Untitled1

December 18, 2023

0.1 ELECTRIC VEHICLE REGISTRATION PROJECT

```
[1]: import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import seaborn as sns
```

```
[2]: data_x = pd.read_csv('EV_Registration_Dataset.csv')
     data_x
```

```
[2]:         Identifier           City  Postal Code  Model Year        Make  \
     0       KL8CL6S05E         Tacoma      98407.0        2014   CHEVROLET
     1       JTDKARFP0H  Port Townsend      98368.0        2017      TOYOTA
     2       JHMZC5F34J         Vashon      98070.0        2018       HONDA
     3       KMHC65LD0K     Ridgefield      98642.0        2019     HYUNDAI
     4       1N4AZ1CP6J      Bremerton      98337.0        2018      NISSAN
     …            …            …          …         …         …
     135033  JTDKARFP0H   Port Angeles      98362.0        2017      TOYOTA
     135034  5YJ3E1EB7L        Seattle      98134.0        2020       TESLA
     135035  7FCTGAAL4N         Renton      98059.0        2022      RIVIAN
     135036  WVGGNPE28N     Bellingham      98225.0        2022  VOLKSWAGEN
     135037  2C4RC1N70L        Seattle      98126.0        2020    CHRYSLER

                   Model                   Electric Vehicle Type  \
     0             SPARK          Battery Electric Vehicle (BEV)
     1       PRIUS PRIME  Plug-in Hybrid Electric Vehicle (PHEV)
     2           CLARITY  Plug-in Hybrid Electric Vehicle (PHEV)
     3             IONIQ  Plug-in Hybrid Electric Vehicle (PHEV)
     4              LEAF          Battery Electric Vehicle (BEV)
     …             …                                      …
     135033  PRIUS PRIME  Plug-in Hybrid Electric Vehicle (PHEV)
     135034      MODEL 3          Battery Electric Vehicle (BEV)
     135035          R1T          Battery Electric Vehicle (BEV)
     135036         ID.4          Battery Electric Vehicle (BEV)
     135037     PACIFICA  Plug-in Hybrid Electric Vehicle (PHEV)

             Clean Alternative Fuel Vehicle (CAFV) Eligibility  Electric Range  \
     0                 Clean Alternative Fuel Vehicle Eligible            82.0
```

```
1                   Not eligible due to low battery range            25.0
2                 Clean Alternative Fuel Vehicle Eligible            47.0
3                   Not eligible due to low battery range            29.0
4                 Clean Alternative Fuel Vehicle Eligible           151.0
…                                                   …             …
135033              Not eligible due to low battery range            25.0
135034            Clean Alternative Fuel Vehicle Eligible           322.0
135035  Eligibility unknown as battery range has not b…             0.0
135036  Eligibility unknown as battery range has not b…             0.0
135037            Clean Alternative Fuel Vehicle Eligible            32.0

        Base MSRP  Legislative District  Vehicle ID  \
0             0.0                  27.0   259013639
1             0.0                  24.0   220589904
2             0.0                  34.0   109177015
3             0.0                  18.0   196216282
4             0.0                  26.0   187956821
…           …                   …         …
135033        0.0                  24.0   170415311
135034        0.0                  11.0     7846793
135035        0.0                  11.0   209943625
135036        0.0                  42.0   224427346
135037        0.0                  34.0   107603933

                                      Vehicle Location  \
0               POINT (-122.5113356 47.29238280000004)
1        POINT (-122.76441969999996 48.11958740000006)
2       POINT (-122.45867519999996 47.448468700000035)
3        POINT (-122.74348499999996 45.81886000000003)
4       POINT (-122.63590499999998 47.570970000000045)
…                                                …
135033   POINT (-123.42556499999995 48.10979500000008)
135034  POINT (-122.32981499999994 47.579810000000066)
135035  POINT (-122.15733999999998 47.487175000000036)
135036   POINT (-122.48611499999998 48.76161500000006)
135037   POINT (-122.37410499999999 47.54468000000003)

                                         Electric Utility  2020 Census Tract
0       BONNEVILLE POWER ADMINISTRATION||CITY OF TACOM…       5.305306e+10
1       BONNEVILLE POWER ADMINISTRATION||PUGET SOUND E…       5.303195e+10
2           PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)       5.303303e+10
3       BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF C…       5.301104e+10
4                                  PUGET SOUND ENERGY INC       5.303508e+10
…                                                   …                …
135033  BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF C…       5.300900e+10
135034       CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)       5.303301e+10
135035      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)       5.303303e+10
```

```
135036  PUGET SOUND ENERGY INC||PUD NO 1 OF WHATCOM CO…       5.307300e+10
135037       CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)        5.303301e+10

[135038 rows x 15 columns]
```

[3]:

```
data_x.head()
```

[3]:

```
   Identifier           City  Postal Code  Model Year       Make        Model  \
0  KL8CL6S05E         Tacoma      98407.0        2014  CHEVROLET        SPARK
1  JTDKARFP0H  Port Townsend      98368.0        2017     TOYOTA  PRIUS PRIME
2  JHMZC5F34J         Vashon      98070.0        2018      HONDA      CLARITY
3  KMHC65LD0K     Ridgefield      98642.0        2019    HYUNDAI        IONIQ
4  1N4AZ1CP6J      Bremerton      98337.0        2018     NISSAN         LEAF

                    Electric Vehicle Type  \
0          Battery Electric Vehicle (BEV)
1  Plug-in Hybrid Electric Vehicle (PHEV)
2  Plug-in Hybrid Electric Vehicle (PHEV)
3  Plug-in Hybrid Electric Vehicle (PHEV)
4          Battery Electric Vehicle (BEV)

  Clean Alternative Fuel Vehicle (CAFV) Eligibility  Electric Range  \
0           Clean Alternative Fuel Vehicle Eligible            82.0
1             Not eligible due to low battery range            25.0
2           Clean Alternative Fuel Vehicle Eligible            47.0
3             Not eligible due to low battery range            29.0
4           Clean Alternative Fuel Vehicle Eligible           151.0

   Base MSRP  Legislative District  Vehicle ID  \
0        0.0                  27.0   259013639
1        0.0                  24.0   220589904
2        0.0                  34.0   109177015
3        0.0                  18.0   196216282
4        0.0                  26.0   187956821

                                 Vehicle Location  \
0          POINT (-122.5113356 47.29238280000004)
1   POINT (-122.76441969999996 48.11958740000006)
2  POINT (-122.45867519999996 47.448468700000035)
3   POINT (-122.74348499999996 45.81886000000003)
4  POINT (-122.63590499999998 47.570970000000045)

                                    Electric Utility  2020 Census Tract
0  BONNEVILLE POWER ADMINISTRATION||CITY OF TACOM…       5.305306e+10
1  BONNEVILLE POWER ADMINISTRATION||PUGET SOUND E…       5.303195e+10
2      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)       5.303303e+10
3  BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF C…       5.301104e+10
```

```
4                              PUGET SOUND ENERGY INC       5.303508e+10
```

[4]:

```
data_x.describe(include="object").T
```

[4]:

```
                                                     count unique  \
Identifier                                          135038   9059
City                                                135030    651
Make                                                135038     36
Model                                               134789    125
Electric Vehicle Type                               135038      2
Clean Alternative Fuel Vehicle (CAFV) Eligibility   135038      3
Vehicle Location                                    135028    785
Electric Utility                                    135030     76

             top  \
Identifier
5YJYGDEE9M
City
Seattle
Make
TESLA
Model
MODEL 3
Electric Vehicle Type                                                  Battery
Electric Vehicle (BEV)
Clean Alternative Fuel Vehicle (CAFV) Eligibility         Clean Alternative Fuel
Vehicle Eligible
Vehicle Location                                    POINT (-122.12301999999994
47.67668000000003)
Electric Utility                                    PUGET SOUND ENERGY INC||CITY
OF TACOMA - (WA)

                                                      freq
Identifier                                             473
City                                                 23489
Make                                                 61808
Model                                                25837
Electric Vehicle Type                               103882
Clean Alternative Fuel Vehicle (CAFV) Eligibility    61221
Vehicle Location                                      3482
Electric Utility                                     49369
```

[5]:

```
data_x.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 135038 entries, 0 to 135037
Data columns (total 15 columns):
 #   Column                                             Non-Null Count   Dtype
---  ------                                             --------------   -----
 0   Identifier                                         135038 non-null  object
 1   City                                               135030 non-null  object
 2   Postal Code                                        135030 non-null  float64
 3   Model Year                                         135038 non-null  int64
 4   Make                                               135038 non-null  object
 5   Model                                              134789 non-null  object
 6   Electric Vehicle Type                              135038 non-null  object
 7   Clean Alternative Fuel Vehicle (CAFV) Eligibility  135038 non-null  object
 8   Electric Range                                     135037 non-null  float64
 9   Base MSRP                                          135037 non-null  float64
 10  Legislative District                               134726 non-null  float64
 11  Vehicle ID                                         135038 non-null  int64
 12  Vehicle Location                                   135028 non-null  object
 13  Electric Utility                                   135030 non-null  object
 14  2020 Census Tract                                  135030 non-null  float64
dtypes: float64(5), int64(2), object(8)
memory usage: 15.5+ MB
```

[6]:

```python
data_x.isnull().sum()
```

[6]:

```
Identifier                                             0
City                                                   8
Postal Code                                            8
Model Year                                             0
Make                                                   0
Model                                                249
Electric Vehicle Type                                  0
Clean Alternative Fuel Vehicle (CAFV) Eligibility      0
Electric Range                                         1
Base MSRP                                              1
Legislative District                                 312
Vehicle ID                                             0
Vehicle Location                                      10
Electric Utility                                       8
2020 Census Tract                                      8
dtype: int64
```

[7]:

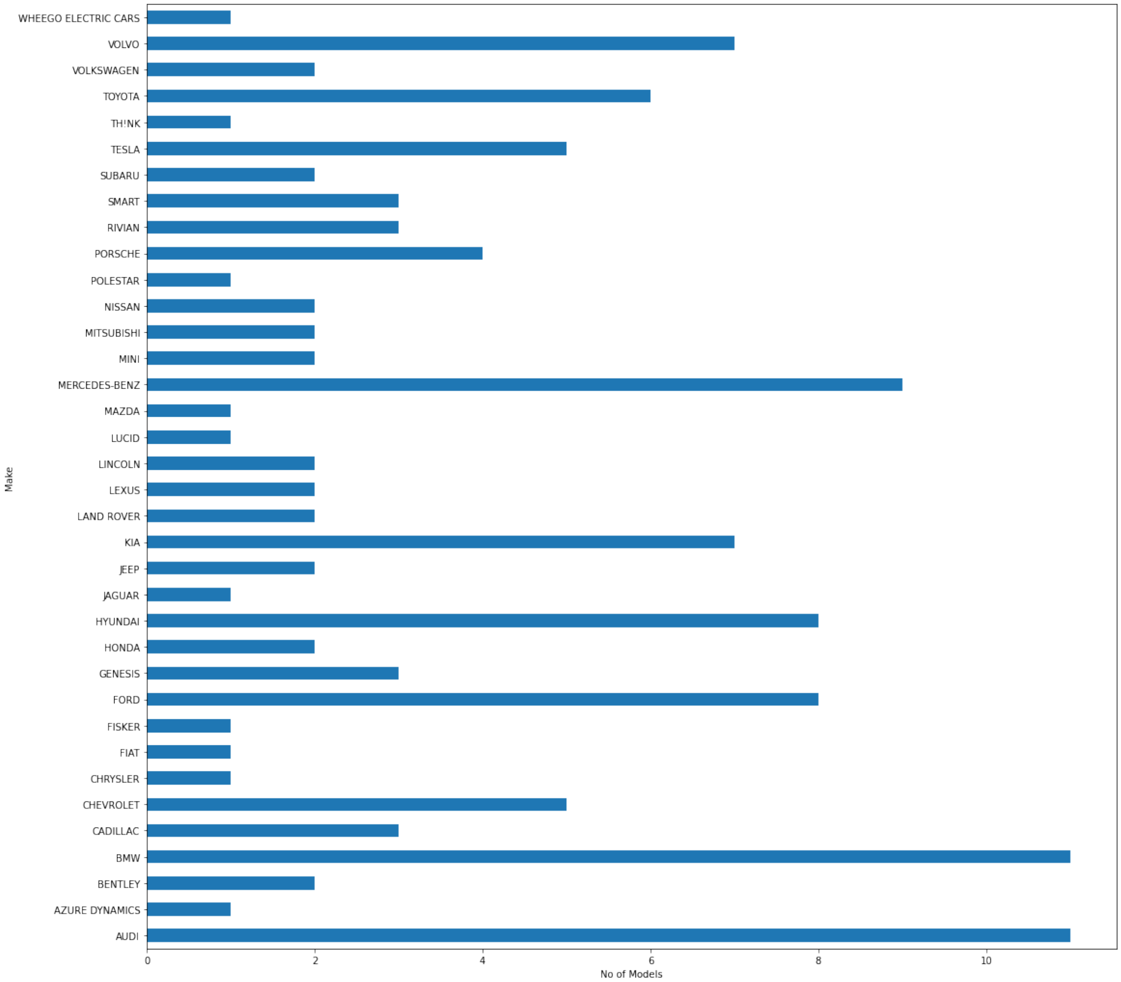
```python
#Different models according to state
data_x.groupby("City")["Model"].count()
```

[7]:

```
City
Aberdeen          119
Acme                5
Addy                2
Airway Heights     20
```

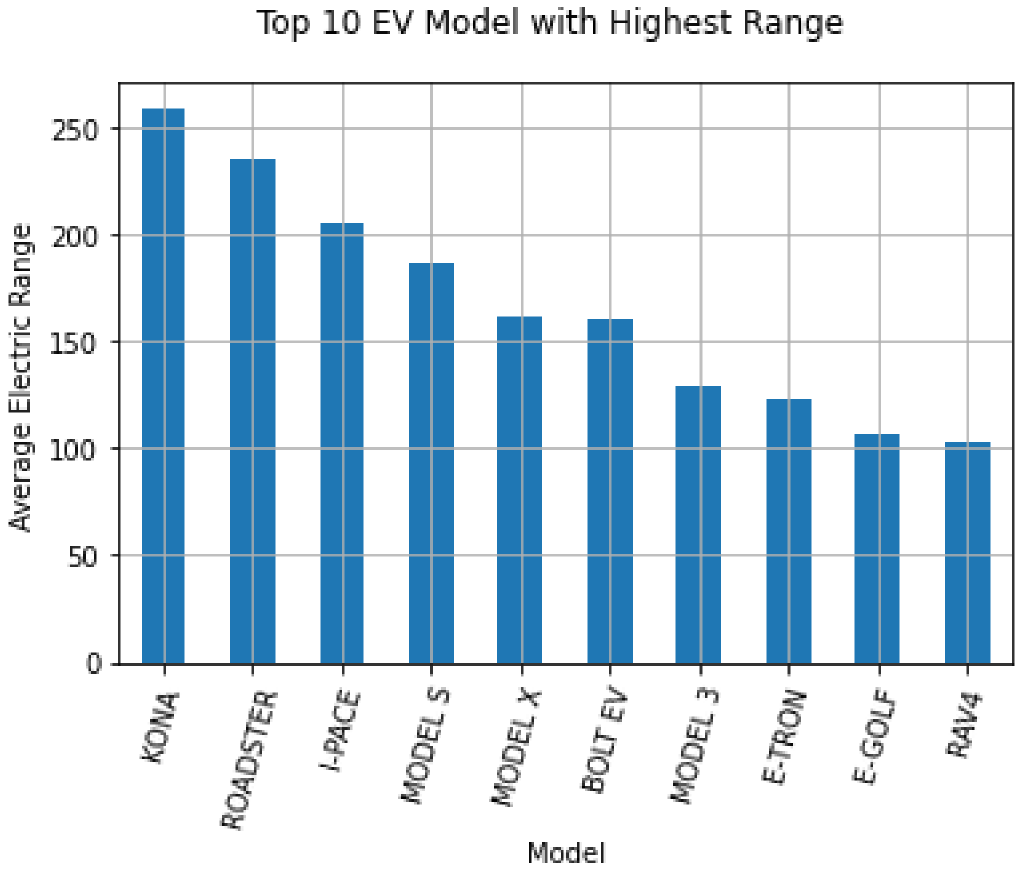
```
Alderdale            1
                  …
Yacolt              33
Yakima             490
Yarrow Point       129
Yelm               204
Zillah              23
Name: Model, Length: 651, dtype: int64
```

```
[8]: ## No of models of EV of different companies
     plt.figure(figsize=(18,18))
     data_x.groupby('Make')['Model'].nunique().plot(kind='barh')
     #plt.figure(figsize=(18,18))
     plt.xlabel('No of Models')
     plt.ylabel('Make',fontsize=10)
     plt.show()
```



[9]:

```
#Mean range of different models
data_x.groupby("Model")["Electric Range"].mean().sort_values(ascending=False)[:
 ↪10].plot(kind="bar")
plt.ylabel("Average Electric Range")
plt.xticks(rotation=75)
plt.grid()
plt.suptitle("Top 10 EV Model with Highest Range")
plt.show()
```



[10]:

```
## For which utility, the following shows which "Make" is the most preferred...

utility_make_counts = data_x.groupby(['Electric Utility', 'Make']).size()

# Sort the result in descending order within each utility and get the top make␣
 ↪for each utility
most_preferred_makes = utility_make_counts.groupby('Electric Utility').
 ↪apply(lambda x: x.sort_values(ascending=False).index[0])

print("Most preferred makes for each utility:")
print(most_preferred_makes.unique())
```

```
Most preferred makes for each utility:
[('AVISTA CORP', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||AVISTA CORP||BIG BEND ELECTRIC COOP, INC',
'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||AVISTA CORP||INLAND POWER & LIGHT COMPANY',
'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||AVISTA CORP||PUD NO 1 OF ASOTIN COUNTY',
'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||BENTON RURAL ELECTRIC ASSN', 'BMW')
 ('BONNEVILLE POWER ADMINISTRATION||BIG BEND ELECTRIC COOP, INC', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF CENTRALIA - (WA)|CITY OF TACOMA -
(WA)', 'NISSAN')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF COULEE DAM - (WA)', 'LINCOLN')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF ELLENSBURG - (WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF MCCLEARY - (WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF MILTON - (WA)|CITY OF TACOMA -
(WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF PORT ANGELES - (WA)', 'CHEVROLET')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF RICHLAND - (WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||ALDER MUTUAL LIGHT
CO, INC|PENINSULA LIGHT COMPANY', 'RIVIAN')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||BENTON RURAL ELECTRIC
ASSN|PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||ELMHURST MUTUAL POWER
& LIGHT CO|PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||LAKEVIEW LIGHT &
POWER|PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||OHOP MUTUAL LIGHT
COMPANY, INC|PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PARKLAND LIGHT &
WATER COMPANY|PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PENINSULA LIGHT
COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PUD NO 1 OF LEWIS
COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PUD NO 1 OF MASON
COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PUD NO 3 OF MASON
COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||COLUMBIA RURAL ELEC ASSN, INC', 'CHEVROLET')
 ('BONNEVILLE POWER ADMINISTRATION||INLAND POWER & LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||NESPELEM VALLEY ELEC COOP, INC', 'NISSAN')
 ('BONNEVILLE POWER ADMINISTRATION||ORCAS POWER & LIGHT COOP', 'NISSAN')
 ('BONNEVILLE POWER ADMINISTRATION||PACIFICORP||BENTON RURAL ELECTRIC ASSN',
'TESLA')
```

```
 ('BONNEVILLE POWER ADMINISTRATION||PACIFICORP||COLUMBIA RURAL ELEC ASSN, INC',
'CHEVROLET')
 ('BONNEVILLE POWER ADMINISTRATION||PACIFICORP||PUD NO 1 OF CLARK COUNTY -
(WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PENINSULA LIGHT COMPANY', 'AUDI')
 ('BONNEVILLE POWER ADMINISTRATION||PUD 1 OF SNOHOMISH COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF ASOTIN COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF ASOTIN COUNTY||INLAND POWER &
LIGHT COMPANY', 'TOYOTA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF BENTON COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF CLALLAM COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF CLARK COUNTY - (WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF COWLITZ COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF FERRY COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF FRANKLIN COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF GRAYS HARBOR COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF JEFFERSON COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF KITTITAS COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF KLICKITAT COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF MASON COUNTY|PUD NO 1 OF
JEFFERSON COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF SKAMANIA CO', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF WAHKIAKUM COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUD NO 2 OF PACIFIC COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||PUGET SOUND ENERGY INC||PUD NO 1 OF
JEFFERSON COUNTY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||TOWN OF EATONVILLE - (WA)|CITY OF TACOMA -
(WA)', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||TOWN OF RUSTON - (WA)|CITY OF TACOMA -
(WA)||PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||TOWN OF STEILACOOM|CITY OF TACOMA -
(WA)||PENINSULA LIGHT COMPANY', 'TESLA')
 ('BONNEVILLE POWER ADMINISTRATION||VERA IRRIGATION DISTRICT #15', 'TESLA')
 ('CITY OF BLAINE - (WA)||PUD NO 1 OF WHATCOM COUNTY', 'TESLA')
 ('CITY OF CHENEY - (WA)', 'TESLA') ('CITY OF CHEWELAH', 'TOYOTA')
 ('CITY OF SEATTLE - (WA)', 'BMW')
 ('CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)', 'TESLA')
 ('CITY OF SUMAS - (WA)||PUD NO 1 OF WHATCOM COUNTY', 'CHEVROLET')
 ('CITY OF TACOMA - (WA)', 'TESLA')
 ('CITY OF TACOMA - (WA)||TANNER ELECTRIC COOP', 'TESLA')
 ('MODERN ELECTRIC WATER COMPANY', 'TESLA')
 ('NO KNOWN ELECTRIC UTILITY SERVICE', 'TESLA')
 ('NON WASHINGTON STATE ELECTRIC UTILITY', 'TESLA')
 ('OKANOGAN COUNTY ELEC COOP, INC', 'TESLA') ('PACIFICORP', 'TESLA')
 ('PORTLAND GENERAL ELECTRIC CO', 'TESLA')
 ('PUD NO 1 OF CHELAN COUNTY', 'TESLA')
 ('PUD NO 1 OF DOUGLAS COUNTY', 'TESLA')
 ('PUD NO 1 OF OKANOGAN COUNTY', 'TESLA')
```

```
('PUD NO 1 OF PEND OREILLE COUNTY', 'TESLA')
('PUD NO 1 OF WHATCOM COUNTY', 'TESLA')
('PUD NO 2 OF GRANT COUNTY', 'TESLA') ('PUGET SOUND ENERGY INC', 'TESLA')
('PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)', 'TESLA')
('PUGET SOUND ENERGY INC||PUD NO 1 OF WHATCOM COUNTY', 'TESLA')]
```

[13]:

```
#different models available per country
data_x.groupby(["Country","Model"]).size()
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/tmp/ipykernel_309/1768378594.py in <cell line: 2>()
      1 #different models available per country
----> 2 data_x.groupby(["Country","Model"]).size()

/usr/local/lib/python3.10/site-packages/pandas/core/frame.py in groupby(self,␣
 ↪by, axis, level, as_index, sort, group_keys, squeeze, observed, dropna)
   8400         axis = self._get_axis_number(axis)
   8401
-> 8402         return DataFrameGroupBy(

   8403             obj=self,
   8404             keys=by,

/usr/local/lib/python3.10/site-packages/pandas/core/groupby/groupby.py in␣
 ↪__init__(self, obj, keys, axis, level, grouper, exclusions, selection,␣
 ↪as_index, sort, group_keys, squeeze, observed, mutated, dropna)
    963             from pandas.core.groupby.grouper import get_grouper
    964
--> 965             grouper, exclusions, obj = get_grouper(

    966                 obj,
    967                 keys,

/usr/local/lib/python3.10/site-packages/pandas/core/groupby/grouper.py in␣
 ↪get_grouper(obj, key, axis, level, sort, observed, mutated, validate, dropna)
    886                 in_axis, level, gpr = False, gpr, None
    887             else:
--> 888                 raise KeyError(gpr)
    889         elif isinstance(gpr, Grouper) and gpr.key is not None:
    890             # Add key to exclusions

KeyError: 'Country'
```

[14]:

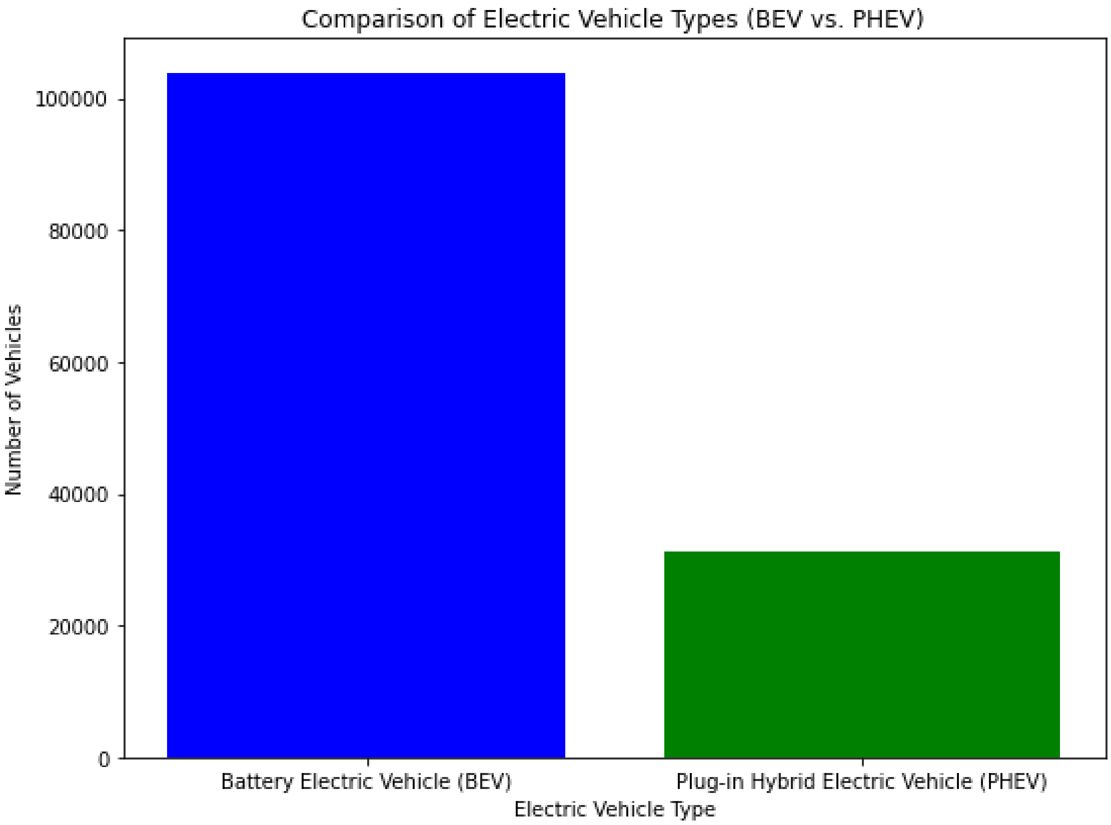
```
## Mean MSRP per model of EVs
data_x.groupby('Model')['Base MSRP'].mean()
```

[14]:

```
Model
330E    20094.348894
500         0.000000
530E    40609.007833
740E    90394.230769
745E        0.000000
            …
X3          0.000000
X5          0.000000
XC40        0.000000
XC60    12849.716232
XC90     4798.711340
Name: Base MSRP, Length: 125, dtype: float64
```

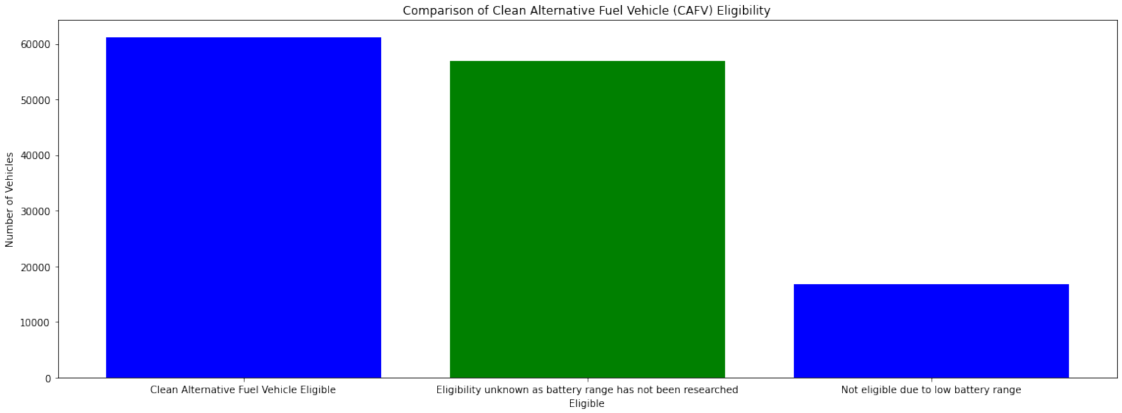
[15]:

```python
EV_types_counts = data_x["Electric Vehicle Type"].value_counts()

#create Bar chart to compare between the two types
plt.figure(figsize=(8,6))
plt.bar(EV_types_counts.index,EV_types_counts.values,color=["b","g"])
plt.xlabel("Electric Vehicle Type")
plt.ylabel("Number of Vehicles")
plt.title("Comparison of Electric Vehicle Types (BEV vs. PHEV)")
plt.tight_layout()
plt.show()
```



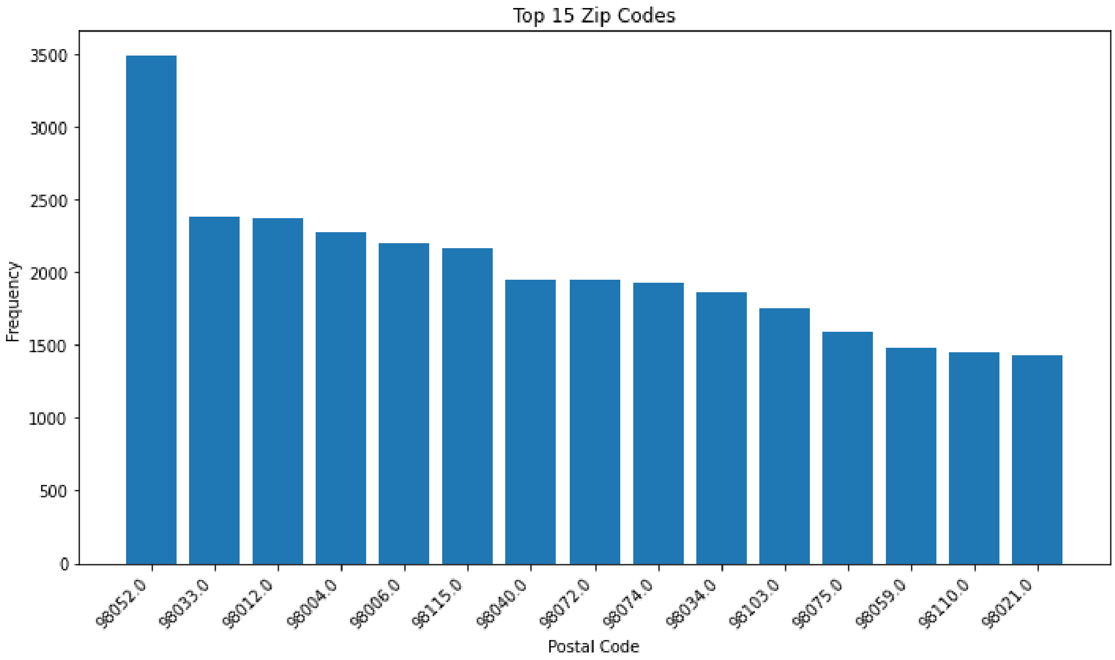
[16]:

```
EV_fuel_counts = data_x["Clean Alternative Fuel Vehicle (CAFV) Eligibility"].
 ↪value_counts()

#Create a bar chart to compare the two types
plt.figure(figsize=(16,6))
plt.bar(EV_fuel_counts.index,EV_fuel_counts.values,color=["b","g"])
plt.xlabel('Eligible')
plt.ylabel('Number of Vehicles')
plt.title('Comparison of Clean Alternative Fuel Vehicle (CAFV) Eligibility')
plt.tight_layout()
plt.show()
```

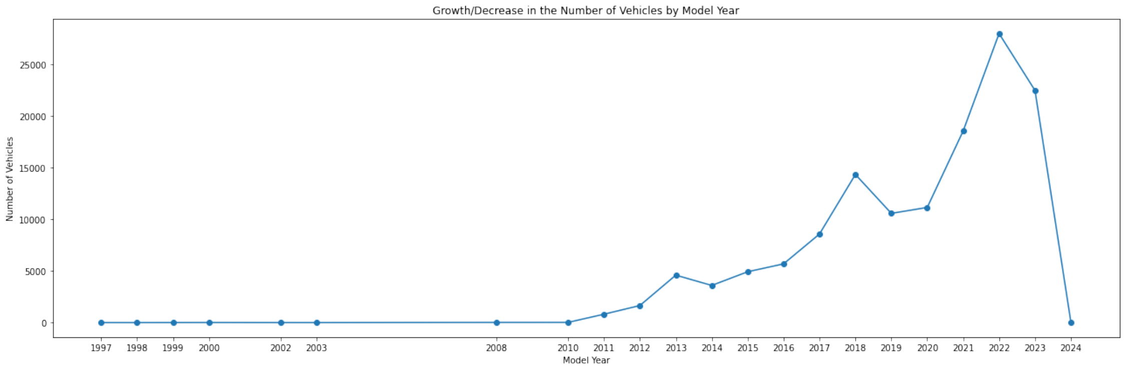


[17]:

```
#Count the occurrences of each postal code
postal_code_counts = data_x["Postal Code"].value_counts()

#Get the top 15 postal codes
top_15_postal_codes = postal_code_counts.head(15)

#create a bar graph for the top 15 postal code
plt.figure(figsize=(10,6))
plt.bar(top_15_postal_codes.index.astype(str),top_15_postal_codes.values)
plt.xlabel('Postal Code')
plt.ylabel('Frequency')
plt.title('Top 15 Zip Codes')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```

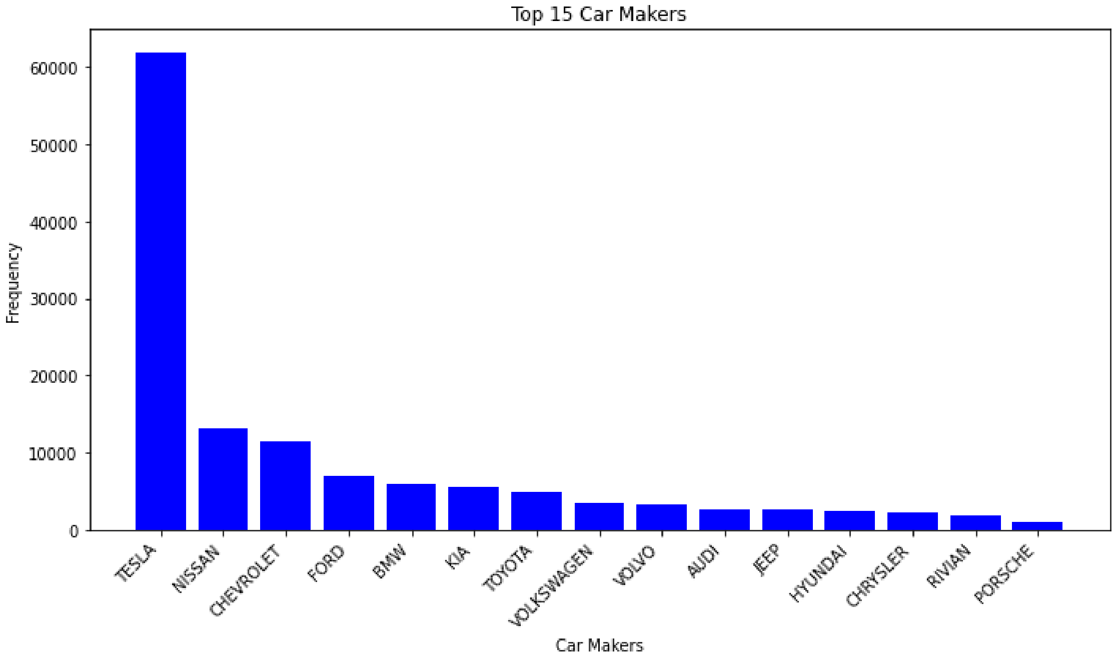


[19]:
```
# Count the occurrences of each Model Year
model_year_counts = data_x['Model Year'].value_counts().sort_index()
# Create a line plot to show the growth or decrease in the number of vehicles␣
  ↪by Model Year
plt.figure(figsize=(18, 6))
plt.plot(model_year_counts.index, model_year_counts.values, marker='o',␣
  ↪linestyle='-')
plt.xlabel('Model Year')
plt.ylabel('Number of Vehicles')
plt.title('Growth/Decrease in the Number of Vehicles by Model Year')

plt.xticks(model_year_counts.index)
plt.tight_layout()
plt.show()
```



[20]:

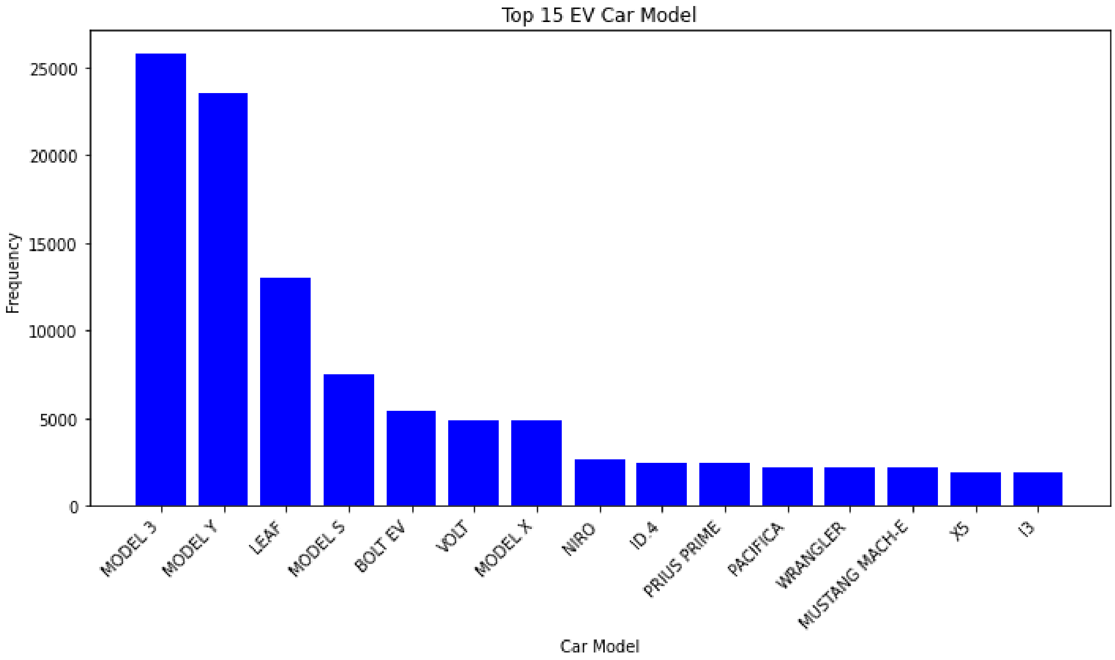
```
# Count the occurrences of each postal code
make_counts = data_x['Make'].value_counts()

# Get the top 15 makers
top_15_make_counts = make_counts.head(15)

# Create a bar graph for the top 15 EV makers
plt.figure(figsize=(10, 6))
plt.bar(top_15_make_counts.index.astype(str), top_15_make_counts.values,␣
 ↪color='b')
plt.xlabel('Car Makers')
plt.ylabel('Frequency')
plt.title('Top 15 Car Makers')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



[21]:

```
# Count the occurrences of each postal code
model_counts = data_x['Model'].value_counts()

# Get the top 15 makers
top_15_model_counts = model_counts.head(15)
```

```
# Create a bar graph for the top 15 EV models
plt.figure(figsize=(10, 6))
plt.bar(top_15_model_counts.index.astype(str), top_15_model_counts.values,␣
 ↪color='b')
plt.xlabel('Car Model')
plt.ylabel('Frequency')
plt.title('Top 15 EV Car Model')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



[22]:

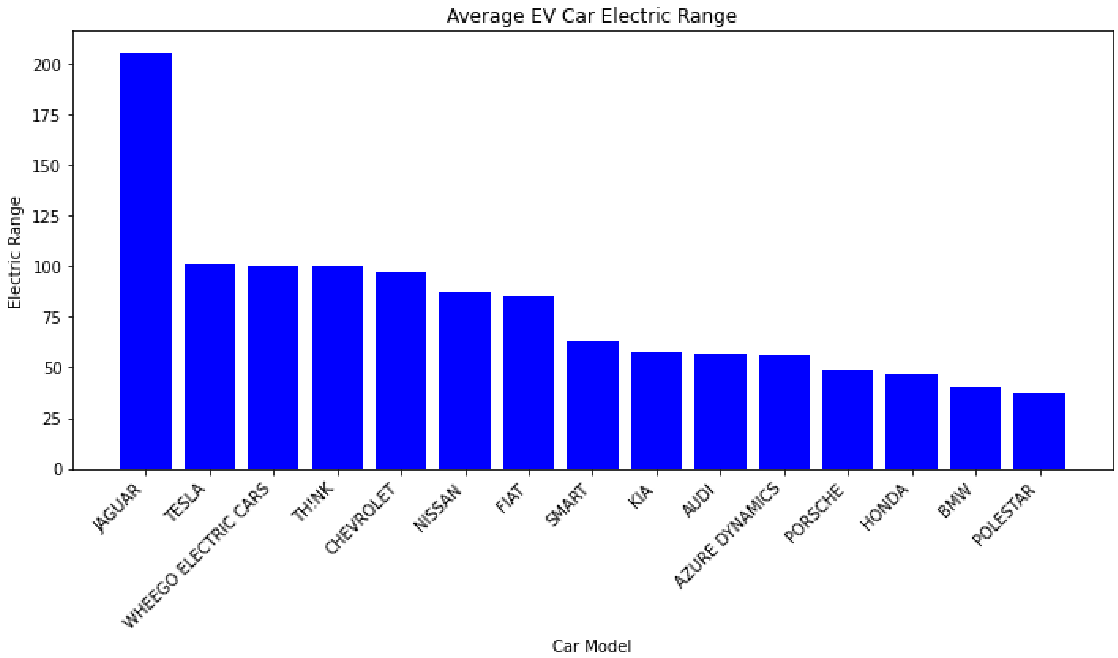
```
data_x.dropna(subset=["Electric Range"],inplace=True)
```

[23]:

```
df1 = data_x["Electric Range"].dropna()
```

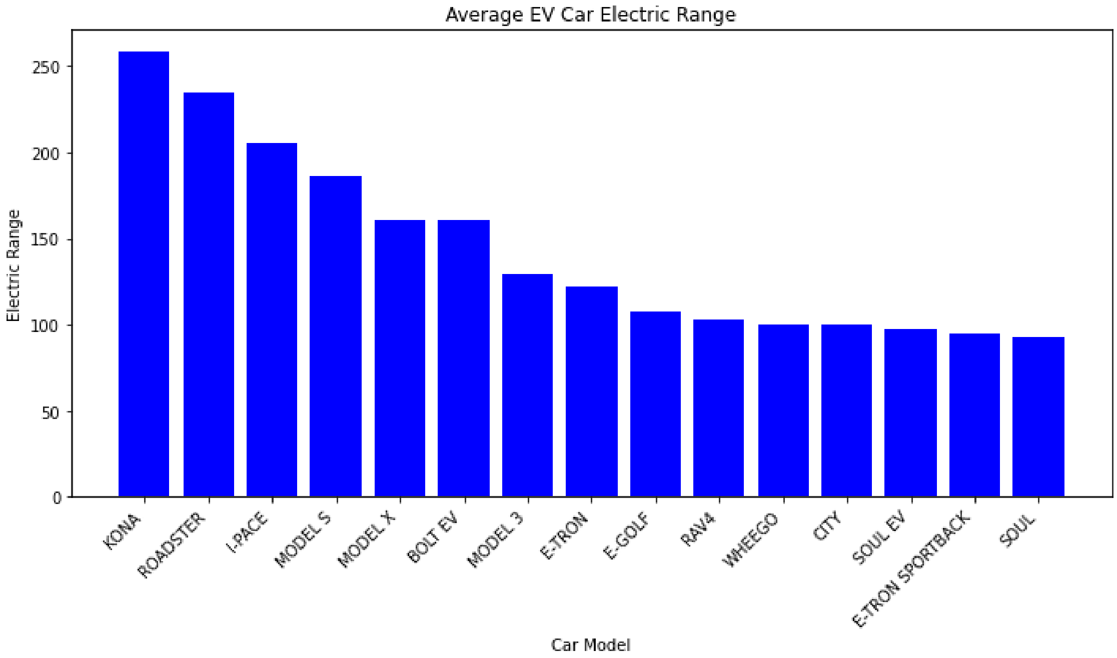
[24]:

```
# Count the occurrences of each postal code
electric_range_counts = data_x.groupby(['Make'])['Electric Range'].mean().
 ↪sort_values(ascending=False)

# Get the top 15 makers
top_15_model_counts = electric_range_counts.head(15)

# Create a bar graph for the top 15 Car makers with Average EV range
plt.figure(figsize=(10, 6))
plt.bar(top_15_model_counts.index.astype(str), top_15_model_counts.values,␣
 ↪color='b')
plt.xlabel('Car Model')
plt.ylabel('Electric Range')
plt.title('Average EV Car Electric Range')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



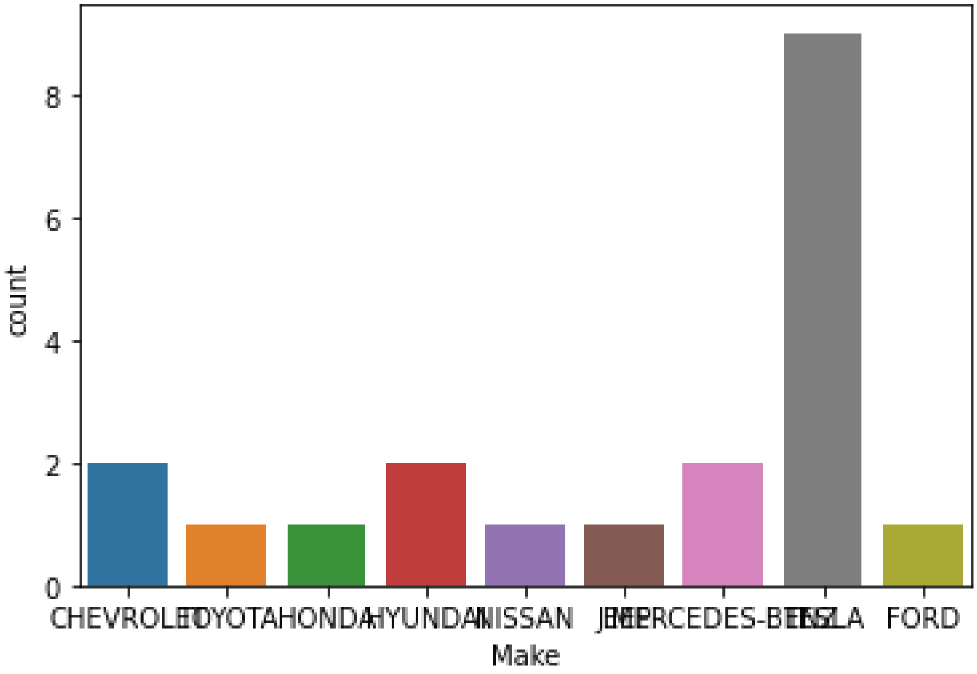
[25]:

```
# Count the occurrences of each postal code
electric_range_model_counts = data_x.groupby(['Model'])['Electric Range'].
 ↪mean().sort_values(ascending=False)

# Get the top 15 makers
electric_range_model_counts_top = electric_range_model_counts.head(15)

#   Create a bar graph for the top 15 Car models with Average EV range
plt.figure(figsize=(10, 6))
plt.bar(electric_range_model_counts_top.index.astype(str),␣
 ↪electric_range_model_counts_top.values, color='b')
plt.xlabel('Car Model')
plt.ylabel('Electric Range')
plt.title('Average EV Car Electric Range')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



[26]:
```
sns.countplot(x="Make",data=data_x.head(20))
```

[26]:
```
<AxesSubplot: xlabel='Make', ylabel='count'>
```



[ ]: