Project Report

By

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SAIKARTHIK

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Market Overview:

The electric vehicles industry at a nascent stage in India. It is less than 1% of the total vehicle sales however has the potential to grow to more than 5% in a few years. At present there are more than 5 lac electric two-wheelers and few thousand electric cars on Indian roads. The industry volumes have been fluctuating, mostly depending on the incentives offered by the government. Many serious players (Hero Eco, Ather, Avon, Lohia, Ampere, etc) are continuing with the mission and trying to enforce the positive change under the banner of SMEV.

More than 90% of electric vehicles on Indian roads are low-speed electric scooters (less than 25km/hr) that do not require registration and licenses. Almost all electric scooters run on lead batteries to keep the prices low, however, battery failures and low life of batteries have become major limiting factors for sales besides government subsidies. Many manufacturers have taken initiatives to install the charging station with limited success. Players like Lohia and Electrotherm have developed Electric three-wheelers. Ampere and Hero have entered Electric Cycles segments. There are numbers of E-Rickshaw players mushrooming across the country and selling good numbers of E rickshaw for last-mile connectivity.

The Industry is almost ready for take-off but for the incentives. It is expected that with FAME-2 the Industry may witness a quantum leap in volumes and technology. SMEV sees a great opportunity with EVs in reducing the Carbon footprint, dependence on Crude oil imports, creating jobs and building a new Technology knowledge hub in India.

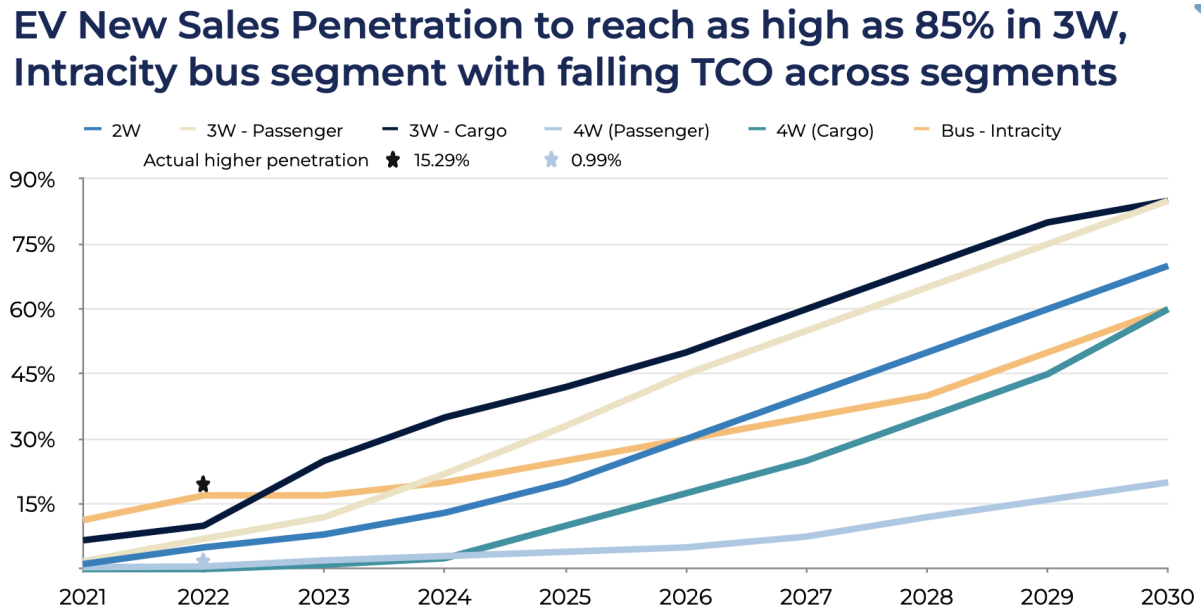
India leads on sales of electric three-wheelers thanks to policy support and innovative business models.

Sales of electric three-wheelers, which play an important role in urban mobility in India for both cargo and passenger services, soared to 425,000 units in 2022. Sales have been strong in India for a number of years, with hundreds of thousands of electric three-wheelers sold every year since 2012, with the exception of 2020, when the Covid-19 pandemic reduced sales volumes to 30% of the previous year.

Over half of India’s three-wheeler registrations in 2022 were electric, demonstrating their growing popularity due government incentives and lower lifecycle costs compared with conventional models, as well as higher fuel prices. IEA analysis on the TCO in India suggests that electric three-wheelers are already 70% cheaper than their gasoline-power ICE equivalents over their lifetime (IEA, forthcoming).

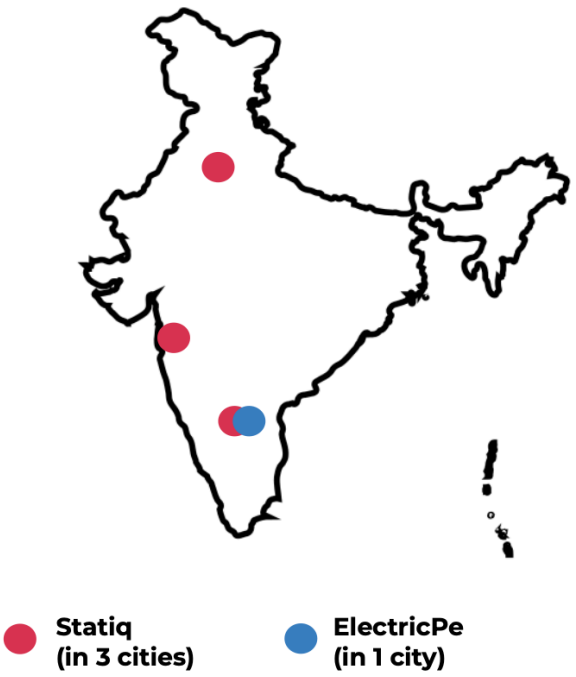
Policies including the purchase incentives under FAME II, supply-side incentives under the PLI scheme, tax benefits and India's Go Electric campaign all contributed to reducing the higher upfront costs. A total of 15 Indian States have already adopted EV policies to promote stronger EV deployment, the majority of which include additional demand incentives. Bulk procurement schemes, the emergence of the battery-as-a-service (BaaS) business model and India's draft battery swapping policy all give further impetus to the rapidly rising sales of electric three-wheelers.

Electric Vehicle sales penetration will reach over 85% by 2030 in 3 Wheelers segment and Total Cost of Ownership will decrease in all segments of vehicles.

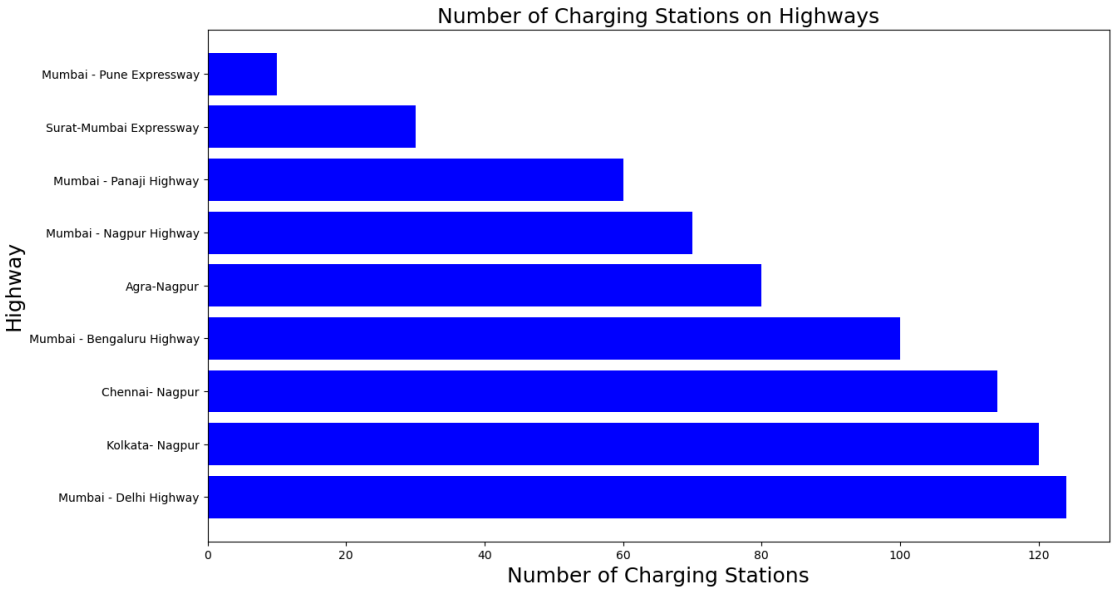


Demographics:

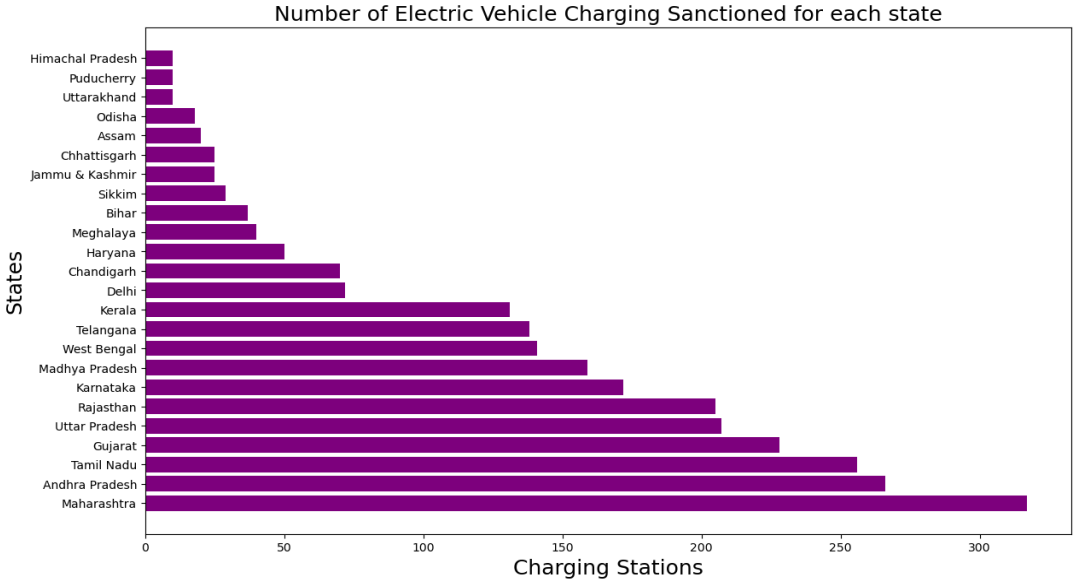
Charging Aggregators in India:



Number of Charging stations and Highways:

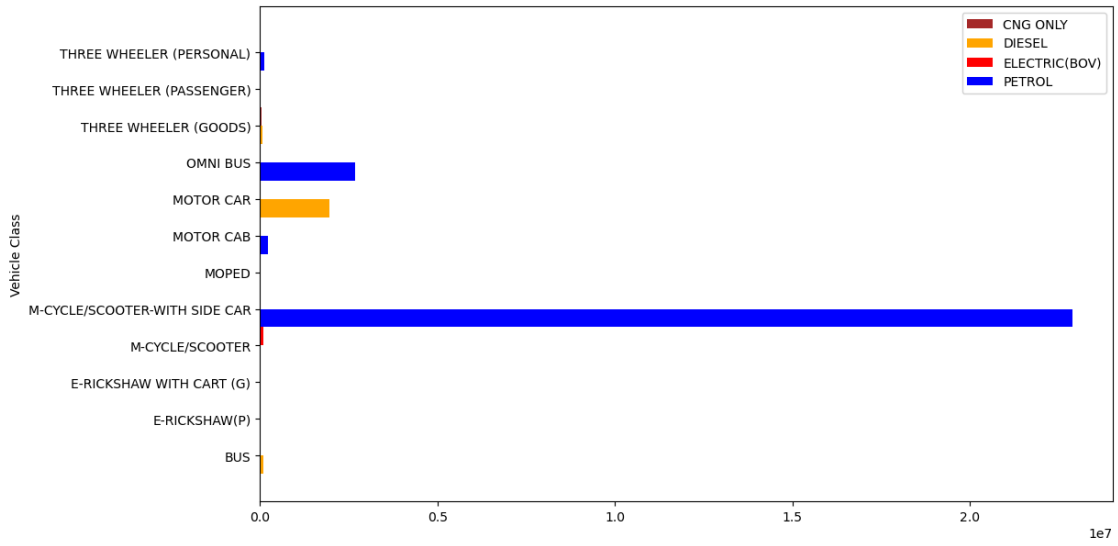


State wise Number of charging stations:

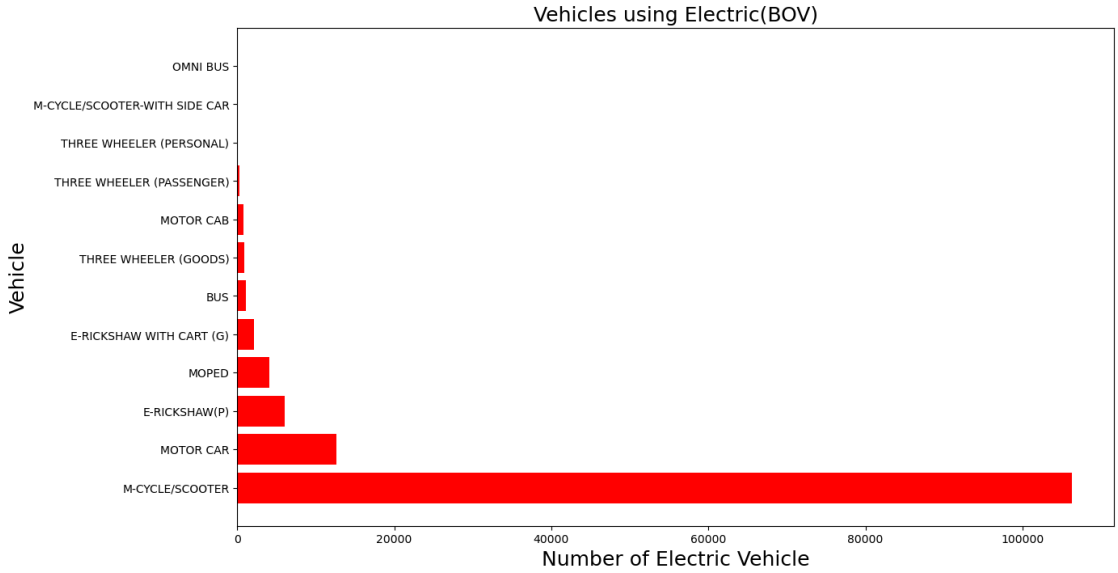


Visualizing the fuel types used for each vehicle class & identifying vehicle categories utilizing Battery Electric Vehicle (BEV) technology.

Maharashtra:

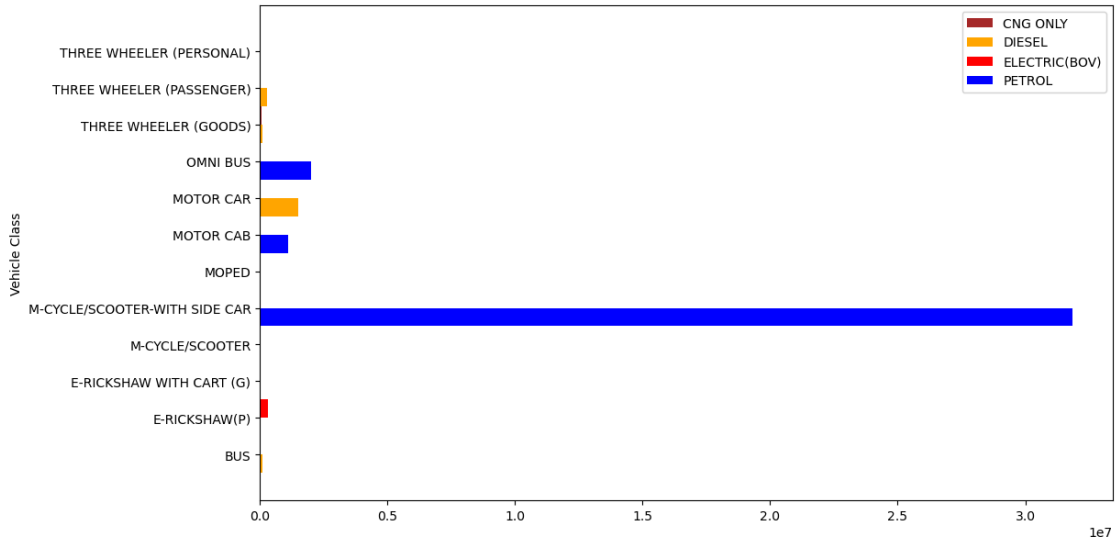


- The visualization displays the utilization of different fuel types across various vehicle classes.

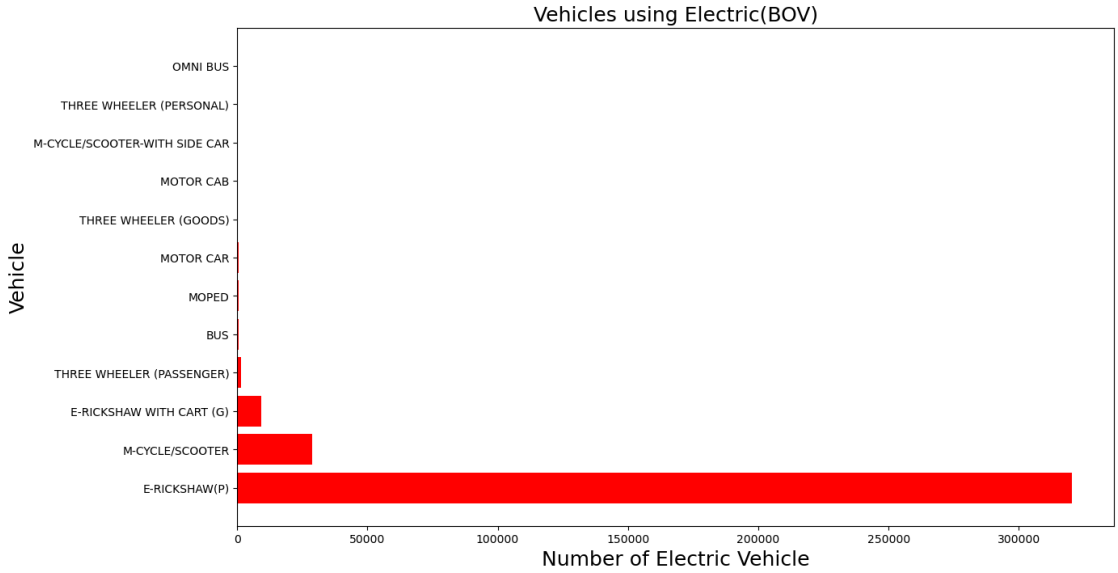


- The visualization highlights specific vehicle categories within the Maharashtra state that present opportunities for targeting Battery Electric Vehicles (BEVs).

Uttar Pradesh:

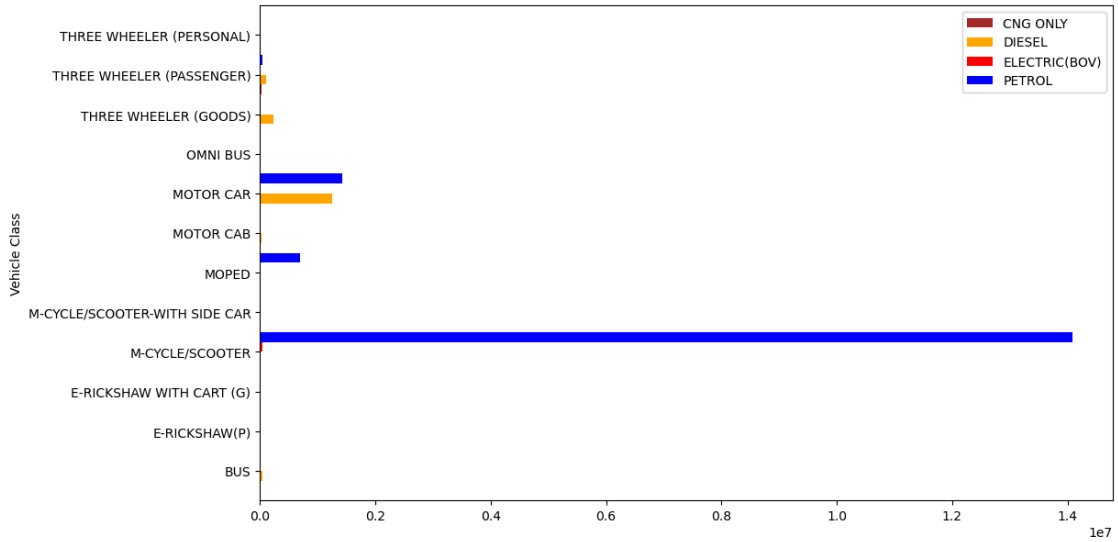


- This plot explains utilisation of different fuels in the state UP.

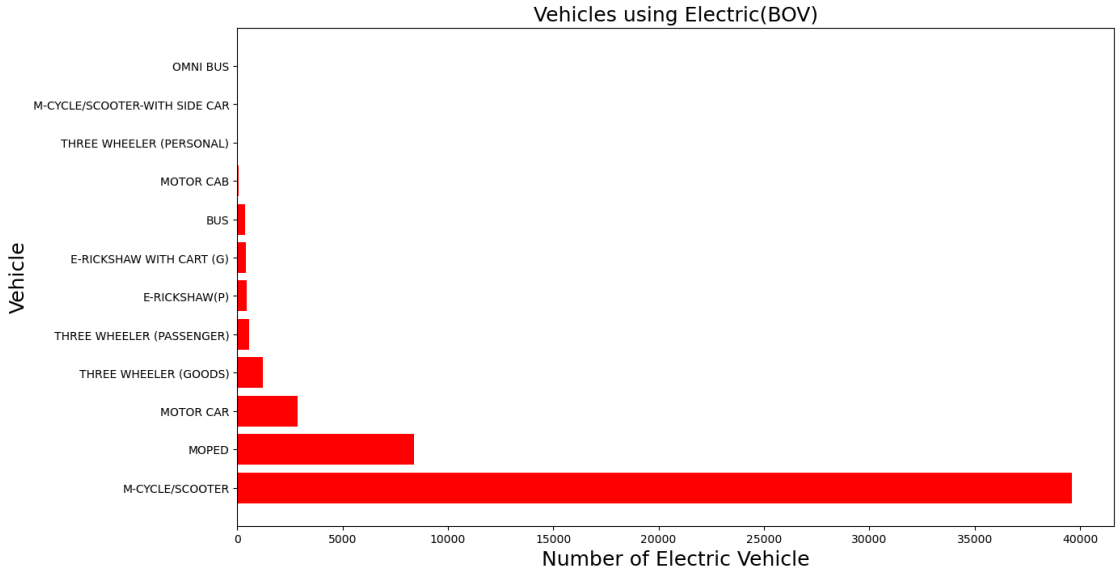


- This plot illustrates the potential opportunities within the Electric Vehicle (EV) market in Uttar Pradesh (UP).

Gujarat

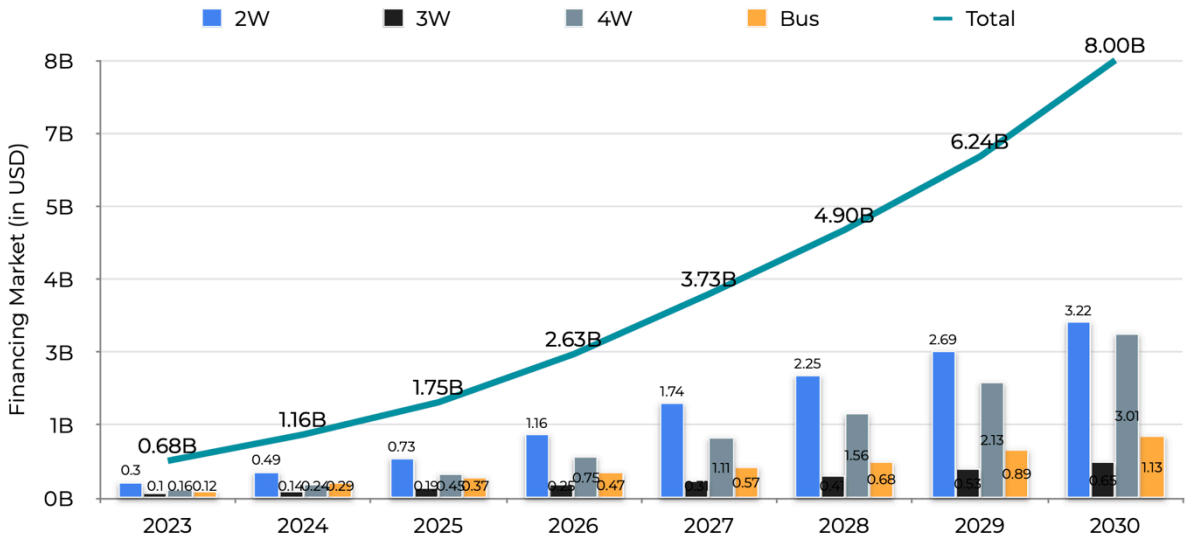


- This plot explains utilisation of different fuels in the state Gujarat



- This plot illustrates the potential opportunities within the Electric Vehicle (EV) market in Gujarat.

Vehicles Sales Forecasting:

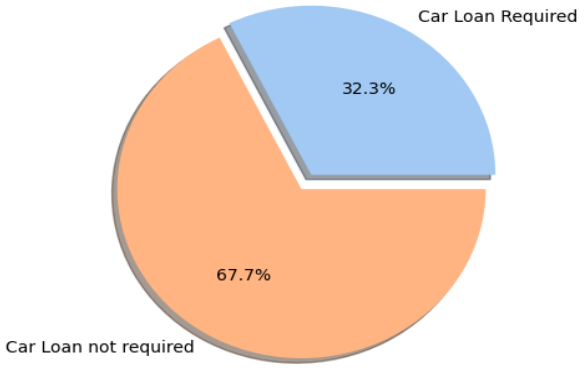


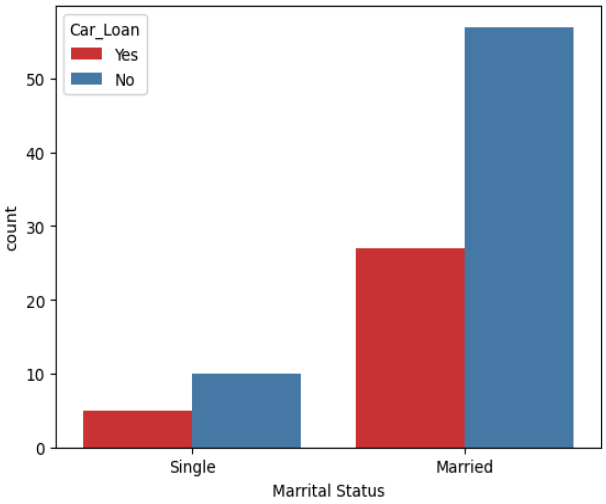
Vehicle Financing:

Although the electric vehicle industry has seen significant progress, the EV financing market is hindered by several fundamental challenges.

These challenges include higher interest rates for non-premium vehicle categories and a widespread lack of understanding and apprehension regarding EVs and their battery life.

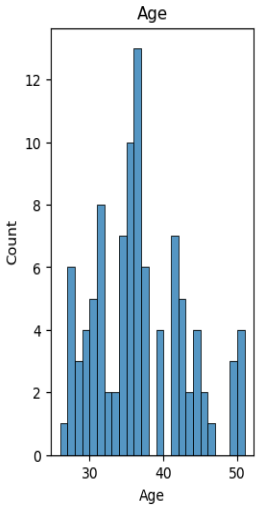
According to NITI Aayog, the two-wheeler EV market is projected to reach INR 35K Cr - INR 40K Cr by FY26, with the EV financing market for this segment expected to reach INR 13K Cr - INR 15K Cr by then.

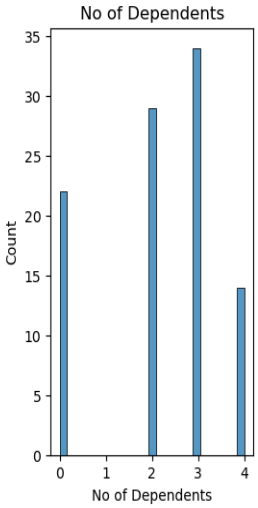


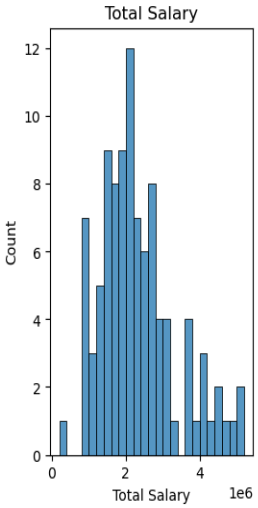


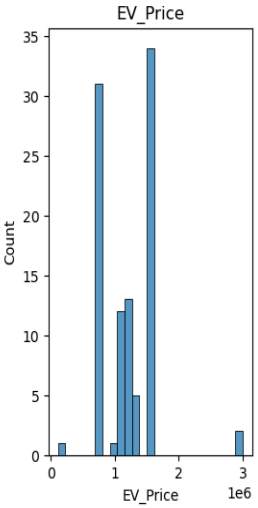
	EV Penetration	EV Market Volume	EV Market Size (Rs. Cr.)	Financing Market Size (Rs. Cr.)
2W	13-15%	2800-3200k	35-40k	13-15k
3W	18-20%	85-95k	3.5-4k	2.5-3k
Cars	3-5%	170-230k	28-36k	20-27k
LCV	3-5%	18-22k	1.9-3.2k	1.5-2.5k
Bus	8-9%	15-20k	10-12k	8-10k
Total	11-13%	3000-3600k	75-95k	45-55k

Analysis of EV Purchases: Age, Dependents, Salary, and EV Price Trends

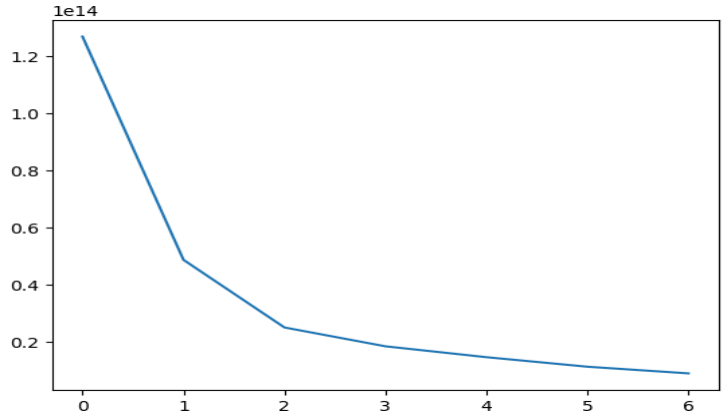


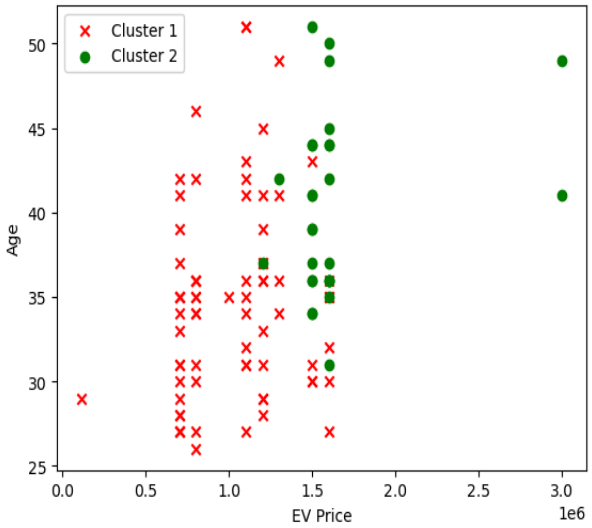


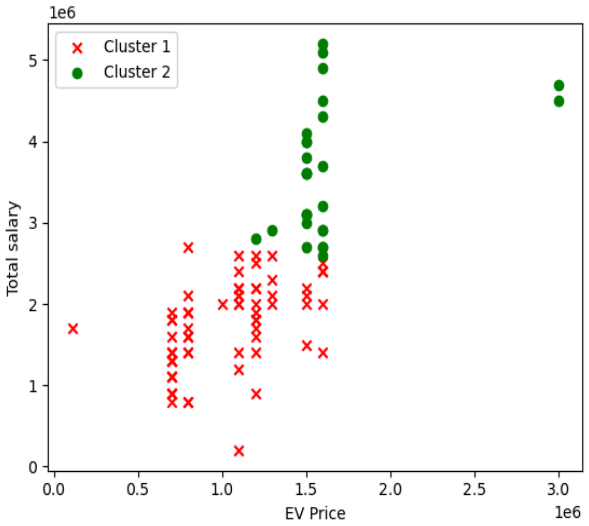


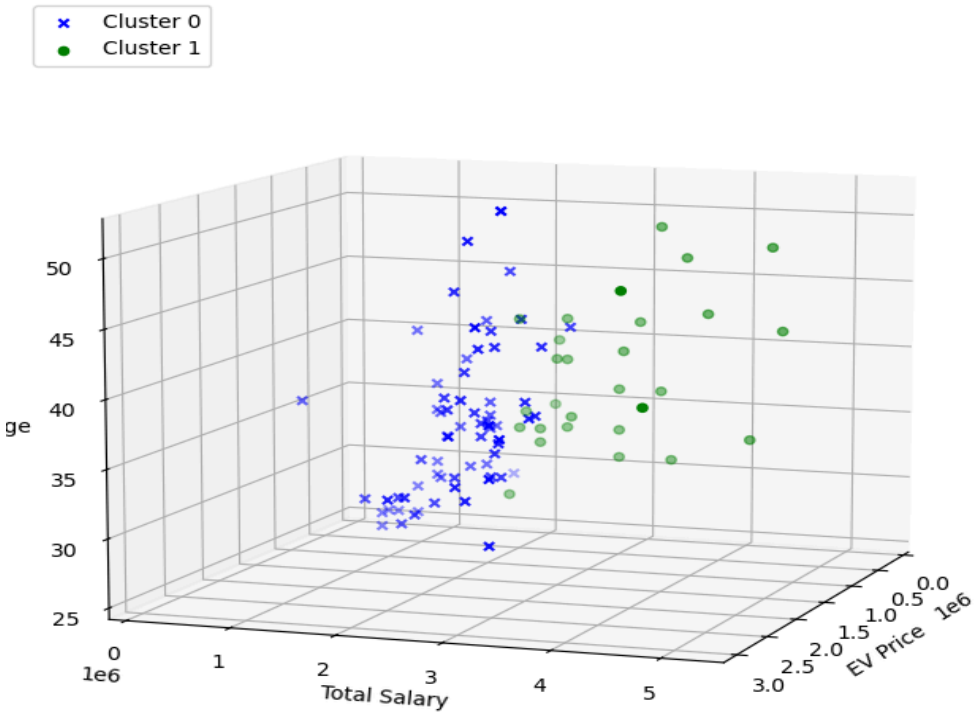


Finding number of optimal clusters, K- Means: By Elbow method we got K = 2.




Cluster 1
Cluster 2
Age
EV Price
1e6

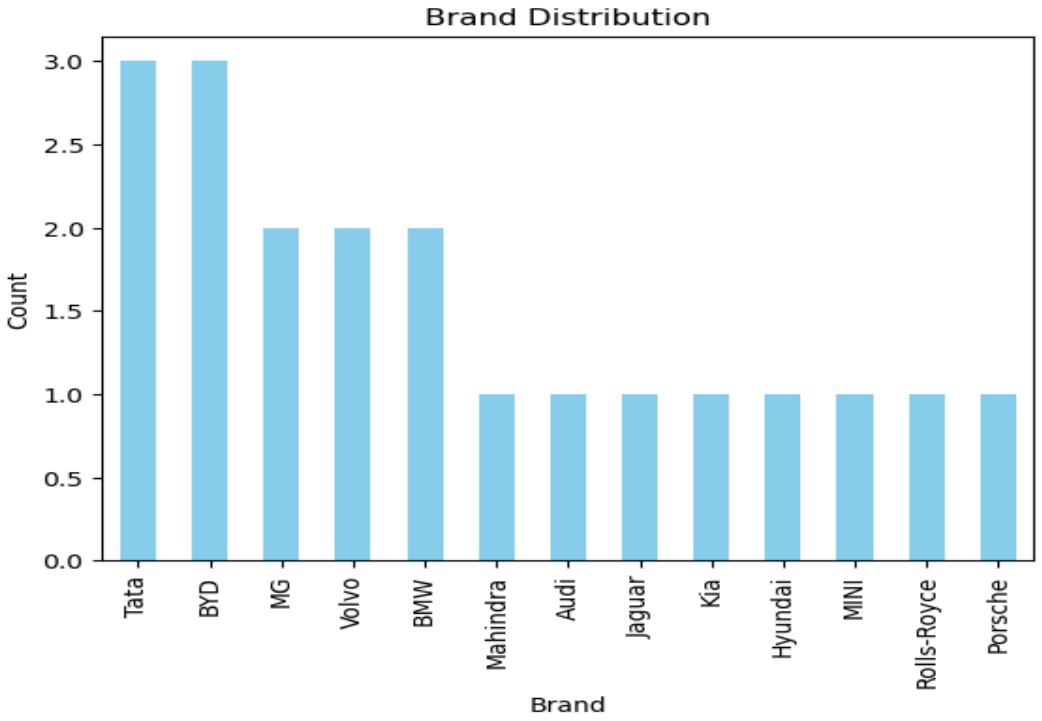

1e6
Cluster 1
Cluster 2
Total salary
EV Price
1e6

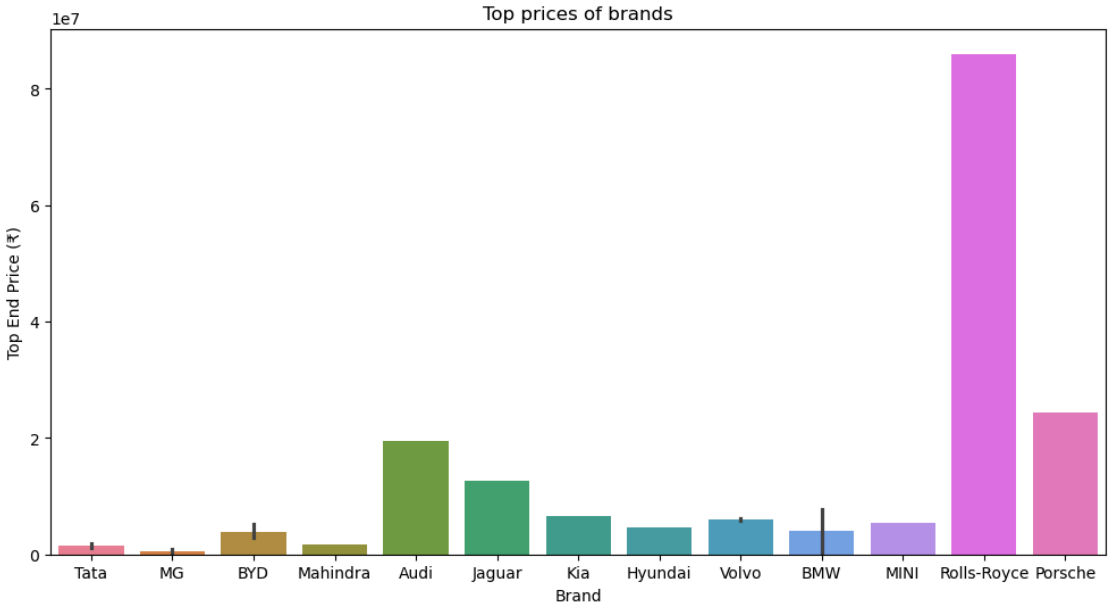


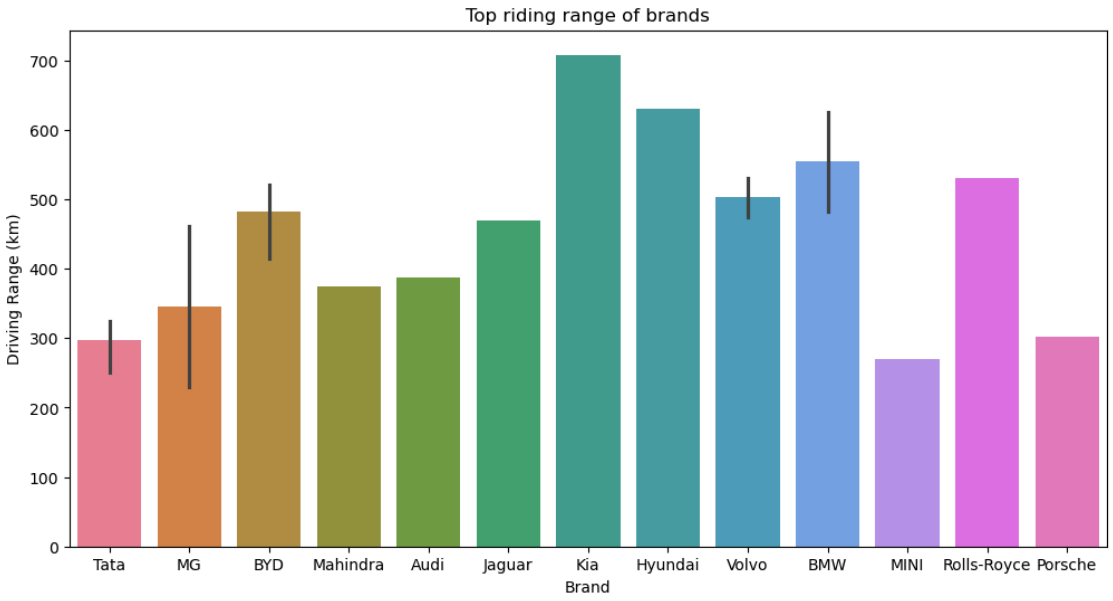
Technology Studies:

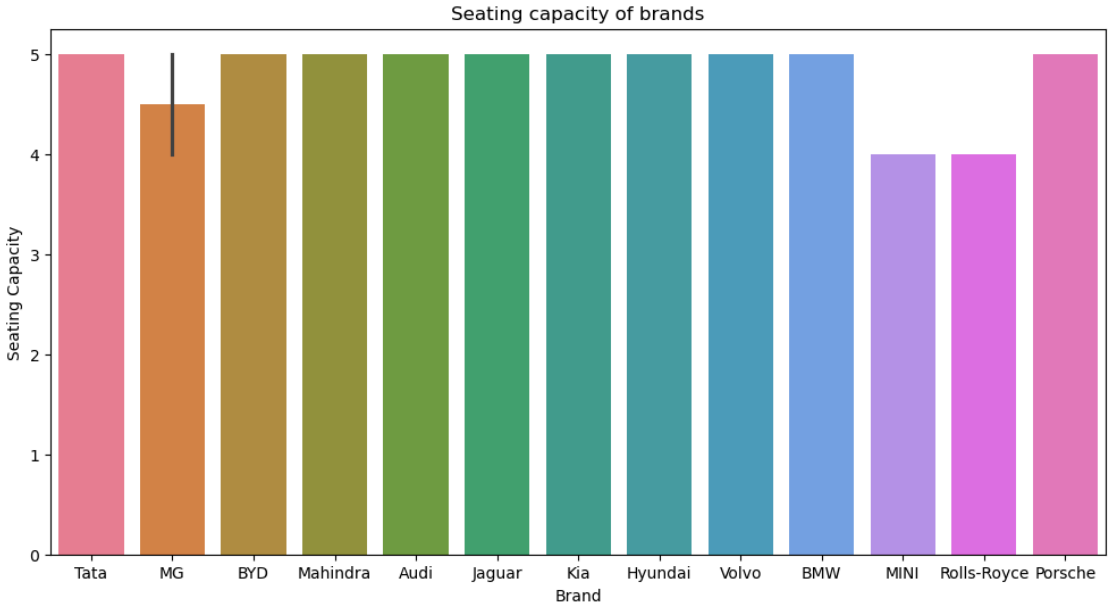
- *3 WHEELERS:*

Brand wise Vehicle Sales count

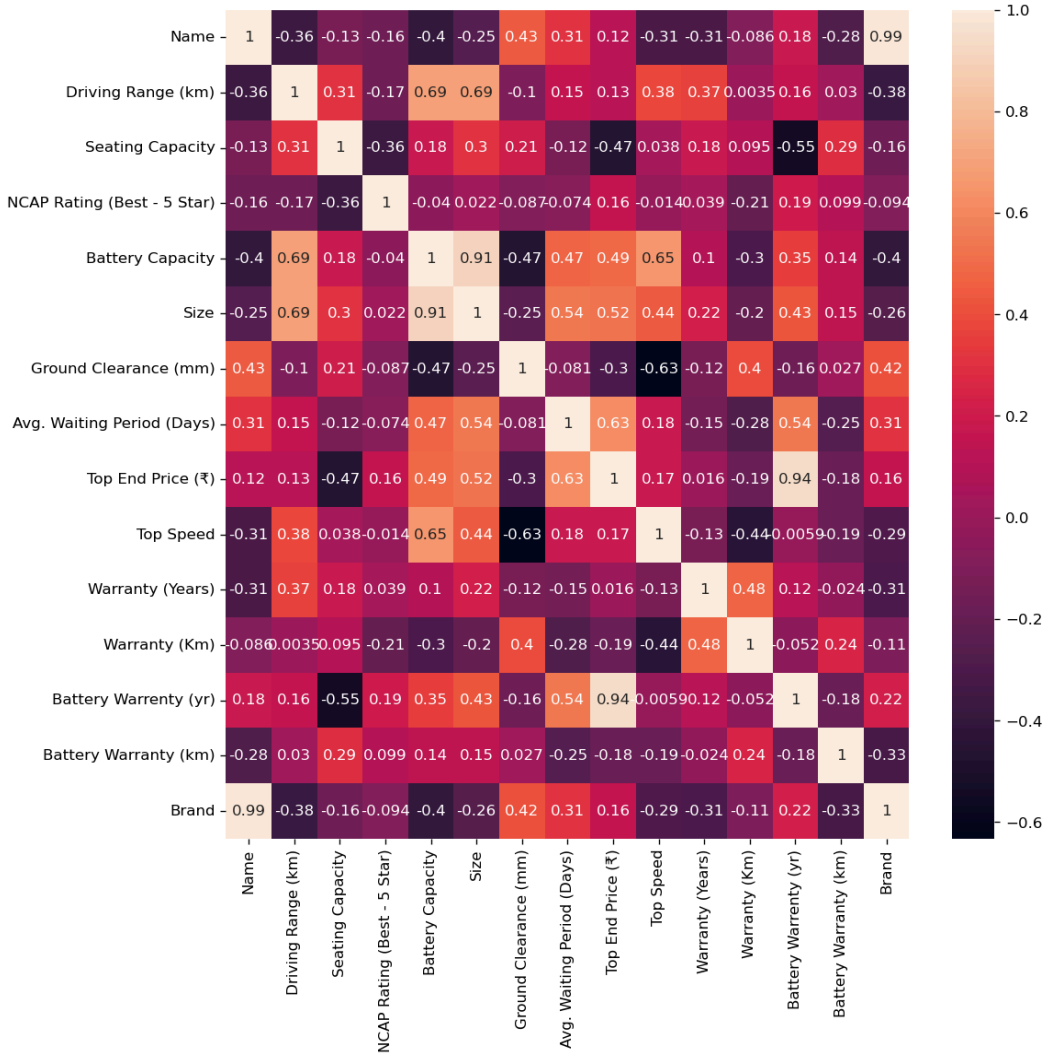

Brand Distribution
Count
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Tata
BYD
MG
Volvo
BMW
Mahindra
Audi
Jaguar
Kia
Hyundai
MINI
Rolls-Royce
Porsche
Brand


Top prices of brands
1e7
Top End Price (₹)
8
6
4
2
0
Tata
MG
BYD
Mahindra
Audi
Jaguar
Kia
Hyundai
Volvo
BMW
MINI
Rolls-Royce
Porsche
Brand

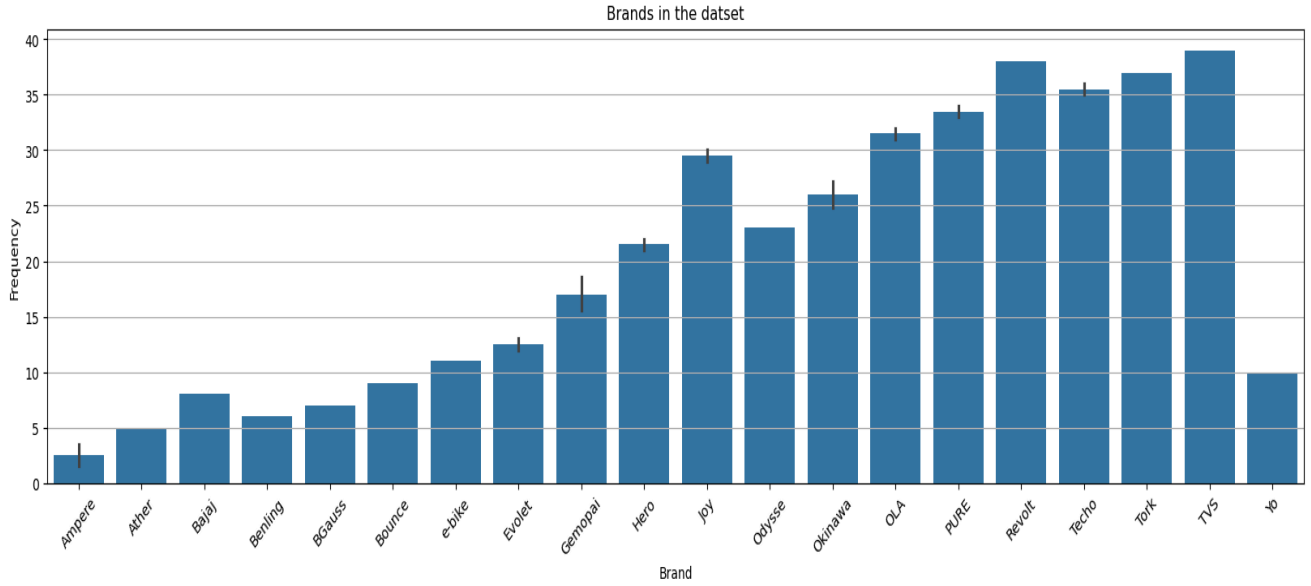

Top riding range of brands
Driving Range (km)
0
100
200
300
400
500
600
700
Tata
MG
BYD
Mahindra
Audi
Jaguar
Kia
Hyundai
Volvo
BMW
MINI
Rolls-Royce
Porsche
Brand

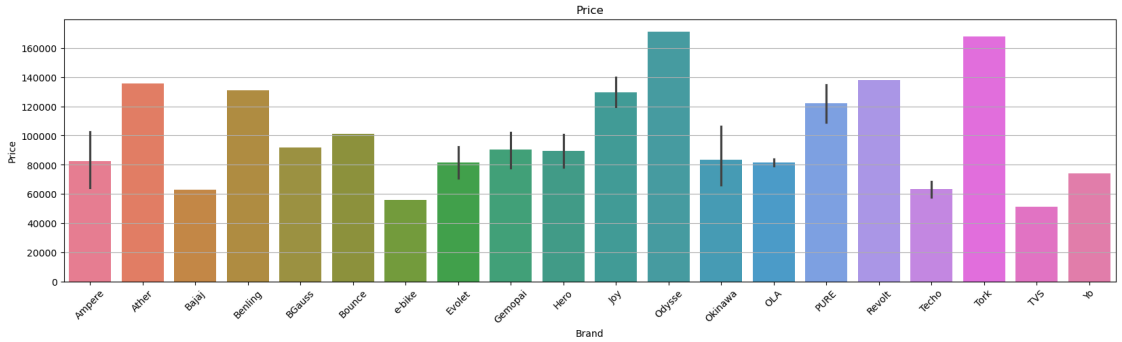

Seating capacity of brands
Seating Capacity
0
1
2
3
4
5
Tata
MG
BYD
Mahindra
Audi
Jaguar
Kia
Hyundai
Volvo
BMW
MINI
Rolls-Royce
Porsche
Brand

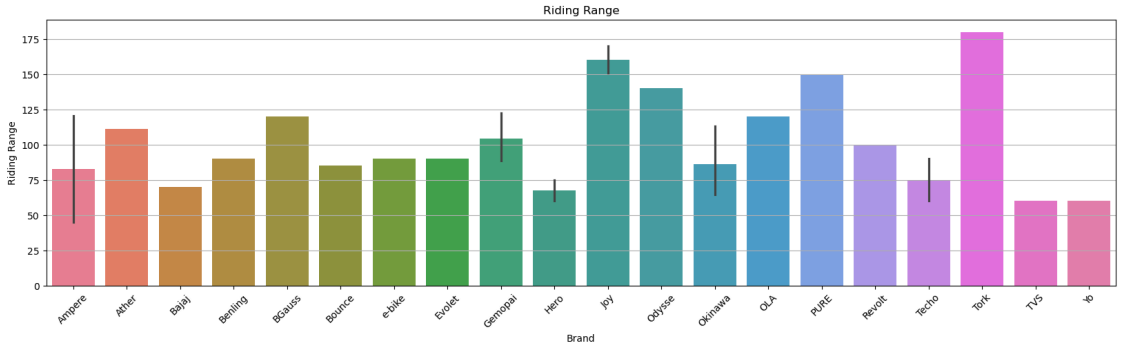
Heat Map:

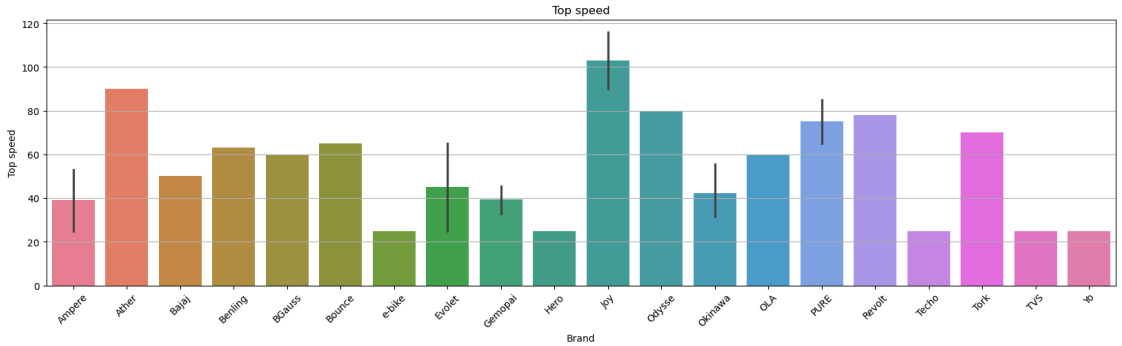

Name 1 -0.36 -0.13 -0.16 -0.4 -0.25 0.43 0.31 0.12 -0.31 -0.31 -0.086 0.18 -0.28 0.99
Driving Range (km) -0.36 1 0.31 -0.17 0.69 0.69 -0.1 0.15 0.13 0.38 0.37 0.0035 0.16 0.03 -0.38
Seating Capacity -0.13 0.31 1 -0.36 0.18 0.3 0.21 -0.12 -0.47 0.038 0.18 0.095 -0.55 0.29 -0.16
NCAP Rating (Best - 5 Star) -0.16 -0.17 -0.36 1 -0.04 0.022 -0.087 -0.074 0.16 -0.014 0.039 -0.21 0.19 0.099 -0.094
Battery Capacity -0.4 0.69 0.18 -0.04 1 0.91 -0.47 0.47 0.49 0.65 0.1 -0.3 0.35 0.14 -0.4
Size -0.25 0.69 0.3 0.022 0.91 1 -0.25 0.54 0.52 0.44 0.22 -0.2 0.43 0.15 -0.26
Ground Clearance (mm) 0.43 -0.1 0.21 -0.087 -0.47 -0.25 1 -0.081 -0.3 -0.63 -0.12 0.4 -0.16 0.027 0.42
Avg. Waiting Period (Days) 0.31 0.15 -0.12 -0.074 0.47 0.54 -0.081 1 0.63 0.18 -0.15 -0.28 0.54 -0.25 0.31
Top End Price (₹) 0.12 0.13 -0.47 0.16 0.49 0.52 -0.3 0.63 1 0.17 0.016 -0.19 0.94 -0.18 0.16
Top Speed -0.31 0.38 0.038 -0.014 0.65 0.44 -0.63 0.18 0.17 1 -0.13 -0.44 0.0059 -0.19 -0.29
Warranty (Years) -0.31 0.37 0.18 0.039 0.1 0.22 -0.12 -0.15 0.016 -0.13 1 0.48 0.12 -0.024 -0.31
Warranty (Km) -0.086 0.0035 0.095 -0.21 -0.3 -0.2 0.4 -0.28 -0.19 -0.44 0.48 1 -0.052 0.24 -0.11
Battery Warrenty (yr) 0.18 0.16 -0.55 0.19 0.35 0.43 -0.16 0.54 0.94 0.0059 0.12 -0.052 1 -0.18 0.22
Battery Warranty (km) -0.28 0.03 0.29 0.099 0.14 0.15 0.027 -0.25 -0.18 -0.19 -0.024 0.24 -0.18 1 -0.33
Brand 0.99 -0.38 -0.16 -0.094 -0.4 -0.26 0.42 0.31 0.16 -0.29 -0.31 -0.11 0.22 -0.33 1
Name
Driving Range (km)
Seating Capacity
NCAP Rating (Best - 5 Star)
Battery Capacity
Size
Ground Clearance (mm)
Avg. Waiting Period (Days)
Top End Price (₹)
Top Speed
Warranty (Years)
Warranty (Km)
Battery Warrenty (yr)
Battery Warranty (km)
Brand
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6

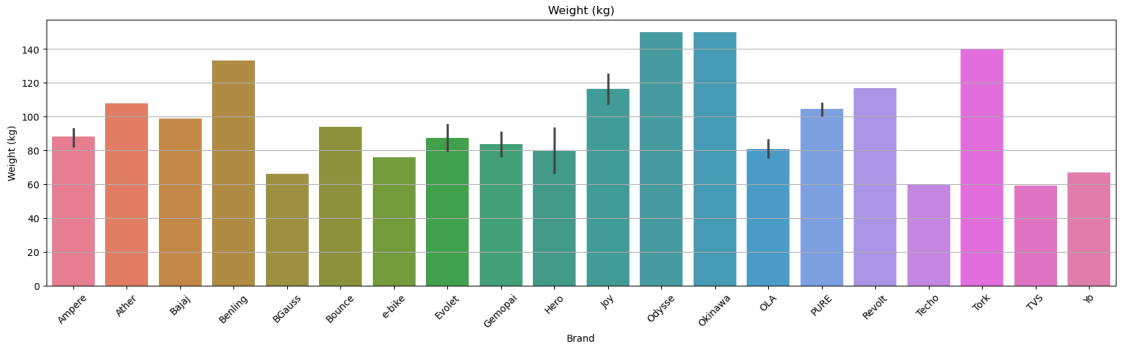
- *2 WHEELERS:*

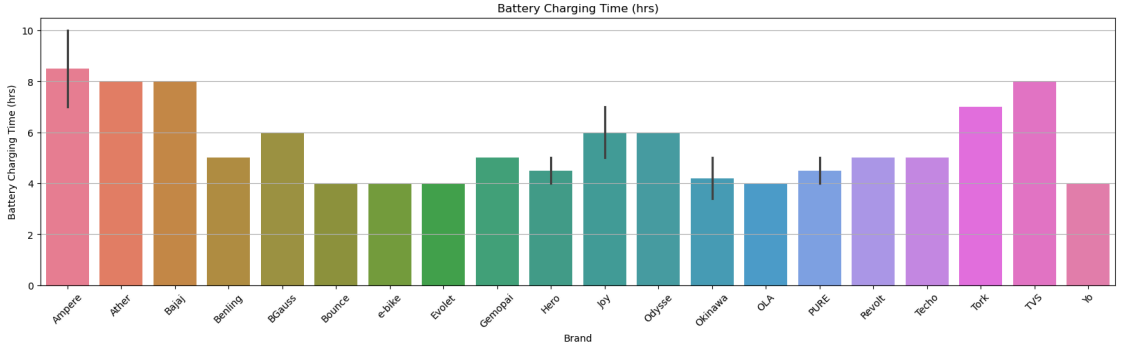

Brands in the datset
Frequency
Brand
Ampere
Ather
Bajaj
Benling
BGauss
Bounce
e-bike
Evolet
Gemopai
Hero
Joy
Odysse
Okinawa
OLA
PURE
Revolt
Techo
Tork
TVS
Yo


Price
Brand

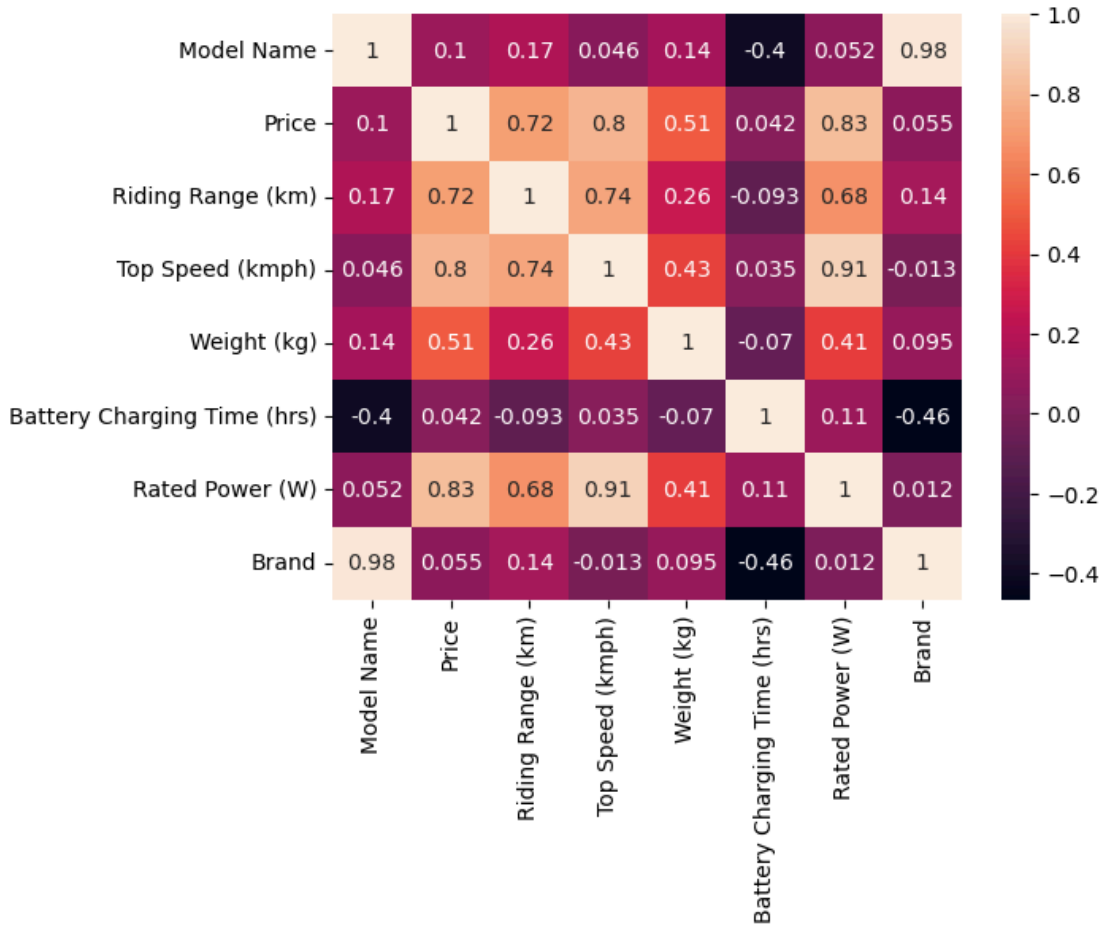

Riding Range
Brand


Top speed
Top Speed
Brand


Weight (kg)
Weight (kg)
0
20
40
60
80
100
120
140
Ampere
Ather
Bajaj
Benling
BGauss
Bounce
e-bike
Evolet
Gemopai
Hero
Joy
Odysse
Okinawa
OLA
PURE
Revolt
Techo
Tork
TVS
Yo
Brand

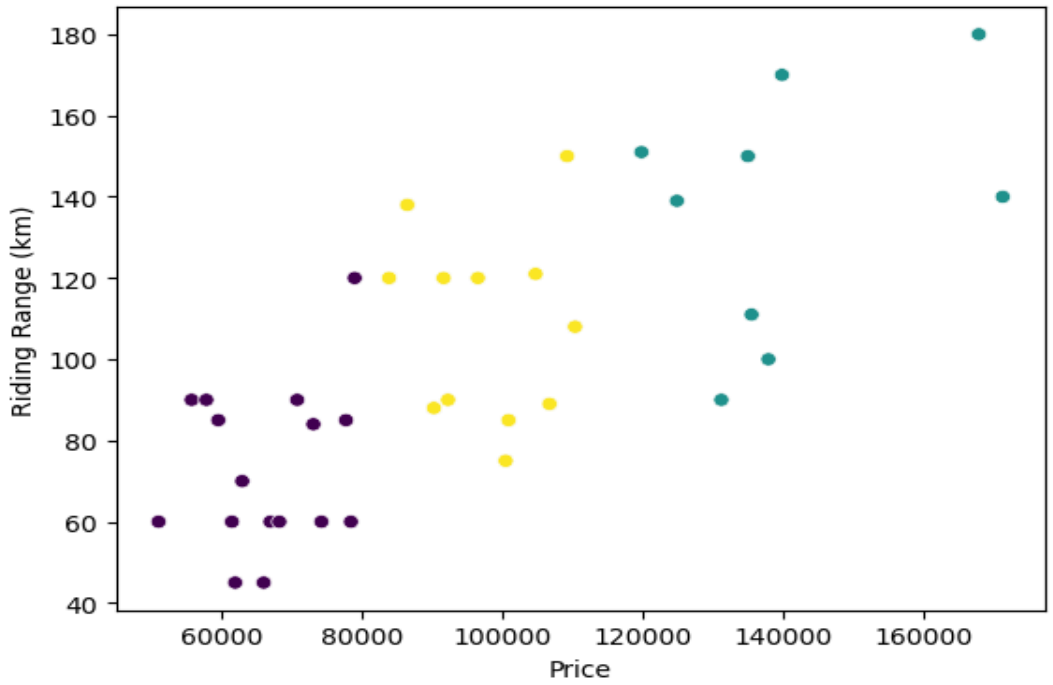

Battery Charging Time (hrs)
Battery Charging Time (hrs)
0
2
4
6
8
10
Ampere
Ather
Bajaj
Benling
BGauss
Bounce
e-bike
Evolet
Gemopai
Hero
Joy
Odysse
Okinawa
OLA
PURE
Revolt
Techo
Tork
TVS
Yo
Brand

Heat Map:



Riding Range:

By Elbow method, K =3.



Weight of Vehicle: