Electric Vehicle Market Segmentation A Report by Team Ajay –

[Ajay , Sanskruti , Monish , Murali, Nivas, Sahaj]

Abstract:

The need for sustainable growth is felt now than ever before because of various disasters and catastrophes due to unplanned human activity. The dwindling fossil fuels are a major issue and various alternate sources of energy are sought by companies. The E vehicle is an emerging concept and the automobile industry is conducting extensive research to make the option feasible and commercially viable. There are already some first movers like Tesla who have successfully developed their model and moving forward. This paper analyses the strategy and leadership of Tesla which have enabled them to be take the first mover advantage. A descriptive research based on secondary data had been employed in this study.

Electric vehicles (EV), as a promising way to reduce the greenhouse effect, have been researched extensively. With improvements in the areas of power electrics, energy storage and support, the plug-in hybrid electric vehicle (PHEV) provides competitive driving range and fuel economy compared to the internal combustion engine vehicle (ICEV). Operating with optimised control strategies or utilising the concept of the energy management system (EMS), the efficiency of the PHEV could be significantly improved. In this review paper, the operating process of the various types of EVs will be explained. Battery technology and super capacitor technology will also be discussed as a possibility to increase the energy capacity of PHEV.

Introduction:

The depletion of fossil fuels and the awareness towards sustainability had made many countries to opt for cleaner fuels. We find that the Government of India, in this regard, had set a 2030 target to migrate completely to electric vehicles. There are lot of questions about the feasibility of this target and the available supporting eco system for this transition. The passenger vehicle segment is yet to upgrade to this technology in India, except for a

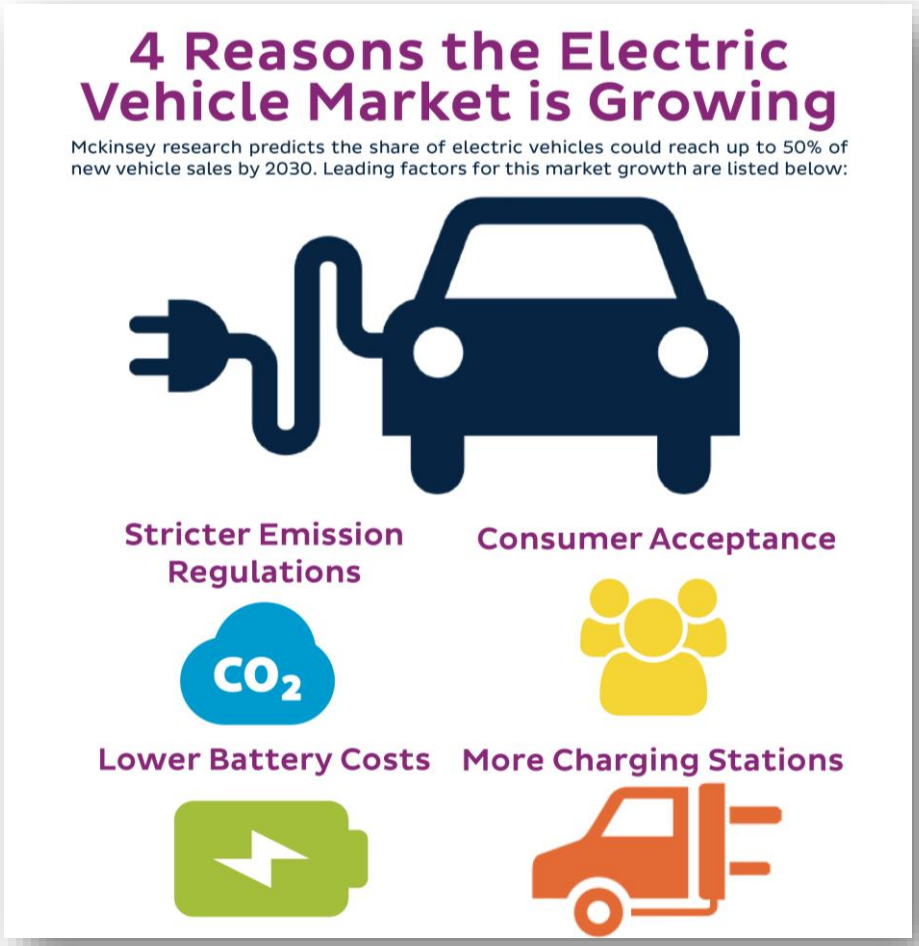
few players like Mahindra& Mahindra, who manufactures and sells electric cars. This study had analysed the case of Tesla in the light of their approach towards technology, scalability and leadership style. The ever rapidly growing transportation sector consumes about 49% of oil resources. Following the current trends of oil consumption and crude oil sources, the world's oil resources are predicted to be depleted by 2038 (Ehsani et al., 2010). Therefore, replacing the non-renewable energy resources with renewable energy sources and use of suitable energy-saving technologies seems to be mandatory.

Context:

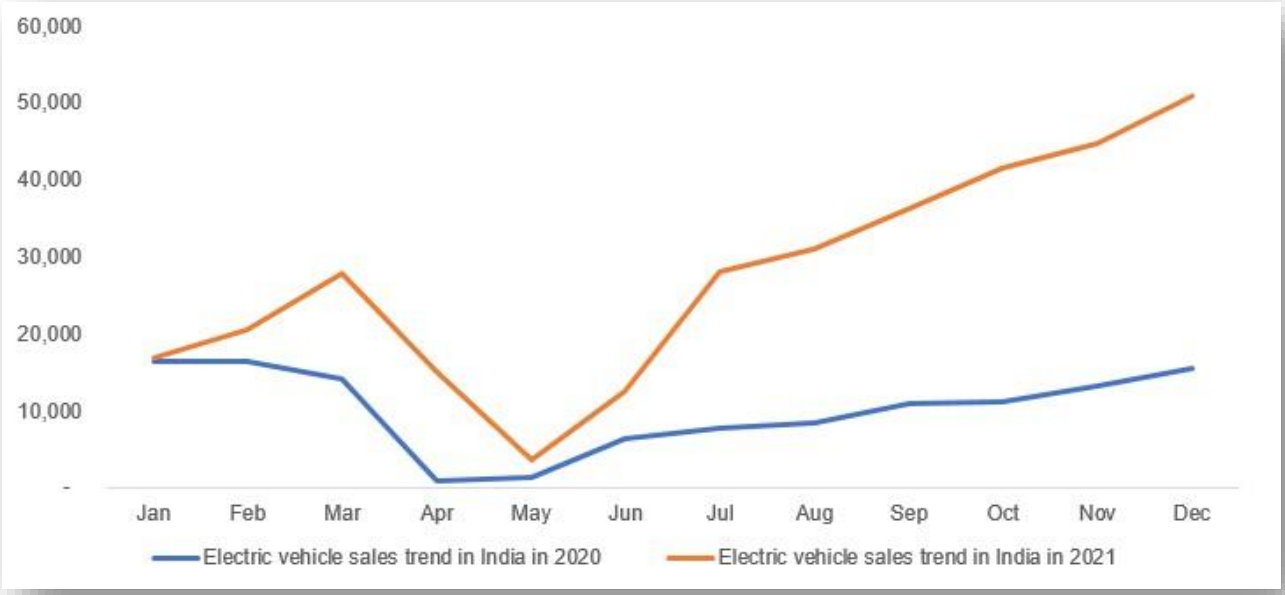
ReNew Power is a rapidly growing renewables company in India that has raised record amounts of capital and has scaled its portfolio to become India's largest renewables power company in a relatively short amount of time. ReNew alone generates more than 1% of all of India's electricity needs each year –all from renewables. Given ReNew's success in the clean electricity generation market, ReNew is now looking to diversify into new business areas. One of the most talked about areas in news media and industry circles is that of Electric Vehicles("EV"). EVs, if charged using electricity generated from clean energy sources, can be good for the environment; large-scale adoption of EVs will stand to reduce India's oil imports, boost employment across the value chain(battery manufacturing, assembly, etc.), increase demand for electricity at home, and promote investments in more clean energy projects in the country

Reasons Why EV Market is Growing –

The global electric vehicle (EV) market is developing at a rapid pace. According to EV volumes, overall electric vehicle reached a global share of 8.3% (including battery electric vehicles [BEVs] and Plug- in hybrid electric vehicles [PHEVs]) in 2021 from 4.2% in 2020 with 6.75 million vehicles on the road. This is an increase of 108% as of



2020. EVs are gaining attention across the globe as they help reduce emissions and depletion of natural resources. The Indian EV market is also evolving fast as close to 0.32 million vehicles were sold in 2021, up 168% YoY. Ongoing electric vehicle adoption in India is based on the Paris agreement to reduce carbon emissions, to improve the air quality in urban areas and reduce oil imports.



EV Market in India –

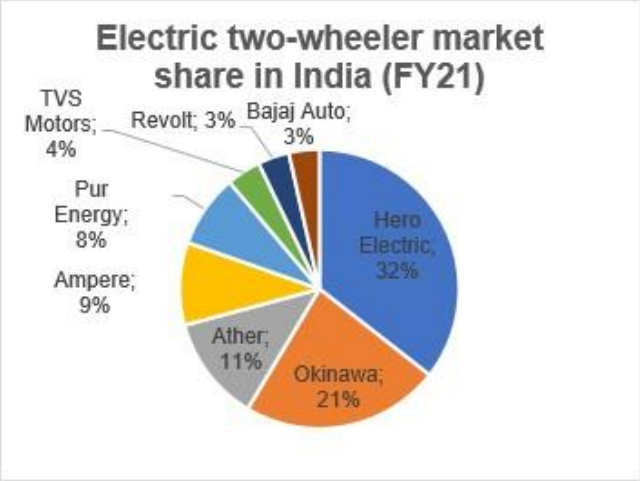
The Indian automobile industry is the fifth largest in the world and is expected to become the third largest by 2030. As per India Energy Storage Alliance (IESA), the Indian EV industry is expected to expand at a CAGR of 36%. As population rises and demand for vehicles grow, dependence on conventional energy resources is not a sustainable option as India imports close to 80% of its crude oil requirements. NITI Aayog aims to achieve EV sales penetration of 70% for all commercial cars, 30% for private cars, 40% for buses and 80% for two and three-wheelers by 2030. This is in line with the goal to achieve net zero carbon emission by 2070. Over the last three years, 0.52 million EVs were registered in India, according to the Ministry of Heavy Industries. EVs recorded robust growth in 2021, supported by the implementation of favourable policies and programmes by the government.

In India, Uttar Pradesh held the highest share in EV sales in 2021, with the number of units sold across all segments reaching 66,704, followed by Karnataka with 33,302 units and Tamil Nadu with 30,036

units. Uttar Pradesh dominated the three-wheeler segment, while Karnataka and Maharashtra led the two-wheeler segment and four-wheeler segment, respectively.

State -Wise-EV Sales Trend in 2021

Hero Electric, Okinawa and Ather Energy controls the electric two-wheeler market in India with a combined market share of 64%. Hero Electric has a market share of 36% followed by Okinawa with 21%. Ather Energy with an 11.1% market share is slowly gaining market share, as the company is currently expanding its distribution network across India. In the passenger vehicle segment, Tata Motors enjoys a commanding position in electric vehicle space with a market share of 71%, led by their two key models, Nexon and Tigor EV. MG Motors India enjoys the second position and offers the longest-range EV (MG EZS provides 439 KM range on a single charge). Other Indian manufacturers have announced their models and is expected to be launched in the future.



Geographic Segmentation -

Highest electric vehicle sales in India: These five states top the list

The map of India is apparently going green. Well, no Not because of forest areas have increased but because these states have registered the most electric vehicle sales in the Country. That is going green in one way –

The Better India has put together an infographic that highlights that five states in India that have the most electric vehicle registration's, namely Uttar Pradesh, Delhi, Karnataka, Bihar, and Maharashtra (in that order).

According to this data, UP has the most EV registrations at 2,55,700, Delhi has 1,25,347, Karnataka has the most EV registrations at 2,55,700, Delhi has 1,25,347 , Karnataka has 72,544, Bihar has 58,014 and Maharashtra has 52,506 EV registrations.

It needs to be noted that the number of EVs includes two- and three-wheelers and most of the EV registrations in India come from these segments. The state of UP tops the list due to the widespread use of electric rickshaws (three-wheelers) in several of its cities.

Delhi sits on the second spot on the list thanks to the subsidies backed by the state's EV policy. The sale of electric scooters has been on the rise here owing to FAME II and other subsidies.

Karnataka is the hub of EV startups and many electric vehicle companies like Ather are based out of Bengaluru and the state's EV charging infrastructure has been growing as well.

Different perspectives :

Individual state policies, however have some difference too. While some are bending over backwards to boost demand for electric scooters and cars, others have chosen to promote EV manufacturing instead, at least for now.

Maharashtra, Delhi and Gujarat are handing out substantial incentives to EV buyers, even making the upfront cost of electric vehicles competitive with their ICE (internal combustion engine) counterparts in certain cases. Notably, these state subsidies are over and above those granted by the Centre under the FAME II scheme. But how do the states manage doling out such heavy incentives?

The answer is simple – the polluter pays. Many of these governments, are imposing additional road tax on ICE vehicles, green tax on re-registration of old vehicles, cess on petrol and diesel and a congestion fee on ICE cabs to fund their EV ambitions.On the other hand, southern states, among others, are primarily targeting electric vehicle production instead. Tamil Nadu, Andhra Pradesh, Telangana and Karnataka are each aiming to attract thousands of crores of investment from EV makers in the next few years by providing them subsidies on capital investment, taxes, power tariff and so on.

Governments all over the country, then, seem to be really warming up to the idea of electric vehicles. Will the consumers follow suit:

THE SUBSIDY EFFECT

Model	On-road price	Remarks
Tata Nexon EV XM ■ Regular Price	**Rs15.86 lakh**	Pan India price with central govt. registration fee waiver
Tata Nexon EV XM ■ Lowest Price	**Rs12.50 lakh***	Price lowest in Maharashtra which offers maximum incentives ** Additional scrapping incentive available*
Tata Nexon Diesel XE	**Rs 10.25 lakh**	(Maharashtra)

FAME II SCHEME

- Direct incentive Rs 15,000 per kWh, up to Rs 30,000 per e2W, capped at 40% of vehicle cost
- Direct incentive Rs 10,000 per kWh, up to Rs 1,50,000 per e4W (EV), up to Rs 13,000 per e4W (Plug-in Hybrid, Strong Hybrid), capped at 20% of vehicle cost
  - Max. ex-factory price: Rs 1,50,000 for e2W and Rs 15,00,000 for e4W
  - Validity, first 10 lakh e2Ws and 55,000 e4Ws
  - Available only for e2W and commercial e4W
  - Provided in addition to state subsidies

DELHI

- Registration fee, road tax waiver for e2W, e4W
- Direct incentive Rs 5,000 per kWh, up to Rs 30,000 per e2W, Rs 10,000 per kWh, up to Rs 1,50,000 per e4W
  - Validity, first 1,000 e4Ws
- Scrapping incentive up to Rs 10,000 per e2W for ICE 2W scrapped in exchange

RAJASTHAN

- Registration fee waiver for e2W, e4W
- Direct incentive up to Rs 10,000 per e2W registered between Apr 1, 2021 - Mar 31, 2022
  - Additional reimbursement of SGST for e2Ws, e4Ws

CHANDIGARH

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W
  - Validity till 2024
- Direct incentive Rs 20,000 per e2W, e3W
  - Validity, first 3,000 e2Ws, e3Ws

PUNJAB

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W (100 percent for EVs and 50 percent for Hybrids)
  - Validity, 5 years

UTTARAKHAND

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W
  - Validity, first 1,00,000 EVs

UTTAR PRADESH

- Registration fee waiver for e2W, e4W
- Road tax waiver 100 percent for e2W, 75 percent for e4W
  - Validity, first 1,00,000 EVs made and sold in UP

MEGHALAYA

- Registration fee, road tax waiver for e2W, e4W
- Direct incentive Rs 10,000 per kWh, up to Rs 20,000 per e2W, Rs 4,000 per kWh, up to Rs 60,000 per e4W
  - Max. ex-factory price: Rs 1,50,000 for e2W and Rs 15,00,000 for e4W
  - Validity, first 3,500 e2Ws and 2,530 e4Ws (2,500 EVs and 30 Hybrids)

BIHAR

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W (100 percent for EVs and 50 percent for Hybrids)
- Direct incentive Rs 10,000 per kWh, up to Rs 20,000 per e2W, up to Rs 1,50,000 per e4W (EV), up to Rs 13,000 per e4W (Hybrid)
  - Additional Rs 7,000 per kWh, up to Rs 14,000 per e2W with Li ion
  - Validity, first 24,000 e2Ws and 5,000 e4Ws (4,000 EVs and 1,000 Hybrids) made and sold in Bihar

MADHYA PRADESH

- Registration fee waiver for e2W, e4W

KERALA

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W
  - Validity till 2022

GUJARAT

- Registration fee waiver for e2W, e4W
- Direct incentive Rs 10,000 per kWh, up to Rs 20,000 per e2W, up to Rs 1,50,000 per e4W
  - Max. ex-factory price: Rs 1,50,000 for e2W and Rs 15,00,000 for e4W
  - Validity, first 1.1 lakh e2Ws and 20,000 e4Ws

GOA

- Registration fee, road tax waiver for e2W, e4W
- Direct incentive Rs 10,000 per kWh, up to Rs 30,000 per e2W, up to Rs 1,50,000 per e4W
  - Validity, 10,000 e2Ws and 500 e4Ws per annum for 5 years
- Scrapping incentive up to Rs 10,000 per e2W for ICE 2W scrapped in exchange

MAHARASHTRA

- Registration fee, road tax waiver for e2W, e4W
- Direct incentive Rs 5,000 per kWh, up to Rs 10,000 per e2W, up to Rs 1,50,000 per e4W
  - Max. battery: 3kWh for e2W and 30kWh for e4W
  - Validity, first 1 lakh e2Ws and 10,000 e4Ws
- Early bird incentive, up to Rs 15,000 per e2W, up to Rs 1,00,000 per e4W
  - Validity till Dec 31, 2021
- Rs 12,000 incentive for e2W sold with buyback scheme and minimum 5-year battery warranty
- Scrapping incentive up to Rs 7,000 per e2W and Rs 25,000 per e4W for ICE 2W and 4W scrapped in exchange, respectively

KARNATAKA

- Registration fee, road tax waiver for e2W, e4W

TELANGANA

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W
  - Validity, first 2,00,000 e2Ws, 5,000 private e4Ws and 5,000 commercial e4Ws

ODISHA

- Registration fee, road tax waiver for e2W, e4W
- Direct incentive up to Rs 5,000 per e2W and Rs 1,00,000 per e4W

TAMIL NADU

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W, e4W
  - Validity from Nov 1, 2020 - Dec 31, 2022

ANDHRA PRADESH

- Registration fee waiver for e2W, e4W
- Road tax waiver for e2W,e4W
  - Validity till 2024

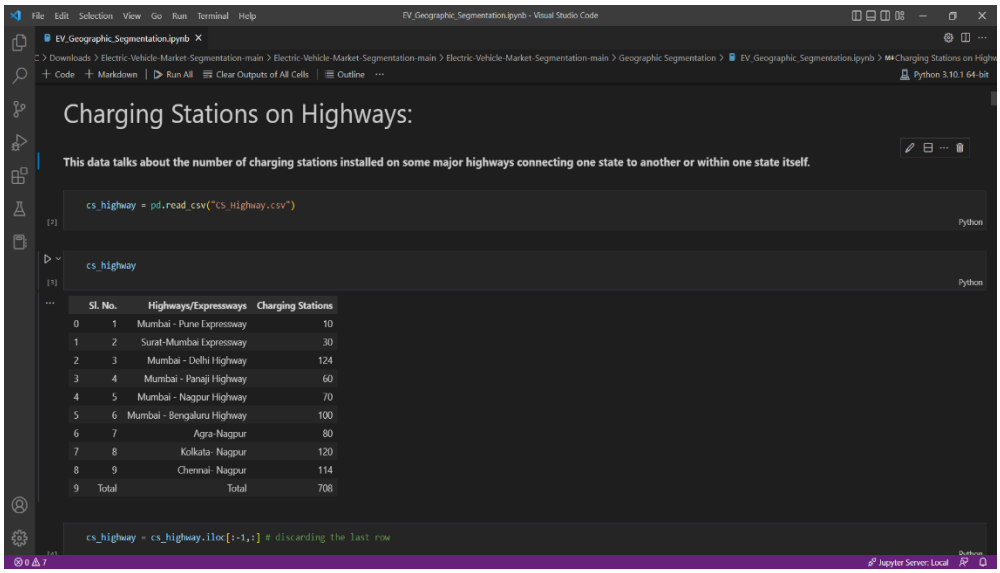
Vehicle Space to target based on State

Sr.	State	Vehicle Type (Based on Rank)
1	Maharashtra	I. Cycle / Scotter II. Car III. E - Rickshaw IV. Moped
2	Uttar Pradesh	I. E - Rickshaw II. Cycle / Scotter III. 3 Wheeler (Passenger)
3	Delhi	I. E - Rickshaw II. Cycle / Scotter III. Car IV. 3 Wheeler (Goods)
4	Karnataka	I. Cycle / Scotter II. 3 Wheeler (Passenger) III. Car IV. Moped
5	Gujarat	I. Cycle / Scotter II. Moped III. Car IV. 3 Wheeler (Goods)
6	Rajasthan	I. Cycle / Scotter II. E - Rickshaw III. Moped IV. Car

Electric Vehicle Charging Station :

There are 2466 EV charging stations in India spread across 273 cities. Of these, Maharashtra has the highest number with 527 charging stations while Tripura has the least with 1 charging stations. Locate electric car charging points across India including charging cost by clicking on the EV brand of your choice.

EV Charging Station’s near highway :



Charging Stations on Highways:

This data talks about the number of charging stations installed on some major highways connecting one state to another or within one state itself.

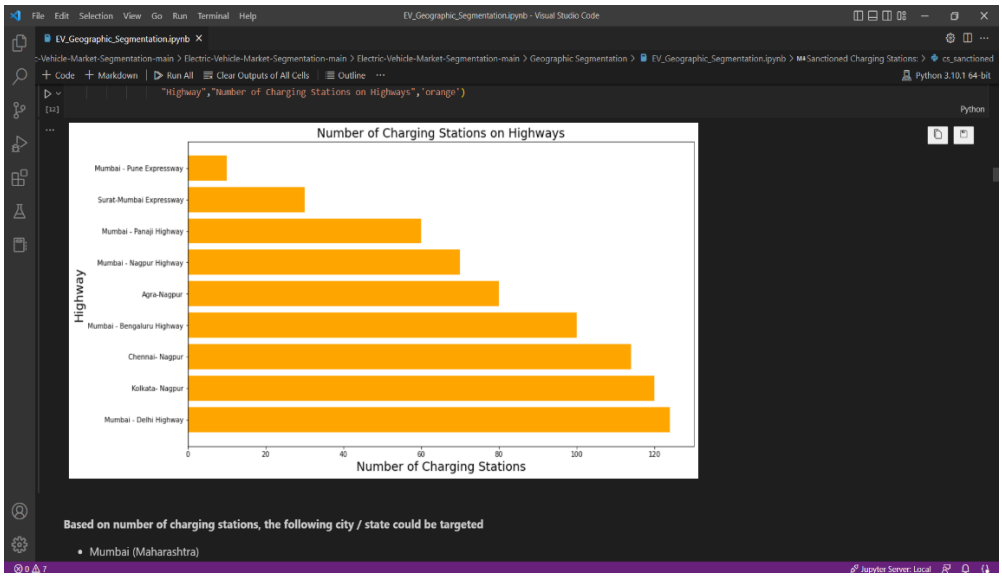
```
cs_highway = pd.read_csv("CS_Highway.csv")
```

```
cs_highway
```

	Sl. No.	Highways/Expressways	Charging Stations
0	1	Mumbai - Pune Expressway	10
1	2	Surat-Mumbai Expressway	30
2	3	Mumbai - Delhi Highway	124
3	4	Mumbai - Panaji Highway	60
4	5	Mumbai - Nagpur Highway	70
5	6	Mumbai - Bengaluru Highway	100
6	7	Agra-Nagpur	80
7	8	Kolkata- Nagpur	120
8	9	Chennai- Nagpur	114
9	Total	Total	708

```
cs_highway = cs_highway.iloc[:-1,:] # discarding the last row
```

The Visualized data:



Based on number of charging stations, the following city / state could be targeted

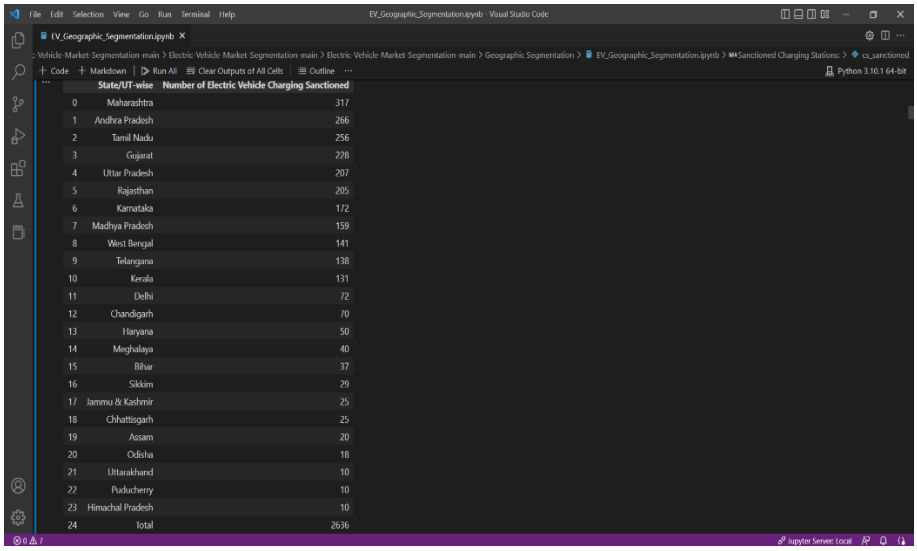
- Mumbai (Maharashtra)

Based on number of charging stations, the following city / state could be targeted:

- Mumbai (Maharashtra)
- Nagpur (Maharashtra)
- Delhi
- Bengaluru (Karnataka)
- Agra (Uttar Pradesh)

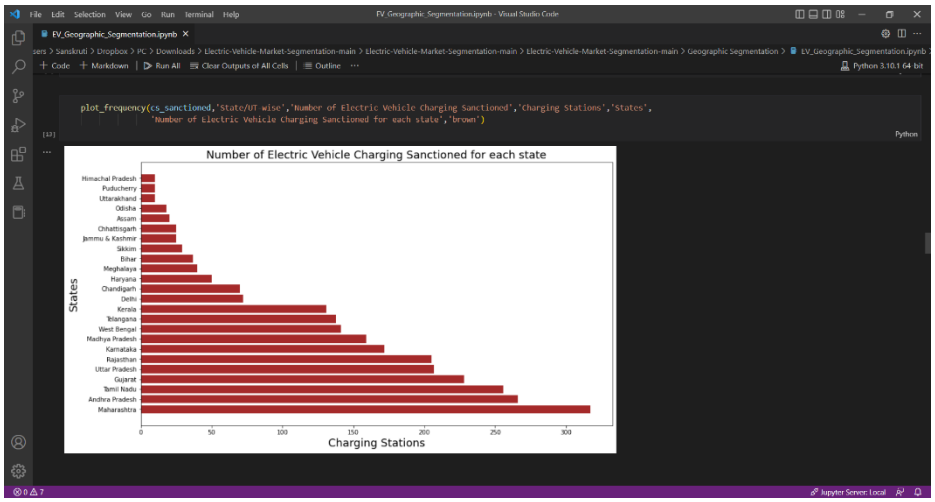
Sanctioned Charging Stations :

According to the data the team studied there are total **2636** EV Charging Stations in India which are sanctioned and near the highways.



	State/UT-wise	Number of Electric Vehicle Charging Sanctioned
0	Maharashtra	317
1	Andhra Pradesh	266
2	Tamil Nadu	256
3	Gujarat	228
4	Uttar Pradesh	207
5	Rajasthan	205
6	Karnataka	172
7	Madhya Pradesh	159
8	West Bengal	141
9	Telangana	138
10	Kerala	131
11	Delhi	72
12	Chandigarh	70
13	Haryana	50
14	Meghalaya	40
15	Bihar	37
16	Sikkim	29
17	Jammu & Kashmir	25
18	Chhattisgarh	25
19	Assam	20
20	Odisha	18
21	Uttarakhand	10
22	Puducherry	10
23	Himachal Pradesh	10
24	Total	2636

The Visualized data:



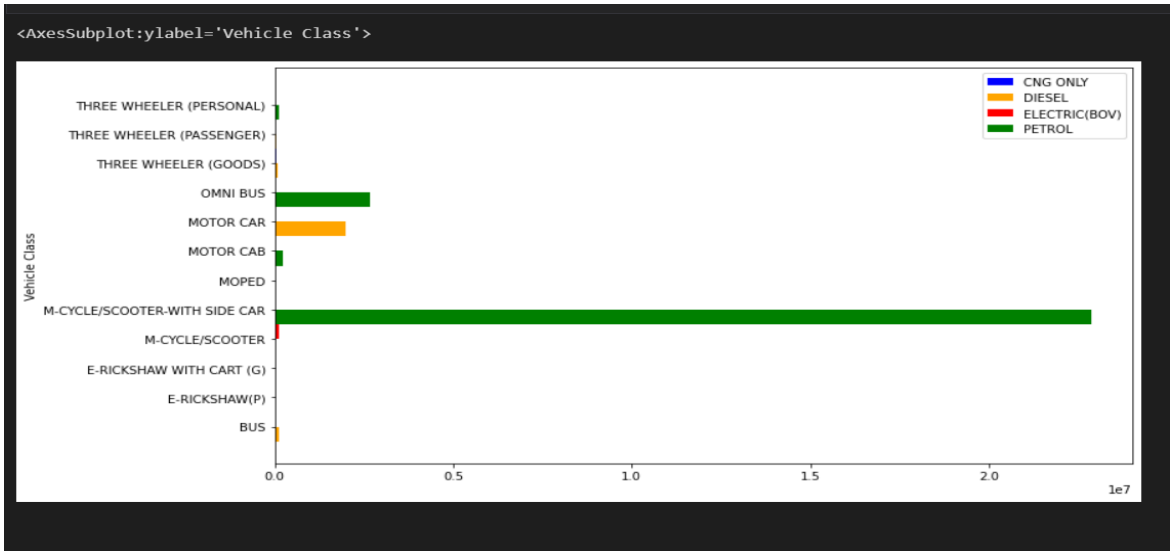
States to target based on charging stations sanctioned**

- Maharashtra
- Andhra Pradesh
- Tamil Nadu
- Gujarat
- Uttar Pradesh
- Rajasthan
- Karnataka

Different Fuel Types :

	Vehicle Class	CNG ONLY	DIESEL	ELECTRIC(BOV)	PETROL
1	ADAPTED VEHICLE	0	421	5	7,225
2	AGRICULTURAL TRACTOR	0	6,61,896	8	470
3	AMBULANCE	35	10,347	1	4,271
4	ANIMAL AMBULANCE	1	17	0	1
5	ARTICULATED VEHICLE	0	31,174	0	0
...	...	...	...	...	...
67	VEHICLE FITTED WITH COMPRESSOR	0	370	0	1
68	VEHICLE FITTED WITH GENERATOR	4	2,380	1	3
69	VEHICLE FITTED WITH RIG	0	1,143	4	4
70	VINTAGE MOTOR VEHICLE	0	19	0	143
71	X-RAY VAN	0	10	0	11

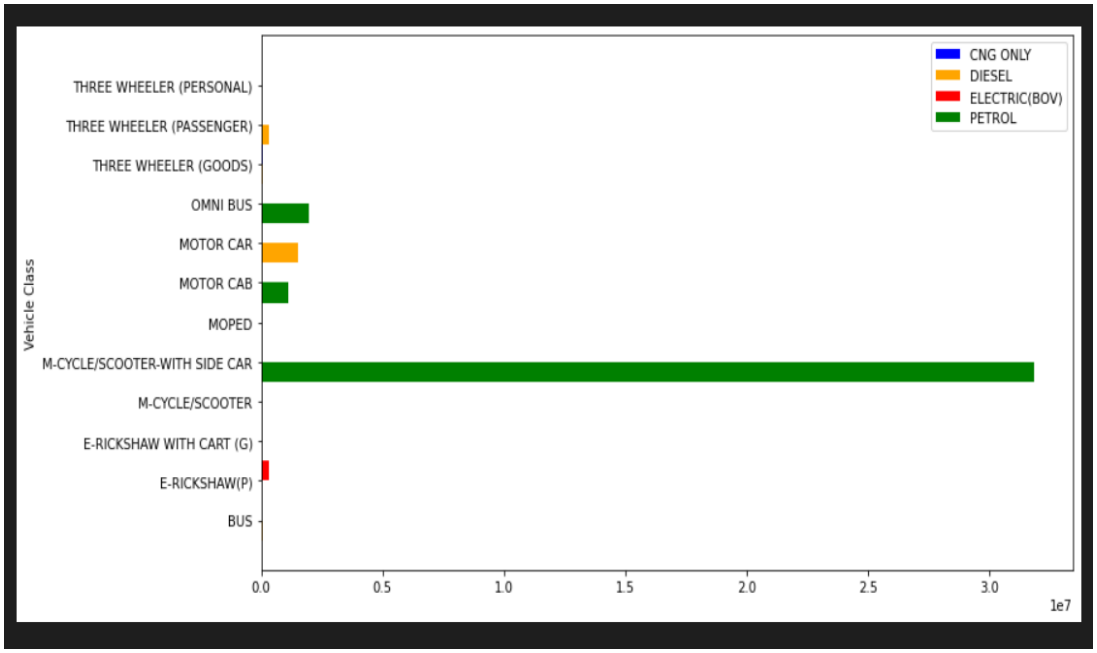
The Visualized data:



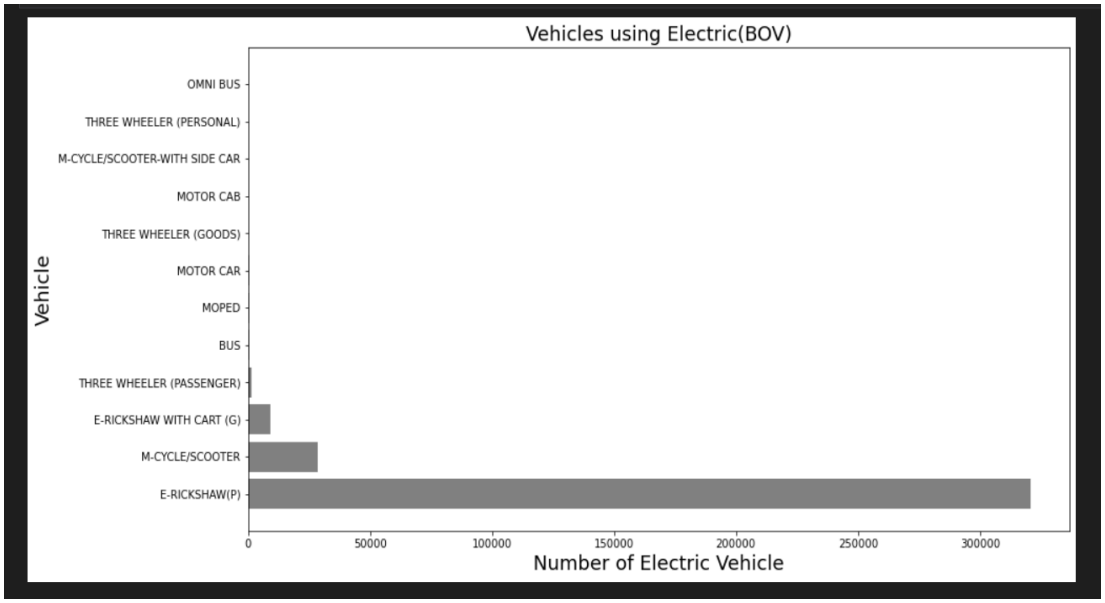
Let’s have a look state wise :

Uttar Pradesh –

Types of Fuels used in UP:

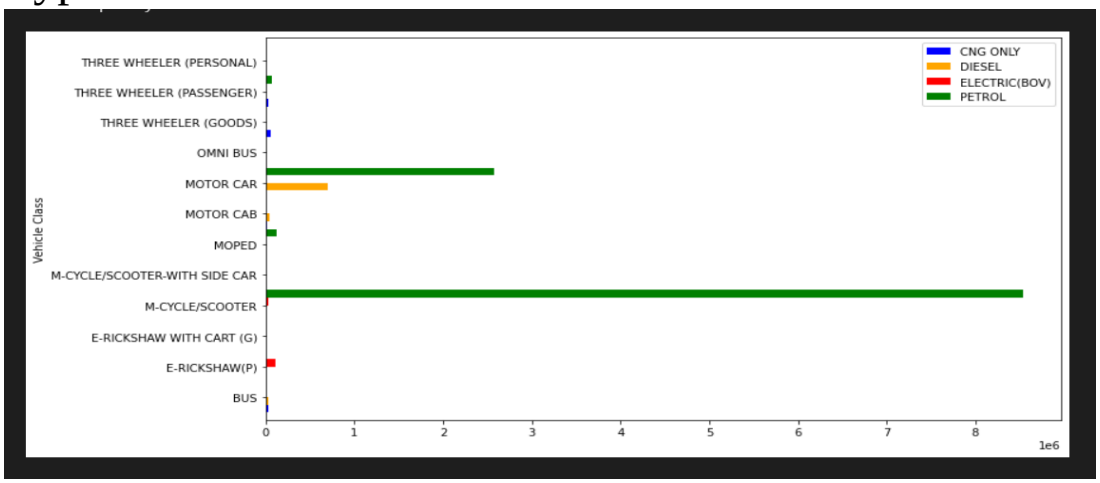


Vehicles Using Electric (BOV) in UP:



Delhi –

Types of Fuel used in Delhi are:



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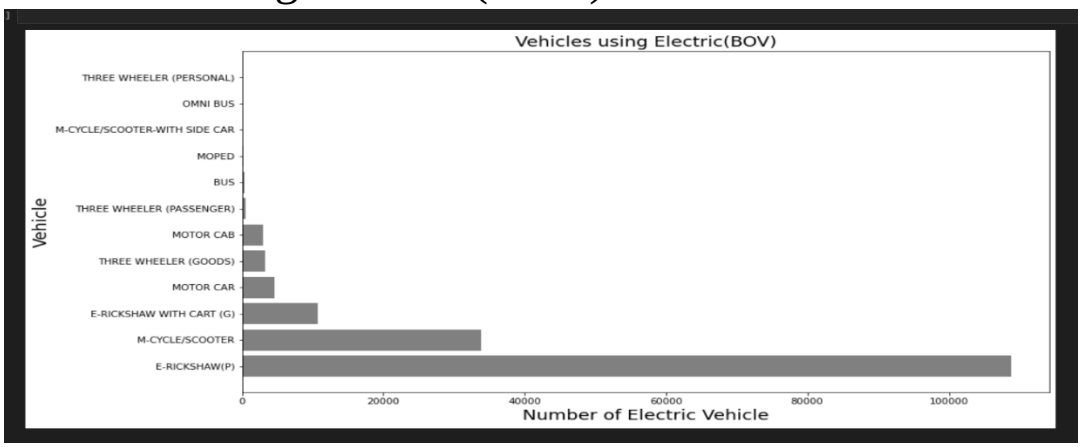
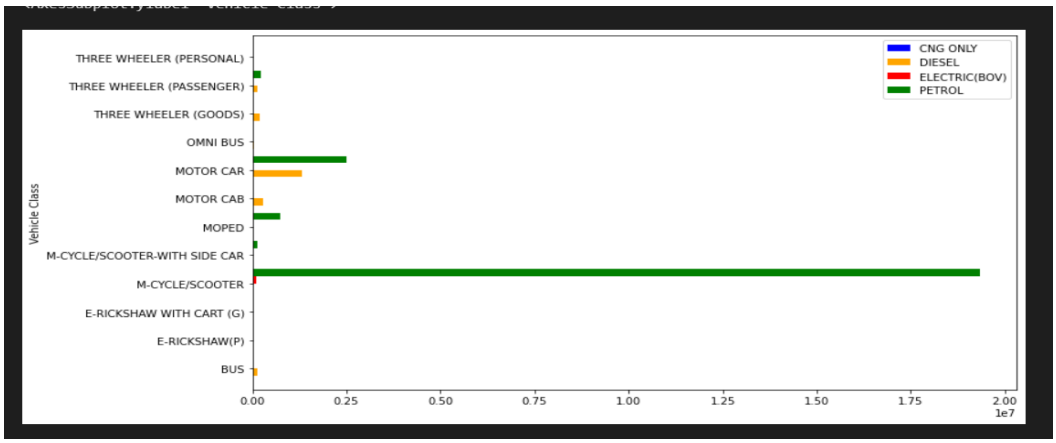
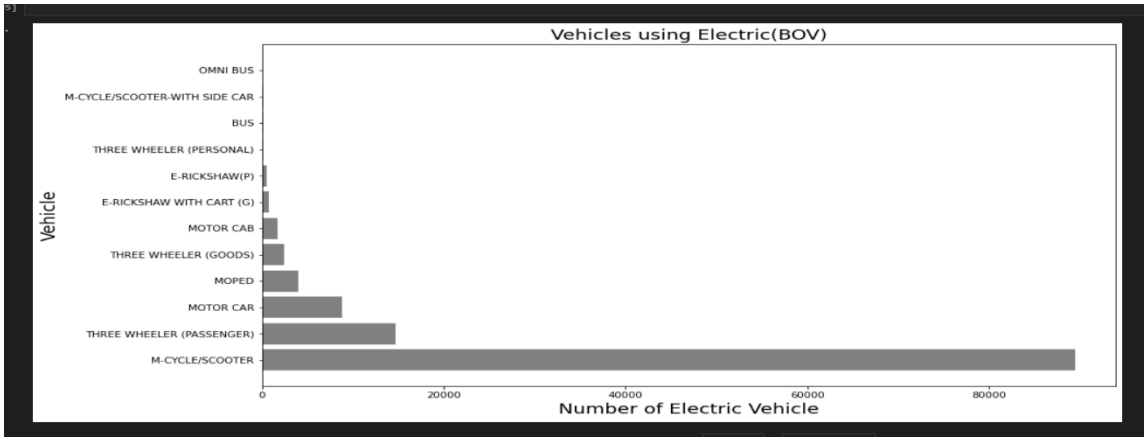


Karnataka:

Types of fuels used in Karnataka:

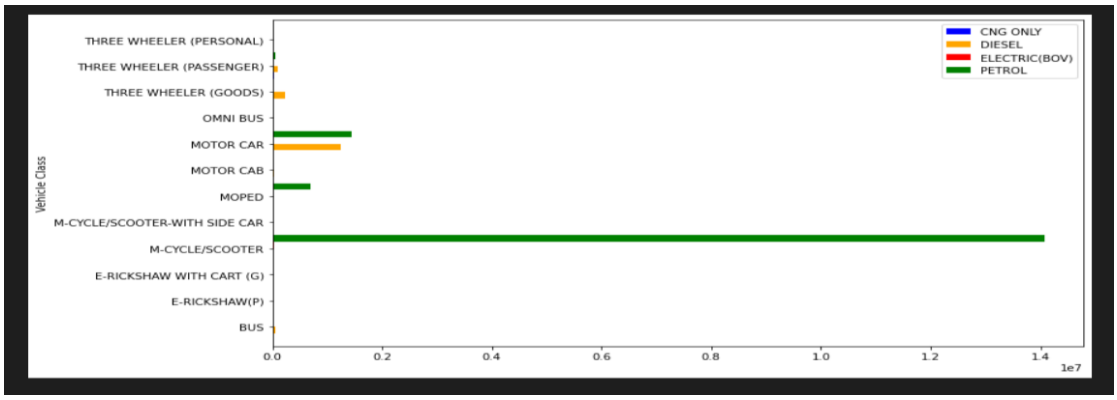


Vehicles Using Electric (BOV) in Karnataka:

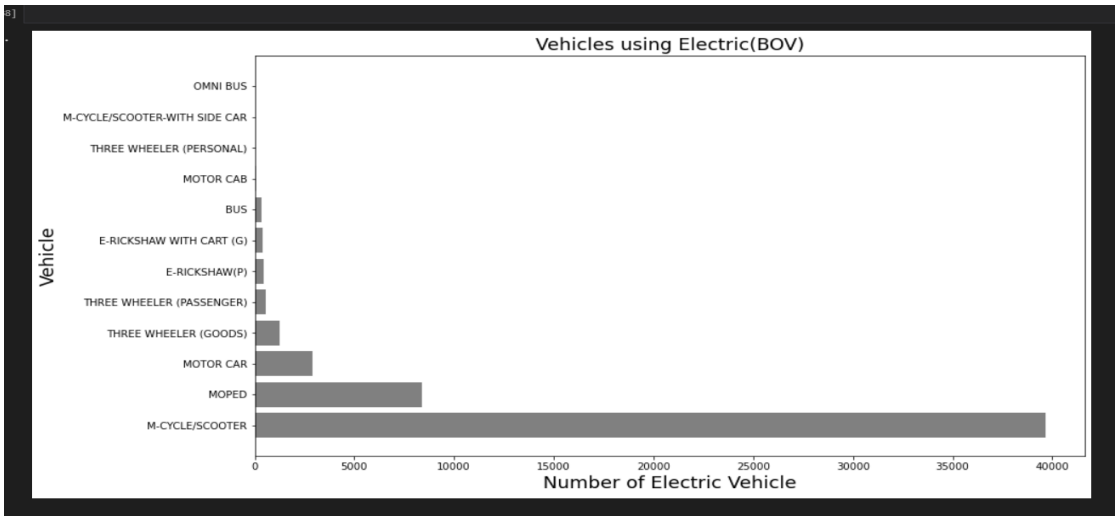


Gujarat –

Types of Fuels used in Gujarat:

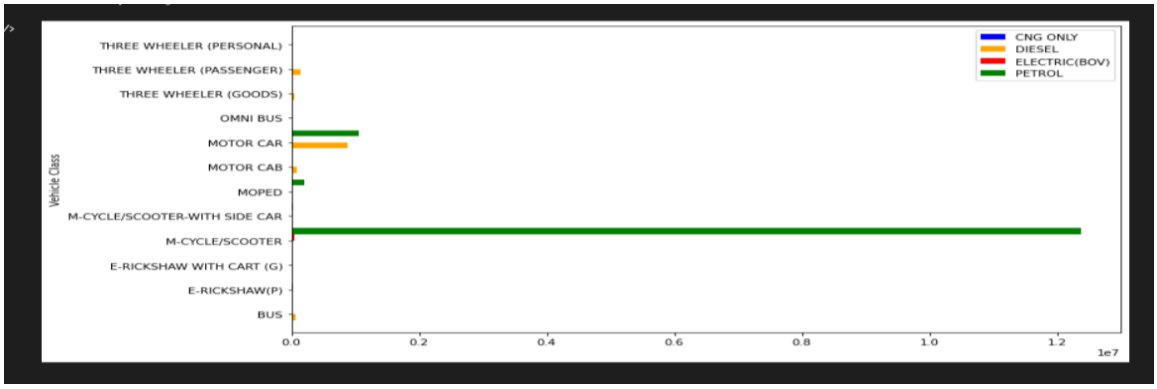


Vehicles Using Electric (BOV) in Gujarat:

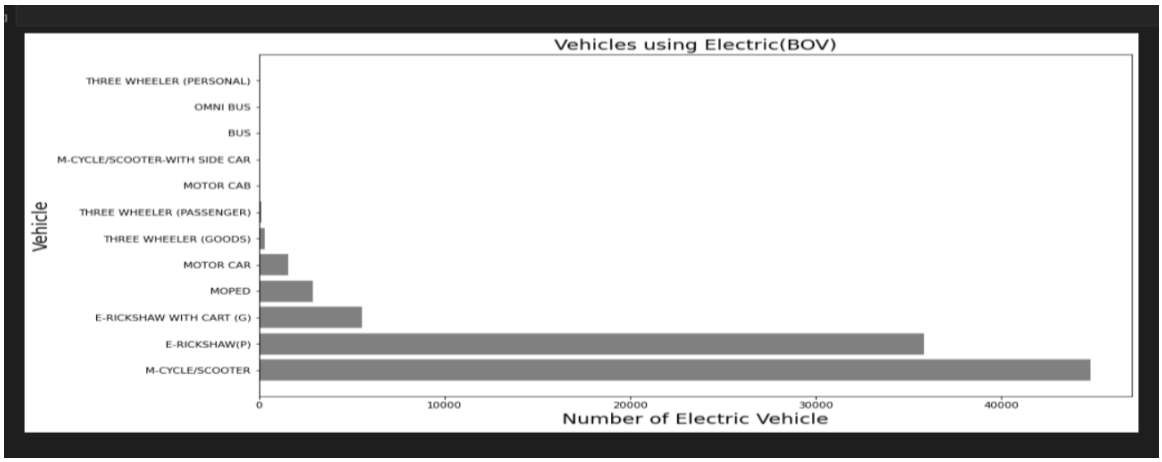


Rajasthan –

Types of Fuels used in Rajasthan:



Vehicles Using Electric (BOV) in Rajasthan:



Haryana –

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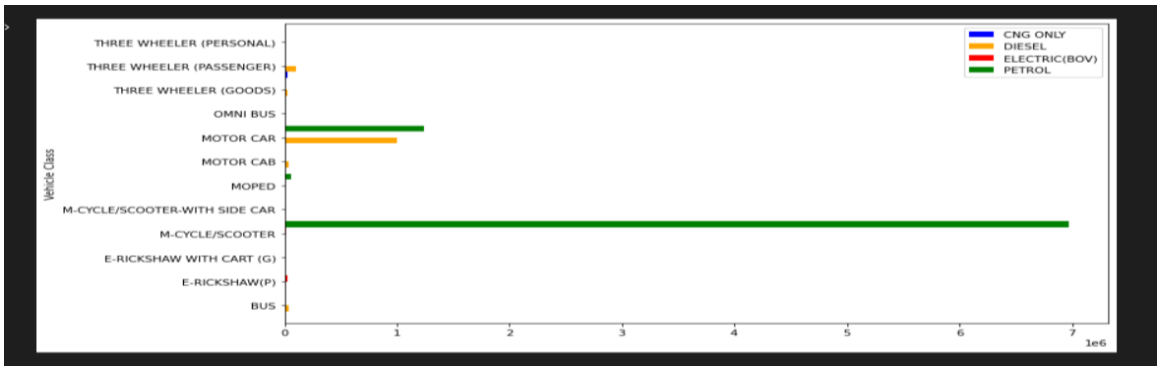
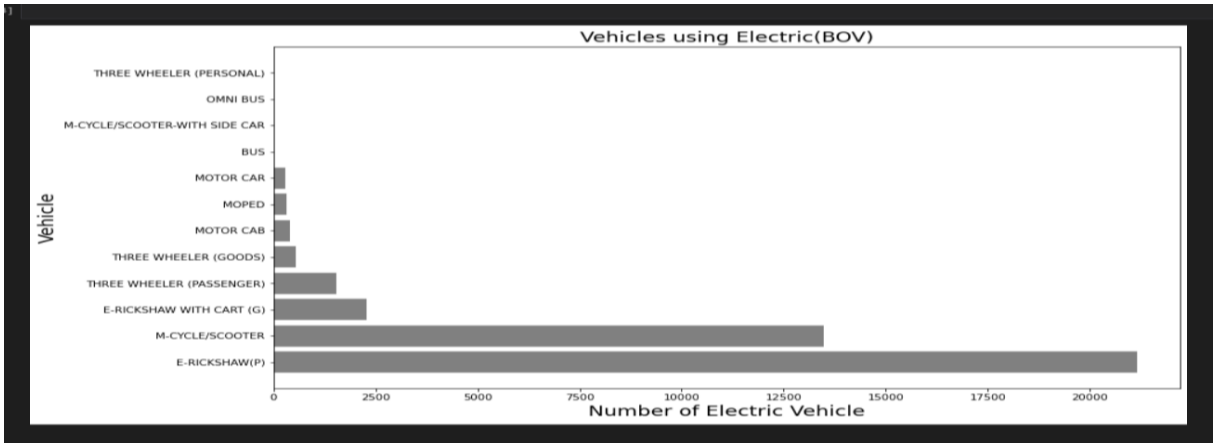
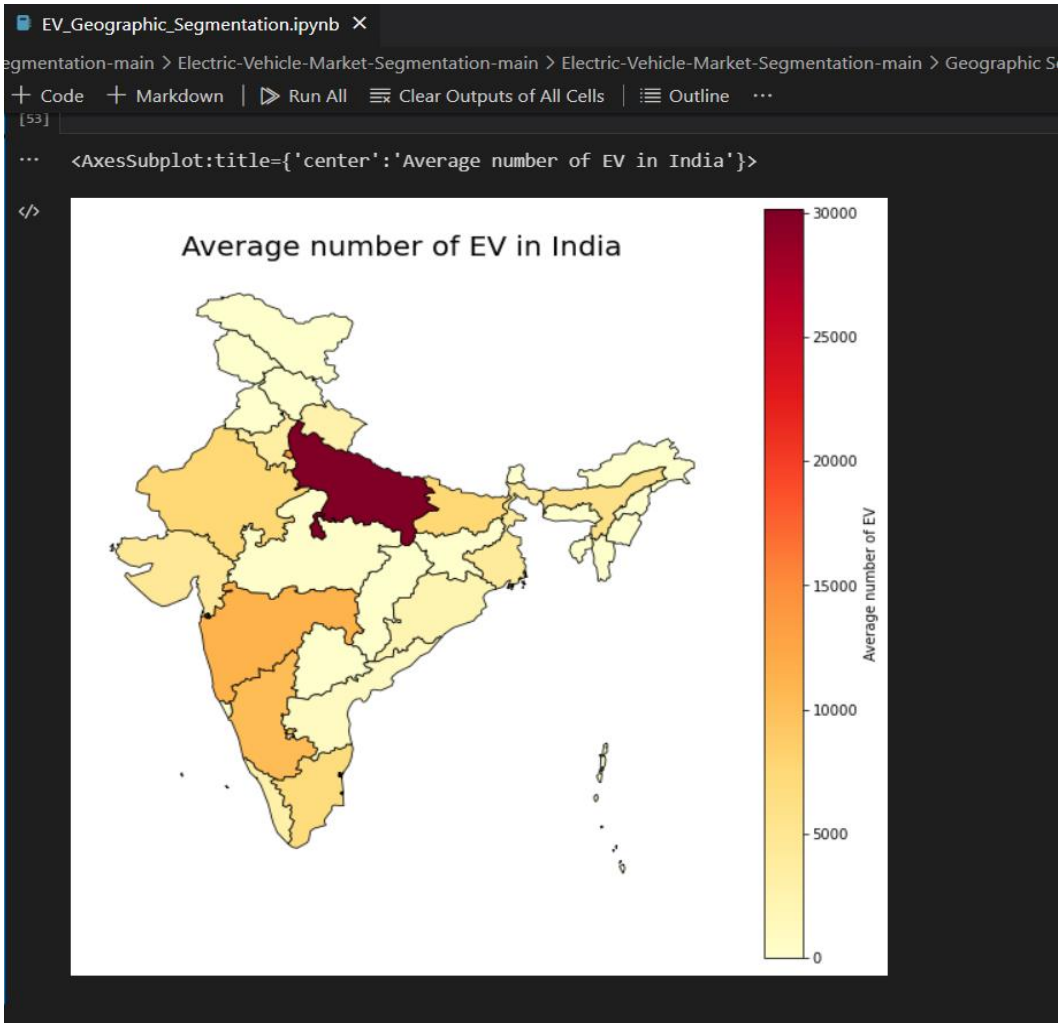


Vehicles using Electric (BOV) in Haryana:



Average no. of EV in India –



Electric Vehicles Future in India –

Most Indian buyers believe that an electric vehicle will be ready by 2022, but the majority also believe that it would no longer be available until 2025. Consumers in India are looking for a lower price for EVs than those in other countries, with the global average tipping price for EVs being $36,000. (around Rs27 lakh).

The cost of lithium-ion batteries is roughly $250/kWh globally, which translates to approximately Rs5.7 lakh in battery prices alone. Currently, lithium-ion batteries account for half of the cost of an electric vehicle, making them more expensive than conventional vehicles.

The safety of the batteries against explosion serves as a stumbling block for Li-ion batteries. Charging is a significant barrier for EVs in India, and a lack of charging stations may also be considered, rendering them impracticable or significantly less feasible for long-distance rides.

Furthermore, some EVs are slower than standard gas-powered engines.

At a critical moment, as many nations are working to free Mother Earth from the clutches of carbon emissions and CO2, India should take the lead by transitioning to EV mobility, making the country a greener and cleaner ecosystem.

Electric Vehicles Market Share in India –

The Indian automobile industry is the world's fifth biggest, and it is anticipated to become the third largest by 2030. According to the India Energy Storage Alliance (IESA), the Indian EV market would develop at a 36% CAGR.

As India's population grows and demand for automobiles increases, reliance on conventional energy supplies is no longer a viable option, as the country imports over 80% of its crude oil.By 2030, NITI Aayog

expects to reach 70% EV market penetration for all commercial vehicles, 30% for private vehicles, 40% for buses, and 80% for two and three-wheelers. This is consistent to reach net zero carbon emissions by 2070.The Indian electric vehicle market was worth USD 1,434.04 million in 2021, and it is predicted to grow to USD 15,397.19 million by 2027, at a CAGR of 47.09% during the forecast period (2022-2027).

Jupyter Notebook:-

"C:\Users\Sanskruti\Dropbox\PC\Downloads\Electric-Vehicle-Market-Segmentation-main\Electric-Vehicle-Market-Segmentation-main\Electric-Vehicle-Market-Segmentation-main\Geographic Segmentation\EV_Geographic_Segmentation.ipynb"

Resources for datasets used:

- https://data.gov.in/

- https://vahan.parivahan.gov.in/vahan4dashboard/vahan/view/reportview.xhtml

- https://www.kaggle.com/datasets?search=+EV+market+data

Conclusion:

Electric vehicles are the wave of the future! Manufacturing businesses are putting more effort into transitioning from traditional automobiles to electric vehicles. There are several advantages to owning an electric car with the appropriate level of functionality and infrastructure. According to our market segmentation of EV the market is going to flourish in the future.