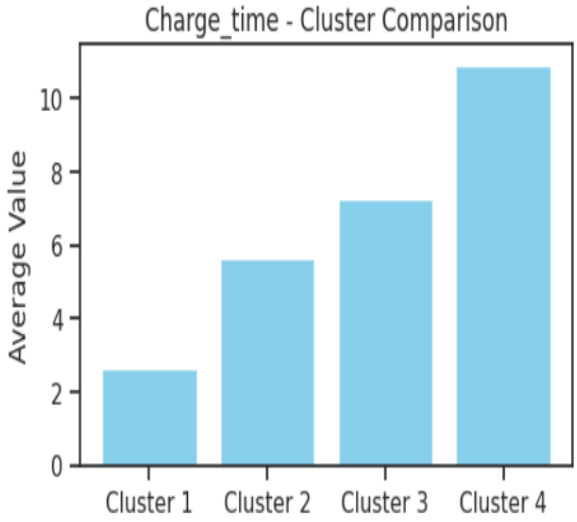
- Car price: low
- Battery capacity: low
- Drive range: moderate
- Power: moderate
- Charge time: High

This segment represents mid-range electric vehicles with moderate prices, balanced features, and performance. These vehicles offer a good balance between affordability, practicality, and performance. They are suitable for customers who are looking for a reliable electric vehicle with decent features and performance at a reasonable price point.

These segment interpretations can provide insights into the characteristics and potential implications for business decisions. They help in understanding the target customer profiles, market positioning, pricing strategies, and product development efforts tailored to each segment.







6. Selection of Target Segment:

Based on the provided information and analysis, the selection of the target segment can be based on the following criteria:

1. Price Range: Consider the segment with a price range that aligns with your target market's affordability and willingness to spend on electric vehicles. Segment 2 and Segment 4 have relatively lower price ranges compared to Segment 1 and Segment 3, making them potentially more attractive to price-conscious customers.

2. Drive Range: If targeting customers who prioritize long drive ranges, Segment 1, Segment 3 and also segment 4 offer higher drive ranges of around 700+ km. These segments may be appealing to customers who require extensive range capabilities, such as frequent long-distance travellers or those without easy access to charging infrastructure.

3. Power and Performance: Segment 1 and Segment 3 offer higher power outputs, indicating superior performance capabilities. If targeting customers who value high power and acceleration, these segments may be more suitable.

4. Demographic Considerations: Consider the demographic characteristics of your target market. Segment 1 and Segment 3, with their higher price points and potentially more luxurious features, may attract customers who prioritize prestige and luxury in their vehicle choices. Segment 2 and Segment 4, with their more affordable price ranges, may

appeal to a broader range of customers, including those who are more budget-conscious.

5. Market Demand: Evaluate the market demand for different segments based on factors like customer preferences, competitors' offerings, and market trends. Conducting market research and analyzing the potential demand for electric vehicles in each segment is essential to determine which segment has a higher growth potential and market opportunity.

Ultimately, the selection of the target segment should be based on a combination of factors, including the market dynamics, customer preferences, and the business's strategic goals and capabilities.

7. Customizing the Marketing Mix:

To customize the marketing mix based on the resulting segments, you can consider the following strategies for each segment:

Segment 1:

- Product: Highlight the advanced features, long drive range, and powerful performance of the electric vehicles in this segment. Emphasize the luxury and premium aspects.

- Price: Set the price at a higher range, reflecting the premium features and positioning of the vehicles.

- Promotion: Use marketing channels that reach affluent customers, such as luxury lifestyle magazines, high-end events, and digital platforms targeting luxury car enthusiasts.

- Place: Focus on exclusive showrooms and dealership networks in upscale locations or areas with high purchasing power.

Segment 2:

- Product: Highlight the value for money, reliability, and practicality of the electric vehicles in this segment. Emphasize the balance between price and features.

- Price: Set the price at a competitive level, offering good value compared to other electric vehicle options.

- Promotion: Utilize digital marketing channels, social media platforms, and online reviews to reach cost-conscious customers seeking reliable electric vehicles.

- Place: Ensure availability of these vehicles in a wide range of dealerships and online platforms, making them easily accessible to potential buyers.

Segment 3:

- Product: Highlight the exclusivity, cutting-edge technology, and premium features of the electric vehicles in this segment. Focus on offering a superior luxury experience.

- Price: Set the price at a premium level, reflecting the high-end positioning and exceptional features of the vehicles.

- Promotion: Engage in strategic partnerships with luxury lifestyle brands, showcase the vehicles at high-profile events, and leverage digital marketing campaigns targeting affluent individuals.

- Place: Establish dedicated luxury showrooms in prime locations, offer personalized customer experiences, and provide concierge services to cater to the unique needs of this segment.

Segment 4:

- Product: Highlight the affordability, practicality, and environmental benefits of the electric vehicles in this segment. Focus on cost-saving aspects and ease of use.

- Price: Set the price at a competitive and affordable level to attract budget-conscious customers.

- Promotion: Utilize online advertising, social media platforms, and collaborations with environmentally conscious organizations to reach potential customers seeking affordable and eco-friendly transportation options.

- Place: Ensure availability of these vehicles in a wide range of dealerships, online marketplaces, and rental services to make them easily accessible to a diverse customer base.

By customizing the marketing mix for each segment, you can effectively target the specific needs, preferences, and price sensitivities of different customer groups, maximizing the chances of successful market penetration and profitability.