



```
!pip install pysnp
```

Requirement already satisfied: pysnp in /usr/local/lib/python3.10/dist-packages (2.3.1)

```
import pandas as pd
import numpy as np
import plotly.express as px
import matplotlib.pyplot as plt
import seaborn as sns
import geopandas as gpd
import shapefile as shp
import plotly.graph_objects as go
from shapely.geometry import Point
from sklearn.cluster import KMeans
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import StandardScaler
sns.set_style('whitegrid')
```

```
# Load datasets
electric_vehicle_data = pd.read_csv('/content/Current Sales of Electric Vehicles.csv')
charging_stations_data = pd.read_csv('/content/CS_station.csv')
ev_charging_sanctioned_data = pd.read_csv('/content/CS_Sanctioned.csv')
highways_charging_stations_data = pd.read_csv('/content/CS_Highway.csv')
```

electric_vehicle_data

	State Name	Two Wheeler	Three Wheeler	Four Wheeler	Goods Vehicles	Public Service Vehicle	Special Category Vehicles	Ambulance/Hearses	Construction Equipment Vehicle	Other	Grand Total		
0	Andaman and Nicobar Islands	1	30.0	81	NaN	40.0	NaN	NaN	NaN	7.0	159		
1	Arunachal Pradesh	14	NaN	5	NaN	NaN	NaN	NaN	NaN	1.0	20		
2	Assam	721	47041.0	161	7.0	15.0	NaN	NaN	NaN	2.0	47947		
3	Bihar	5003	59079.0	114	11.0	26.0	NaN	NaN	NaN	8.0	64241		
4	Chandigarh	298	1410.0	182	NaN	40.0	NaN	NaN	NaN	1.0	1931		
5	Chhattisgarh	6424	5341.0	117	1077.0	1.0	NaN	NaN	368.0	100.0	13428		
6	Delhi	14730	112831.0	3051	49.0	39.0	NaN	NaN	NaN	1602.0	132302		
7	Goa	1314	28.0	289	13.0	36.0	2.0	NaN	NaN	4.0	1686		
8	Gujarat	13662	1869.0	1309	28.0	278.0	344.0	NaN	26.0	77.0	17593		
9	Haryana	7777	18595.0	186	122.0	8.0	2.0	NaN	NaN	90.0	26780		
10	Himachal Pradesh	368	167.0	37	7.0	86.0	NaN	NaN	NaN	46.0	711		
11	Jammu and Kashmir	1417	43.0	10	6.0	43.0	NaN	NaN	NaN	8.0	1527		
12	Jharkhand	2961	8986.0	139	24.0	4.0	NaN	NaN	NaN	57.0	12171		
13	Karnataka	56737	16478.0	7212	153.0	44.0	1.0	1.0	NaN	1420.0	82046		
14	Kerala	10299	2115.0	2524	43.0	23.0	NaN	1.0	NaN	17.0	15022		
15	Ladakh	12	NaN	5484	NaN	NaN	NaN	NaN	NaN	NaN	5496		
16	Maharashtra	51149	6155.0	2	30.0	851.0	26.0	1.0	NaN	601.0	58815		
17	Manipur	86	443.0	9	1.0	NaN	NaN	NaN	NaN	1.0	540		
18	Meghalaya	16	6.0	3	3.0	NaN	NaN	NaN	NaN	NaN	28		
19	Mizoram	9	1.0	4	2.0	1.0	NaN	NaN	NaN	3.0	20		
20	Nagaland	44	NaN	121	3.0	NaN	1.0	NaN	1.0	1.0	171		
21	Odisha	10329	1808.0	75	21.0	NaN	25.0	NaN	1.0	23.0	12282		
22	Puducherry	1429	32.0	124	9.0	20.0	NaN	NaN	NaN	NaN	1614		
23	Punjab	6408	2878.0	798	35.0	2.0	NaN	NaN	NaN	21.0	10142		
24	Rajasthan	23446	29631.0	12	25.0	1.0	NaN	1.0	1.0	24.0	53141		
25	Sikkim	1	NaN	2414	1.0	NaN	NaN	NaN	NaN	9.0	2425		
26	Tamil Nadu	44302	4470.0	13	1281.0	37.0	NaN	NaN	NaN	193.0	50296		
27	Tripura	67	7510.0	14	1.0	NaN	NaN	NaN	NaN	1.0	7593		
28	Dadra and Nagar Haveli and Daman and Diu	69	36.0	153	2.0	10.0	7.0	NaN	NaN	NaN	277		
29	Uttar Pradesh	18295	257159.0	368	53.0	327.0	2.0	NaN	NaN	13.0	276217		
30	Uttarakhand	2614	22096.0	709	1.0	10.0	NaN	NaN	NaN	21.0	25451		
31	West Bengal	2540	40948.0	615	28.0	97.0	NaN	2.0	NaN	61.0	44291		
32	Grand Total	282542	647186.0	26335	3036.0	2039.0	410.0	6.0	397.0	4412.0	966363		

charging_stations_data				🔗	📊
	Sl. No.	State/ UT	Charging Stations		
0	1	Telangana	56		
1	2	Jharkhand	29		
2	3	Goa	26		
3	4	Karnataka	48		
4	5	Himachal Pradesh	9		
5	6	Uttar Pradesh	15		
6	7	Rajasthan	49		
7	8	Delhi	94		
8	9	Chandigarh UT	48		
9	Total	Total	374		

ev_charging_sanctioned_data			🔗	📊
	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		

highways_charging_stations_data

	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	Delhi-Jaipur- Agra Highway	29	
9	10	Jaipur- Delhi Highway	9	
10	11	Delhi- Chandigarh Highway	24	
11	12	Total	672	

```
# Data Cleaning for Electric Vehicle Data
electric_vehicle_data = electric_vehicle_data.fillna(0)
electric_vehicle_data = electric_vehicle_data[~electric_vehicle_data['State Name'].str.contains('Total')] # Remove "Total" row
```

```
# Data Cleaning for Charging Stations Data
charging_stations_data = charging_stations_data[~charging_stations_data['State/ UT'].str.contains('Total')] # Remove "Total" row
```

```
# Data Cleaning for Highways/Expressways Charging Stations Data
highways_charging_stations_data = highways_charging_stations_data[~highways_charging_stations_data['Highways/Expressways'].str.contains('Total')] # Remove "Total" row
```

```
# Data Cleaning for Charging Sanctioned Data
ev_charging_sanctioned_data = ev_charging_sanctioned_data[~ev_charging_sanctioned_data['State/UT-wise'].str.contains('Total')] # Remove "Total" row
```

```
# Display cleaned data
print("Cleaned Electric Vehicle Data:")
electric_vehicle_data
```

Cleaned Electric Vehicle Data:

	State Name	Two Wheeler	Three Wheeler	Four Wheeler	Goods Vehicles	Public Service Vehicle	Special Category Vehicles	Ambulance/Hearses	Construction Equipment Vehicle	Other	Grand Total
0	Andaman and Nicobar Islands	1	30.0	81	0.0	40.0	0.0	0.0	0.0	7.0	159
1	Arunachal Pradesh	14	0.0	5	0.0	0.0	0.0	0.0	0.0	1.0	20
2	Assam	721	47041.0	161	7.0	15.0	0.0	0.0	0.0	2.0	47947
3	Bihar	5003	59079.0	114	11.0	26.0	0.0	0.0	0.0	8.0	64241
4	Chandigarh	298	1410.0	182	0.0	40.0	0.0	0.0	0.0	1.0	1931
5	Chhattisgarh	6424	5341.0	117	1077.0	1.0	0.0	0.0	368.0	100.0	13428
6	Delhi	14730	112831.0	3051	49.0	39.0	0.0	0.0	0.0	1602.0	132302
7	Goa	1314	28.0	289	13.0	36.0	2.0	0.0	0.0	4.0	1686
8	Gujarat	13662	1869.0	1309	28.0	278.0	344.0	0.0	26.0	77.0	17593
9	Haryana	7777	18595.0	186	122.0	8.0	2.0	0.0	0.0	90.0	26780
10	Himachal Pradesh	368	167.0	37	7.0	86.0	0.0	0.0	0.0	46.0	711
11	Jammu and Kashmir	1417	43.0	10	6.0	43.0	0.0	0.0	0.0	8.0	1527
12	Jharkhand	2961	8986.0	139	24.0	4.0	0.0	0.0	0.0	57.0	12171
13	Karnataka	56737	16478.0	7212	153.0	44.0	1.0	1.0	0.0	1420.0	82046
14	Kerala	10299	2115.0	2524	43.0	23.0	0.0	1.0	0.0	17.0	15022
15	Ladakh	12	0.0	5484	0.0	0.0	0.0	0.0	0.0	0.0	5496
16	Maharashtra	51149	6155.0	2	30.0	851.0	26.0	1.0	0.0	601.0	58815
17	Manipur	86	443.0	9	1.0	0.0	0.0	0.0	0.0	1.0	540
18	Meghalaya	16	6.0	3	3.0	0.0	0.0	0.0	0.0	0.0	28
19	Mizoram	9	1.0	4	2.0	1.0	0.0	0.0	0.0	3.0	20
20	Nagaland	44	0.0	121	3.0	0.0	1.0	0.0	1.0	1.0	171
21	Odisha	10329	1808.0	75	21.0	0.0	25.0	0.0	1.0	23.0	12282
22	Puducherry	1429	32.0	124	9.0	20.0	0.0	0.0	0.0	0.0	1614
23	Punjab	6408	2878.0	798	35.0	2.0	0.0	0.0	0.0	21.0	10142
24	Rajasthan	23446	29631.0	12	25.0	1.0	0.0	1.0	1.0	24.0	53141
25	Sikkim	1	0.0	2414	1.0	0.0	0.0	0.0	0.0	9.0	2425
26	Tamil Nadu	44302	4470.0	13	1281.0	37.0	0.0	0.0	0.0	193.0	50296
27	Tripura	67	7510.0	14	1.0	0.0	0.0	0.0	0.0	1.0	7593
28	Dadra and Nagar Haveli and Daman and Diu	69	36.0	153	2.0	10.0	7.0	0.0	0.0	0.0	277
29	Uttar Pradesh	18295	257159.0	368	53.0	327.0	2.0	0.0	0.0	13.0	276217
30	Uttarakhand	2614	22096.0	709	1.0	10.0	0.0	0.0	0.0	21.0	25451
31	West Bengal	2540	40948.0	615	28.0	97.0	0.0	2.0	0.0	61.0	44291

```
print("\nCleaned Charging Stations Data:")
charging_stations_data
```

Cleaned Charging Stations Data:

	Sl. No.	State/ UT	Charging Stations	
0	1	Telangana	56	
1	2	Jharkhand	29	
2	3	Goa	26	
3	4	Karnataka	48	
4	5	Himachal Pradesh	9	
5	6	Uttar Pradesh	15	
6	7	Rajasthan	49	
7	8	Delhi	94	
8	9	Chandigarh UT	48	

```
print("\nCleaned EV Charging Sanctioned Data:")
ev_charging_sanctioned_data
```

Cleaned EV Charging Sanctioned Data:

	State/UT-wise	Number of Electric Vehicle Charging Sanctioned		
0	Maharashtra	317		
1	Andhra Pradesh	266		
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4	Uttar Pradesh	207		
5	Rajasthan	205		
6	Karnataka	172		
7	Madhya Pradesh	159		
8	West Bengal	150		
9	Kerala	147		
10	Odisha	141		
11	Uttarakhand	138		
12	Chhattisgarh	137		
13	Goa	136		
14	Assam	135		
15	Madhya Pradesh	134		
16	Andhra Pradesh	133		
17	Uttar Pradesh	132		
18	Uttarakhand	131		
19	Uttarakhand	130		
20	Uttarakhand	129		
21	Uttarakhand	128		
22	Uttarakhand	127		
23	Uttarakhand	126		
24	Uttarakhand	125		
25	Uttarakhand	124		
26	Uttarakhand	123		
27	Uttarakhand	122		
28	Uttarakhand	121		
29	Uttarakhand	120		
30	Uttarakhand	119		
31	Uttarakhand	118		
32	Uttarakhand	117		
33	Uttarakhand	116		
34	Uttarakhand	115		
35	Uttarakhand	114		
36	Uttarakhand	113		
37	Uttarakhand	112		
38	Uttarakhand	111		
39	Uttarakhand	110		
40	Uttarakhand	109		
41	Uttarakhand	108		
42	Uttarakhand	107		
43	Uttarakhand	106		
44	Uttarakhand	105		
45	Uttarakhand	104		
46	Uttarakhand	103		
47	Uttarakhand	102		
48	Uttarakhand	101		
49	Uttarakhand	100		
50	Uttarakhand	99		
51	Uttarakhand	98		
52	Uttarakhand	97		
53	Uttarakhand	96		
54	Uttarakhand	95		
55	Uttarakhand	94		
56	Uttarakhand	93		
57	Uttarakhand	92		
58	Uttarakhand	91		
59	Uttarakhand	90		
60	Uttarakhand	89		
61	Uttarakhand	88		
62	Uttarakhand	87		
63	Uttarakhand	86		
64	Uttarakhand	85		
65	Uttarakhand	84		
66	Uttarakhand	83		
67	Uttarakhand	82		
68	Uttarakhand	81		
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70	Uttarakhand	79		
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77	Uttarakhand	72		
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79	Uttarakhand	70		
80	Uttarakhand	69		
81	Uttarakhand	68		
82	Uttarakhand	67		
83	Uttarakhand	66		
84	Uttarakhand	65		
85	Uttarakhand	64		
86	Uttarakhand	63		
87	Uttarakhand	62		
88	Uttarakhand	61		
89	Uttarakhand	60		
90	Uttarakhand	59		
91	Uttarakhand	58		
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96	Uttarakhand	53		
97	Uttarakhand	52		
98	Uttarakhand	51		
99	Uttarakhand	50		
100	Uttarakhand	49		
101	Uttarakhand	48		
102	Uttarakhand	47		
103	Uttarakhand	46		
104	Uttarakhand	45		
105	Uttarakhand	44		
106	Uttarakhand	43		
107	Uttarakhand	42		
108	Uttarakhand	41		
109	Uttarakhand	40		
110	Uttarakhand	39		
111	Uttarakhand	38		
112	Uttarakhand	37		
113	Uttarakhand	36		
114	Uttarakhand	35		
115	Uttarakhand	34		
116	Uttarakhand	33		
117	Uttarakhand	32		
118	Uttarakhand	31		
119	Uttarakhand	30		
120	Uttarakhand	29		
121	Uttarakhand	28		
122	Uttarakhand	27		
123	Uttarakhand	26		
124	Uttarakhand	25		
125	Uttarakhand	24		
126	Uttarakhand	23		
127	Uttarakhand	22		
128	Uttarakhand	21		
129	Uttarakhand	20		
130	Uttarakhand	19		
131	Uttarakhand	18		
132	Uttarakhand	17		
133	Uttarakhand	16		
134	Uttarakhand	15		
135	Uttarakhand	14		
136	Uttarakhand	13		
137	Uttarakhand	12		
138	Uttarakhand	11		
139	Uttarakhand	10		
140	Uttarakhand	9		
141	Uttarakhand	8		
142	Uttarakhand	7		
143	Uttarakhand	6		
144	Uttarakhand	5		
145	Uttarakhand	4		
146	Uttarakhand	3		
147	Uttarakhand	2		
148	Uttarakhand	1		
149	Uttarakhand	0		
150	Uttarakhand	0		

```
print("\nCleaned Highways/Expressways Charging Stations Data:")
highways_charging_stations_data
```

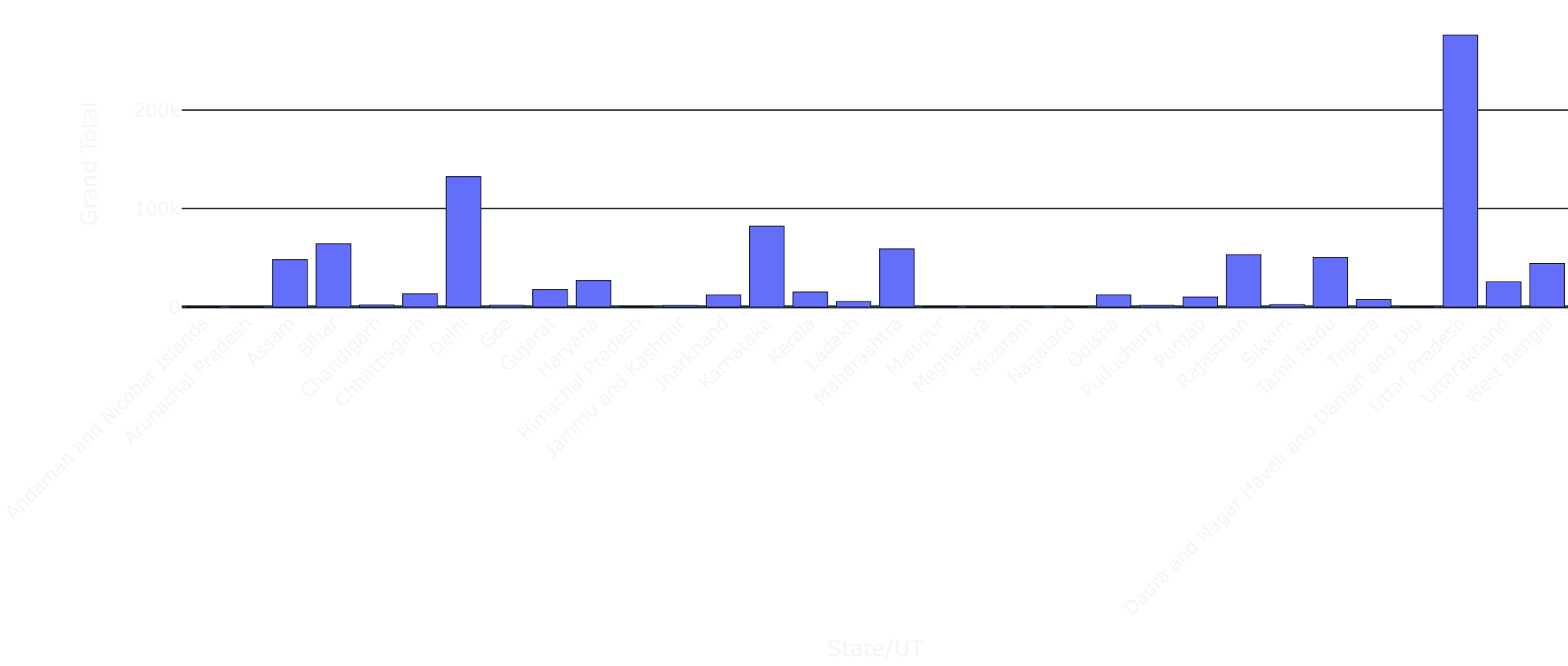
Cleaned Highways/Expressways Charging Stations Data:

	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	Delhi-Jaipur- Agra Highway	29		
9	10	Jaipur- Delhi Highway	9		
10	11	Delhi- Chandigarh Highway	24		

▼ Total Electric Vehicle By State

```
fig = px.bar(electric_vehicle_data, x='State Name', y='Grand Total', title='Total Electric Vehicles by State',
            labels={'State Name': 'State/UT', 'Total EVs': 'Total Electric Vehicles'},
            template='plotly_dark')
fig.update_xaxes(tickangle=-45)
fig.show()
```

Total Electric Vehicles by State



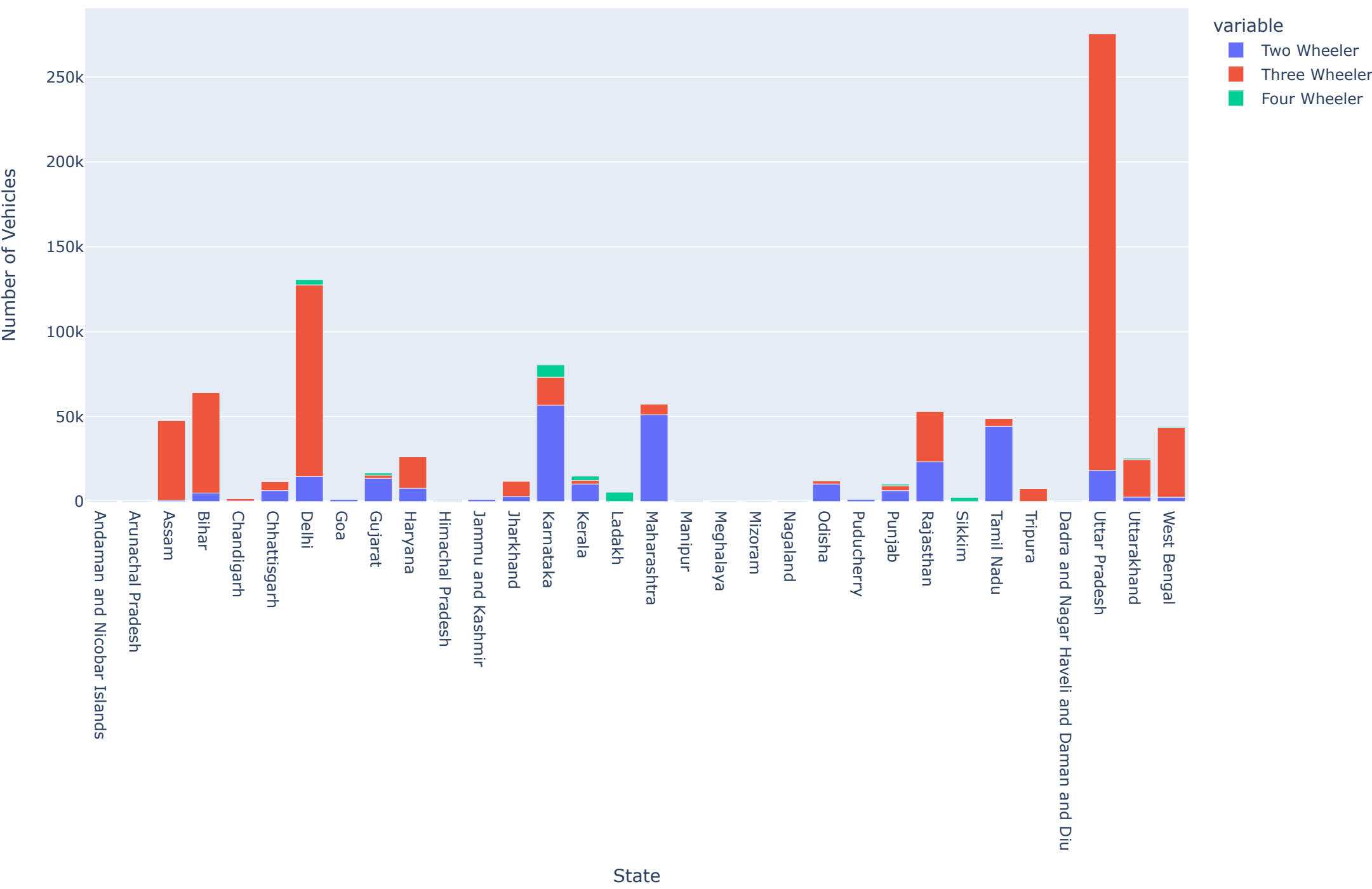
States/UT to target based on Electric Vehicle

- Uttar Pradesh
- Delhi
- Karnataka
- Bihar
- Maharashtra

▼ Different Types of Electric Vehicle Adopted by States

```
# Visualize Electric Vehicle Adoption by State
fig1 = px.bar(electric_vehicle_data, x='State Name', y=['Two Wheeler', 'Three Wheeler', 'Four Wheeler'],
            title='Electric Vehicle Adoption by State',
            labels={'value': 'Number of Vehicles', 'State Name': 'State'}, height=800)
fig1.show()
```

Electric Vehicle Adoption by State



States/UT to target based on High Electric Vehicle Adoption

Two Wheeler:

- Karnataka
- Maharashtra
- Tamil Nadu
- Rajasthan

Three Wheeler:

- Uttar Pradesh
- Delhi
- Bihar
- Assam

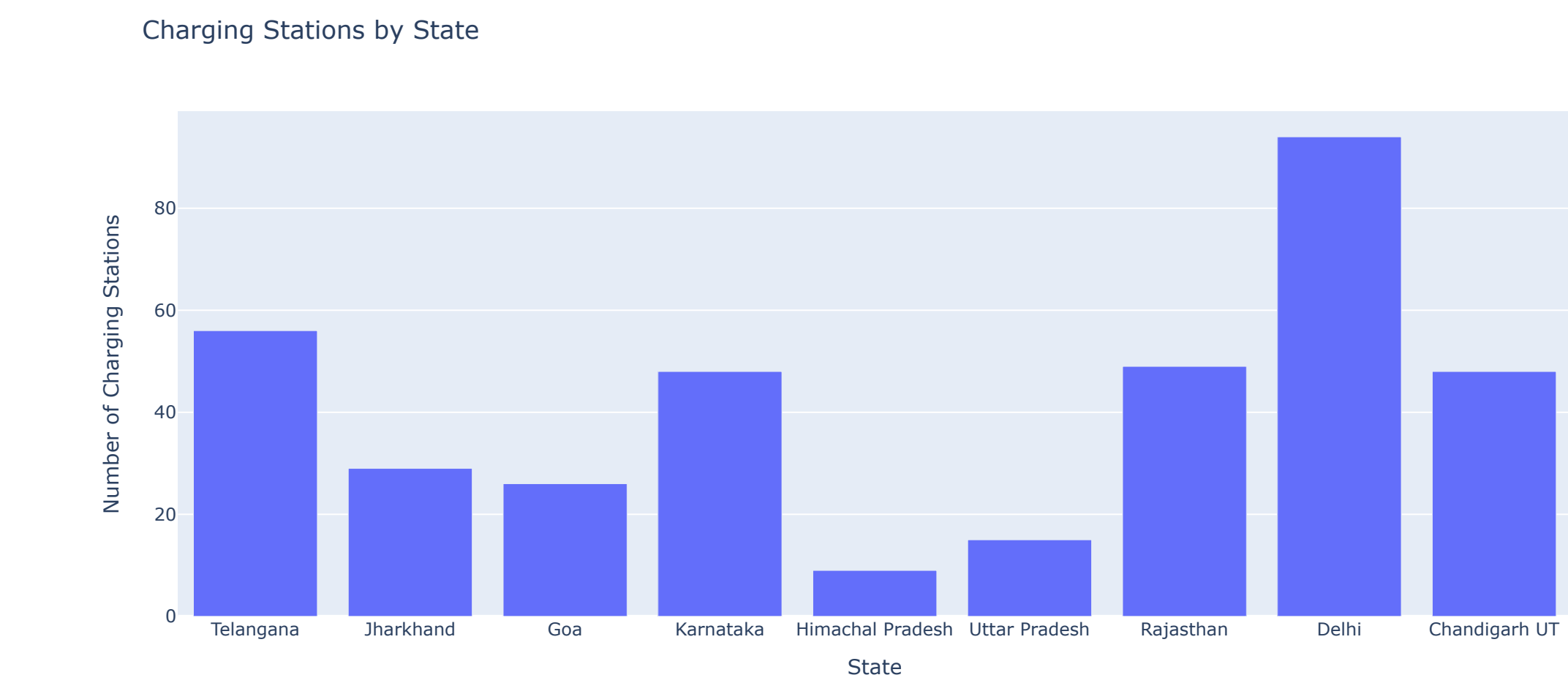
- West Bengal
- Rajasthan

Four Wheeler:

- Karnataka
- Ladakh
- Delhi

▼ Charging Stations in States/UT:

```
# Visualize Charging Infrastructure by State
fig2 = px.bar(charging_stations_data, x='State/ UT', y='Charging Stations',
              title='Charging Stations by State',
              labels={'Charging Stations': 'Number of Charging Stations', 'State/ UT': 'State'})
fig2.show()
```

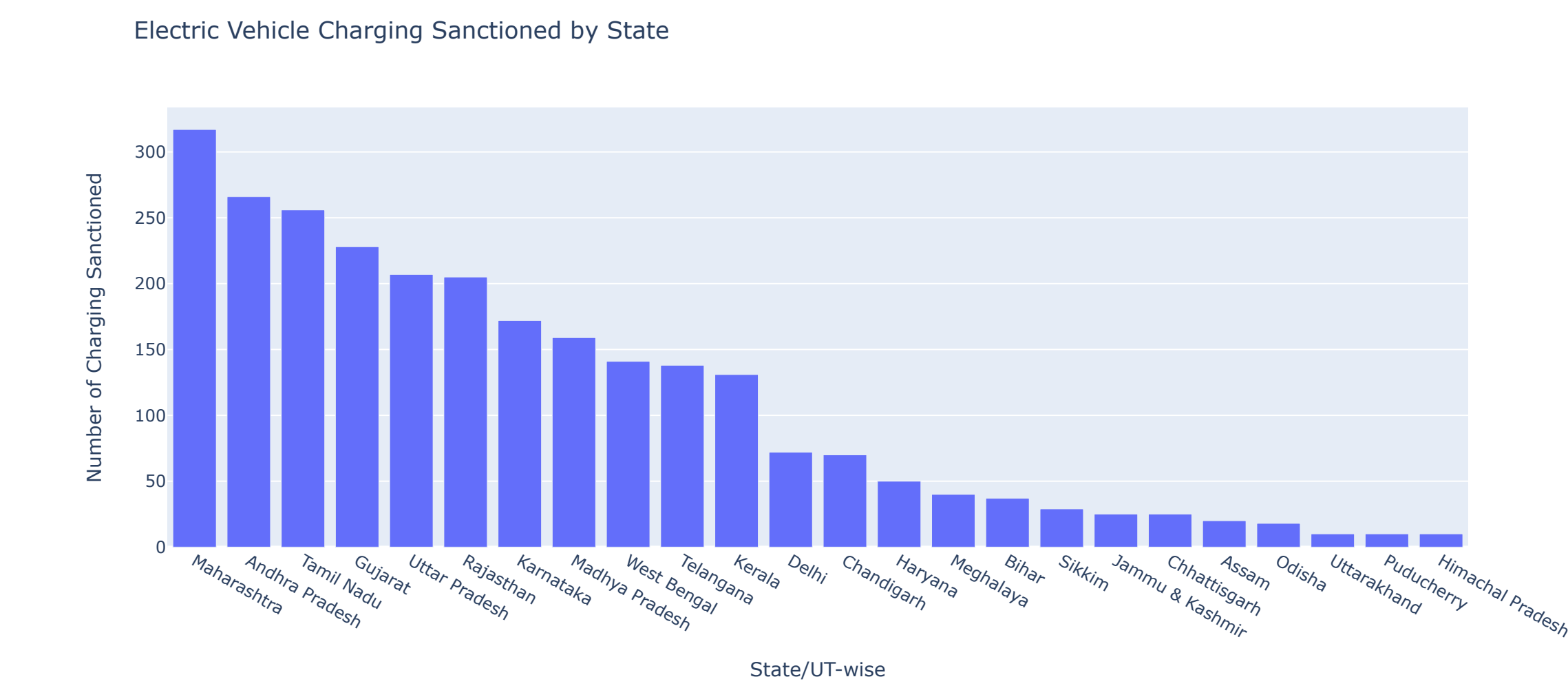


States/UT to target based on Charging Stations

- Delhi
- Telangana
- Rajasthan
- Karnataka
- Chandigarh UT

▼ Sanctioned Charging Stations:

```
# Visualize EV Charging Sanctioned by State
fig3 = px.bar(ev_charging_sanctioned_data, x='State/UT-wise', y='Number of Electric Vehicle Charging Sanctioned',
              title='Electric Vehicle Charging Sanctioned by State',
              labels={'Number of Electric Vehicle Charging Sanctioned': 'Number of Charging Sanctioned', 'State/UT': 'State'})
fig3.show()
```

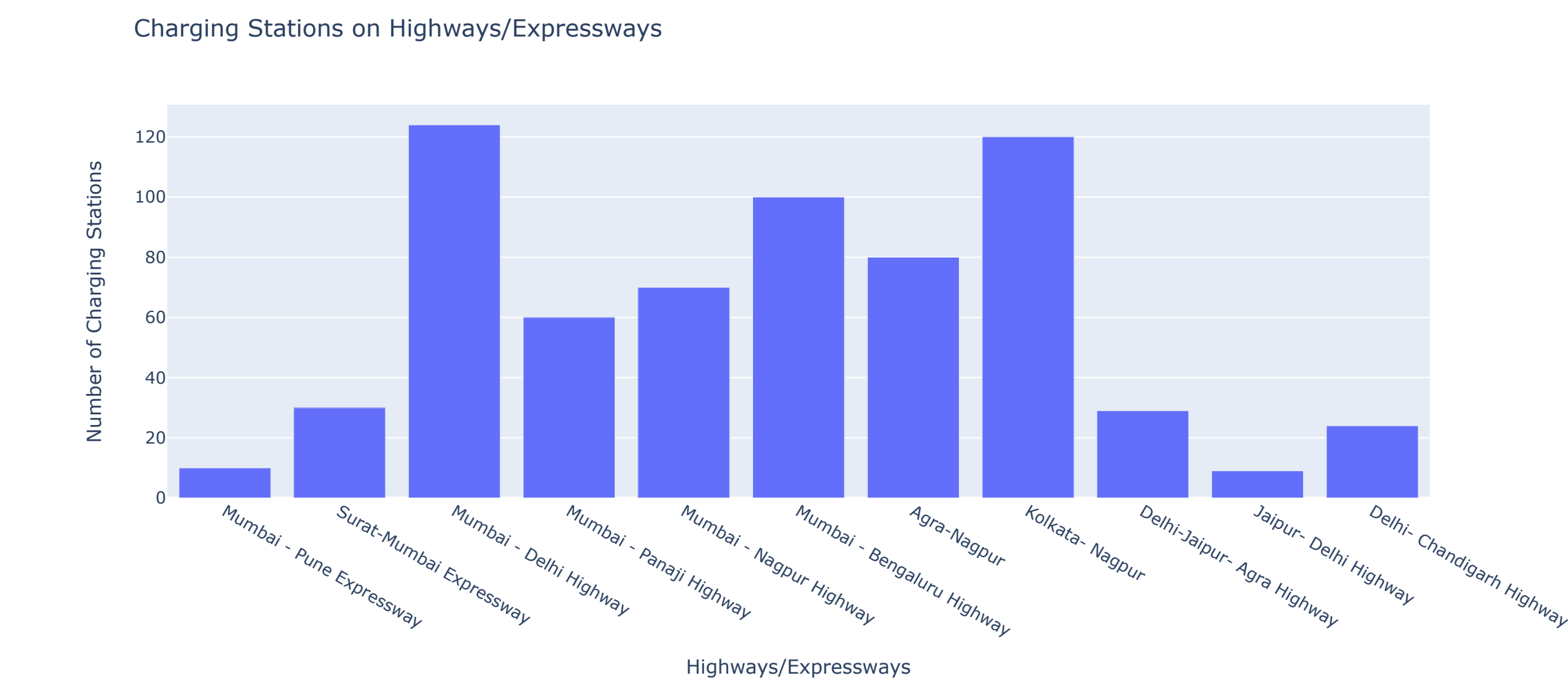


States to target based on charging stations sanctioned

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

▼ Charging stations on highway:



```
# Visualize Charging Stations on Highways/Expressways
fig4 = px.bar(highways_charging_stations_data, x='Highways/Expressways', y='Charging Stations',
              title='Charging Stations on Highways/Expressways',
              labels={'Charging Stations': 'Number of Charging Stations', 'Highways/Expressways': 'Highways/Expressways'})
fig4.show()
```



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

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


```
fp = r'./content/india_st.shp'
map_df = gpd.read_file(fp)
map_df_copy = gpd.read_file(fp)
map_df.head()
```

	STATE	geometry		
0	ANDAMAN AND NICOBAR ISLANDS	MULTIPOLYGON (((94.08923 6.73365, 93.97717 6.9...		
1	ANDHRA PRADESH	POLYGON ((82.00063 17.95354, 82.11718 18.02457...		
2	ARUNACHAL PRADESH	POLYGON ((95.61476 27.34745, 95.69234 27.33888...		
3	ASSAM	POLYGON ((92.82207 25.57781, 92.69672 25.61368...		
4	BIHAR	POLYGON ((84.16946 26.28322, 83.91399 26.38523...		

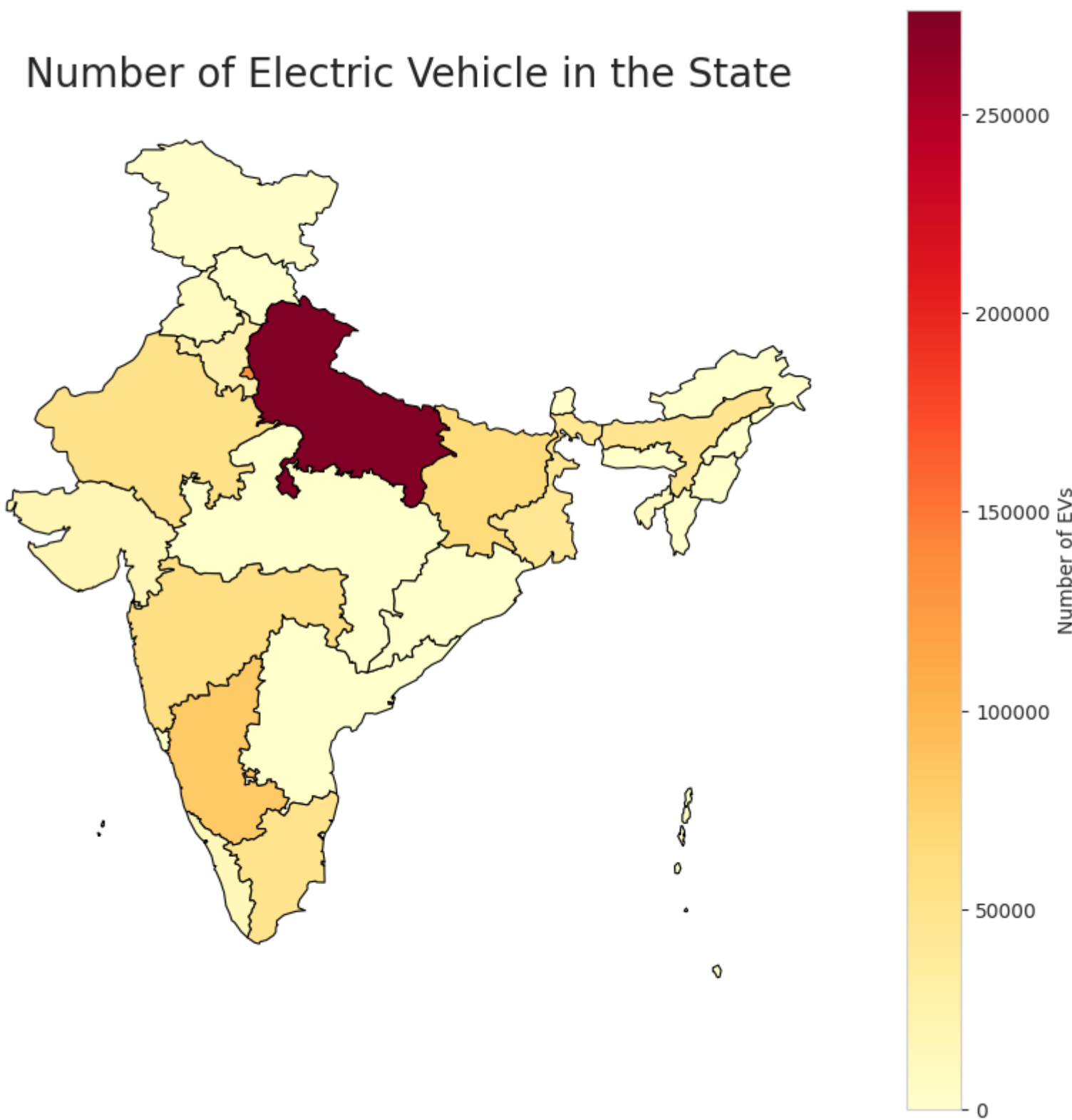
```
# Create a new dataframe for state names and total Evs
electric_vehicle_data_copy = electric_vehicle_data[['State Name', 'Grand Total']].copy()
electric_vehicle_data_copy['State Name'] = electric_vehicle_data_copy['State Name'].str.upper()
```

```
#Merging the data
merged = map_df.set_index('STATE').join(electric_vehicle_data_copy.set_index('State Name'))
merged['Grand Total'] = merged['Grand Total'].replace(np.nan, 0)
```

```
#Create figure and axes for Matplotlib and set the title
fig, ax = plt.subplots(1, figsize=(10, 10))
ax.axis('off')
ax.set_title('Number of Electric Vehicle in the State', fontdict={'fontsize': '20', 'fontweight' : '10'})
# Plot the figure
merged.plot(column='Grand Total',cmap='YlOrRd', linewidth=0.8, ax=ax, edgecolor='0',legend=True,markersize=[39.739192, -104.990337], legend_kwds={'label': "Number of EVs"})
```

<Axes: title={'center': 'Number of Electric Vehicle in the State'}>

Number of Electric Vehicle in the State



▼ According to the above plot we can conclude that UP consist of highest number of EV's in the country.

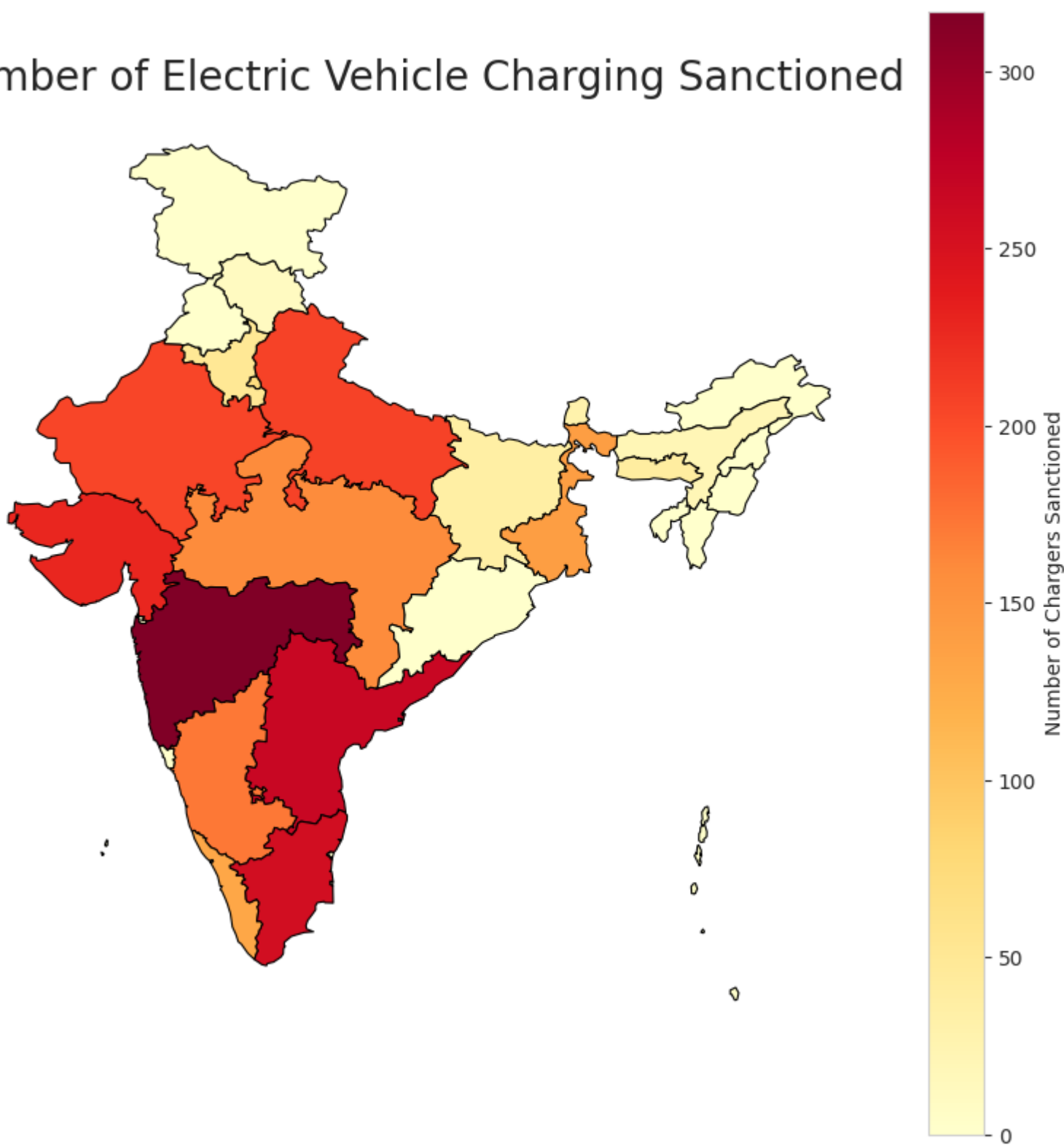
```
# Create a new dataframe for state names and charger sanctioned
ev_charging_sanctioned_data_copy = ev_charging_sanctioned_data[['State/UT-wise', 'Number of Electric Vehicle Charging Sanctioned']].copy()
ev_charging_sanctioned_data_copy['State/UT-wise'] = ev_charging_sanctioned_data_copy['State/UT-wise'].str.upper()
```

```
#Merging the data
merged = map_df.set_index('STATE').join(ev_charging_sanctioned_data_copy.set_index('State/UT-wise'))
merged['Number of Electric Vehicle Charging Sanctioned'] = merged['Number of Electric Vehicle Charging Sanctioned'].replace(np.nan, 0)
```

```
#Create figure and axes for Matplotlib and set the title
fig, ax = plt.subplots(1, figsize=(10, 10))
ax.axis('off')
ax.set_title('Number of Electric Vehicle Charging Sanctioned', fontdict={'fontsize': '20', 'fontweight' : '10'})
# Plot the figure
merged.plot(column='Number of Electric Vehicle Charging Sanctioned',cmap='YlOrRd', linewidth=0.8, ax=ax, edgecolor='0',legend=True,markersize=[39.739192, -104.990337], legend_kwds={'label': "Number of Chargers Sanctioned"})
```

<Axes: title={'center': 'Number of Electric Vehicle Charging Sanctioned'}>

Number of Electric Vehicle Charging Sanctioned



▼ And from the above plot we can see that states like Maharastra, Andhra Pradesh, Tamil Nadu, Gujarat and UP have the highest number of EV charging sanctioned.

```
# Merge datasets based on State/UT
merged_data = pd.merge(electric_vehicle_data, charging_stations_data, how='left', left_on='State Name', right_on='State/ UT')
merged_data = pd.merge(merged_data, ev_charging_sanctioned_data, how='left', left_on='State Name', right_on='State/UT-wise')
```

```
# Select relevant columns for clustering
selected_columns = ['State Name', 'Two Wheeler', 'Three Wheeler', 'Four Wheeler', 'Goods Vehicles', 'Charging Stations', 'Number of Electric Vehicle Charging Sanctioned']
```

```
# Handle missing values by imputing with zeros
imputer = SimpleImputer(strategy='constant', fill_value=0)
cluster_data_imputed = imputer.fit_transform(merged_data[selected_columns[1:]]) # Exclude 'State Name'
```

```
# Standardize the imputed data
scaler = StandardScaler()
cluster_data_scaled = scaler.fit_transform(cluster_data_imputed)
```

```
# Perform K-means clustering
num_clusters = 5 # You can adjust the number of clusters based on your needs
kmeans = KMeans(n_clusters=num_clusters, random_state=0)
```

```
cluster_labels = kmeans.fit_predict(cluster_data_scaled)

# Add cluster labels and state names to the merged data
merged_data['Cluster'] = cluster_labels
merged_data['State'] = merged_data['State Name']

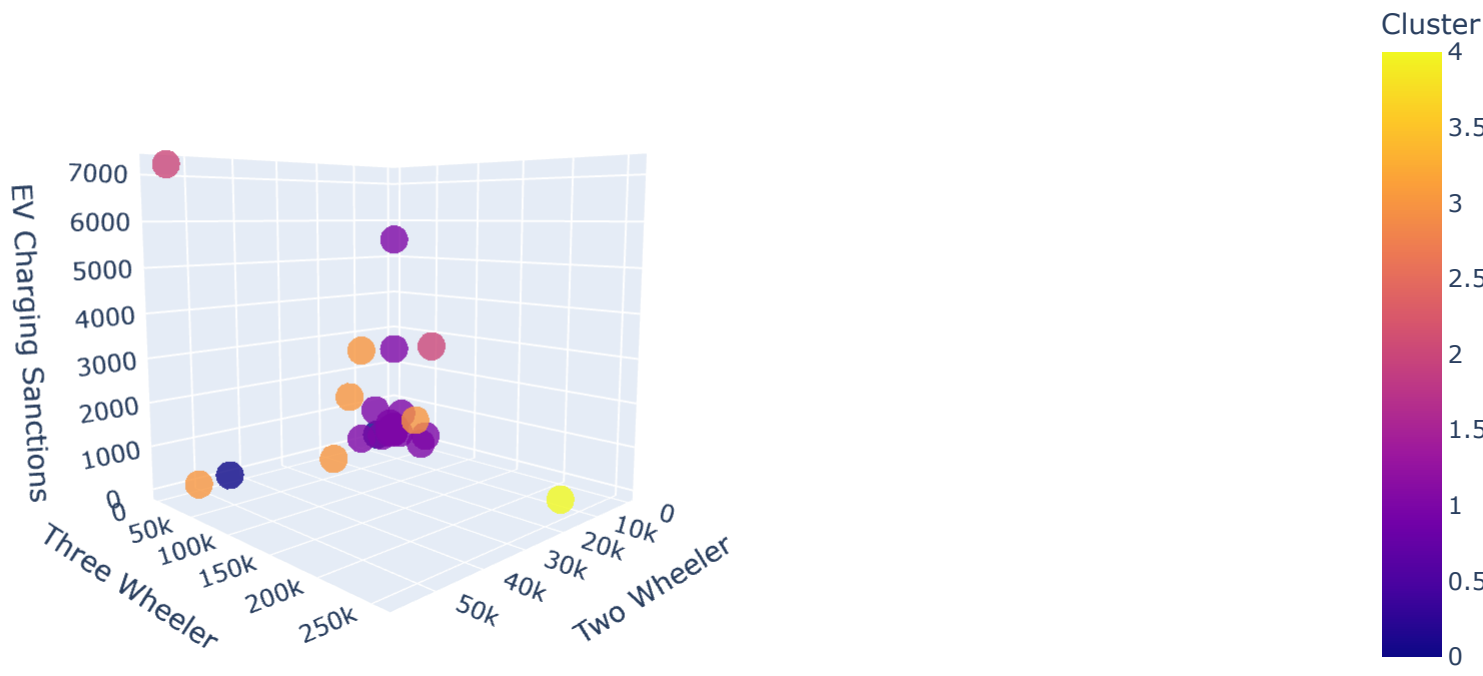
# Visualize clusters
fig = px.scatter_3d(merged_data, x='Two Wheeler', y='Three Wheeler', z='Four Wheeler',
                    color='Cluster', title='Clustering of States Based on EV Adoption, Charging Infrastructure, and EV Charging Sanctions',
                    labels={'Two Wheeler': 'Two Wheeler', 'Three Wheeler': 'Three Wheeler', 'Four Wheeler': 'Four Wheeler'},
                    opacity=0.8, hover_name='State')
fig.update_layout(scene=dict(zaxis_title='EV Charging Sanctions'))
fig.show()

# Display the cluster characteristics
cluster_characteristics = merged_data.groupby('Cluster')[selected_columns[1:]].mean()
print(cluster_characteristics)
```

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning:

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning

Clustering of States Based on EV Adoption, Charging Infrastructure, and EV Charging Sanctions



	Two Wheeler	Three Wheeler	Four Wheeler	Goods Vehicles \
Cluster				
0	25363.000000	4905.500000	65.000000	1179.000000
1	1861.727273	7735.863636	505.090909	12.227273
2	35733.500000	64654.500000	5131.500000	101.000000
3	20219.200000	16143.600000	892.400000	30.800000
4	18295.000000	257159.000000	368.000000	53.000000

	Charging Stations	Number of Electric Vehicle Charging Sanctioned
Cluster		
0	NaN	140.5
1	21.333333	29.4
2	71.000000	122.0
3	49.000000	204.4
4	15.000000	207.0

Let's examine the average characteristics of each cluster:

- Cluster 0 - High EV Adoption, Moderate Charging Infrastructure, Moderate EV Charging Sanctions.

States: Tamil Nadu and Chhattisgarh

- Cluster 1 - Low to Moderate EV Adoption, Low Charging Infrastructure, Low EV Charging Sanctions.

States: Odisha, Punjab, Bihar, Assam, Haryana, Ladhakh, Sikkim, Jharkhand, Puducherry, Goa, Jammu Kashmir, Himachal Pradesh, Nagaland, Tirupura, (

- Cluster 2 - High EV Adoption, High Charging Infrastructure, High EV Charging Sanctions.

States: Karnataka And Delhi

- Cluster 3 - Moderate EV Adoption, Moderate Charging Infrastructure, High EV Charging Sanctions.

States: Maharastra, Rajasthan, West Bengal, Gujarat, Kerala

- Cluster 4 - High EV Adoption (Mainly Three Wheelers and Four Wheelers), Low Charging Infrastructure, Low EV Charging Sanctions.

States: Uttar Pradesh

- Recommendation:

Based on the clustering analysis and our goal of maximizing profit, it is recommended to start the EV company in a state from Cluster 2. This cluster represents states with high adoption of various types of vehicles (Two Wheelers, Three Wheelers, and Four Wheelers), a substantial number of Charging Stations, and a significant number of Electric Vehicle Charging Sanctions. These factors indicate a favorable environment for EV adoption and a potentially lucrative market.

- Profitable Vehicle Type:

Given the characteristics of Cluster 2, the company should consider producing a range of electric vehicles, including Two Wheelers, Three Wheelers, and Four Wheelers. However, since the adoption of Four Wheelers is relatively high in this cluster, focusing on producing electric Four Wheelers could potentially lead to maximum profitability.

In summary, the recommended strategy is to start the EV company in a state from Cluster 2, where high adoption of various vehicle types and a supportive charging infrastructure provide a strong foundation for success. The company should prioritize the production of electric Four Wheelers to tap into the existing demand and achieve maximum profitability in the chosen state.