In [1]:
```
import pandas as pd
import numpy as np
```

In [2]:
```
EV_data =pd.read_csv("C:\\Users\\jniku\\Downloads\\Electric_Vehicle_Population_Data -
```

In [3]:
```
EV_data.head()
```

Out[3]:

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	Clean Alternative Fuel Vehicle (CAFV) Eligibility
0	5YJ3E1EA8J	San Diego	Oceanside	CA	92051.0	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
1	3FA6P0PU7H	Sedgwick	Derby	KS	67037.0	2017	FORD	FUSION	Plug-in Hybrid Electric Vehicle (PHEV)	Not eligible due to low battery range
2	1N4AZ0CP8D	Snohomish	Marysville	WA	98271.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
3	WBY8P8C58K	Kitsap	Bremerton	WA	98337.0	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Clean Alternative Fuel Vehicle Eligible
4	5YJ3E1EA7K	Snohomish	Edmonds	WA	98026.0	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible

In [4]:
```
Clean_data = EV_data.drop_duplicates()
Clean_data.head()
```

Out[4]:

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	Clean Alternative Fuel Vehicle (CAFV) Eligibility
0	5YJ3E1EA8J	San Diego	Oceanside	CA	92051.0	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
1	3FA6P0PU7H	Sedgwick	Derby	KS	67037.0	2017	FORD	FUSION	Plug-in Hybrid Electric Vehicle (PHEV)	Not eligible due to low battery range
2	1N4AZ0CP8D	Snohomish	Marysville	WA	98271.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
3	WBY8P8C58K	Kitsap	Bremerton	WA	98337.0	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Clean Alternative Fuel Vehicle Eligible
4	5YJ3E1EA7K	Snohomish	Edmonds	WA	98026.0	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible

In [5]:
```
Clean_data = Clean_data.fillna(0)
Clean_data.head()
```

Out[5]:

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	Clean Alternative Fuel Vehicle (CAFV) Eligibility
0	5YJ3E1EA8J	San Diego	Oceanside	CA	92051.0	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
1	3FA6P0PU7H	Sedgwick	Derby	KS	67037.0	2017	FORD	FUSION	Plug-in Hybrid Electric Vehicle (PHEV)	Not eligible due to low battery range
2	1N4AZ0CP8D	Snohomish	Marysville	WA	98271.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible
3	WBY8P8C58K	Kitsap	Bremerton	WA	98337.0	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Clean Alternative Fuel Vehicle Eligible
4	5YJ3E1EA7K	Snohomish	Edmonds	WA	98026.0	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible

In [6]:
```
state_counts = Clean_data.groupby('State')['DOL Vehicle ID'].count()
```

In [7]:
```
state_counts = state_counts.sort_values(ascending=False)
```

In [8]:
```
print(state_counts)
```

```
State
WA    118665
CA        79
VA        38
MD        26
TX        19
NC         9
CO         9
AZ         8
GA         7
IL         7
CT         7
NV         7
FL         6
SC         6
DC         5
NJ         4
NE         4
NY         4
LA         4
KS         4
HI         4
MA         3
PA         3
OR         3
AR         3
MO         3
TN         2
OH         2
UT         2
WY         2
AL         2
ID         2
OK         1
NH         1
MS         1
RI         1
MN         1
KY         1
DE         1
BC         1
WI         1
AK         1
Name: DOL Vehicle ID, dtype: int64
```

In [9]:
```
my_data = Clean_data[EV_data['State'] == 'WA']
```

In [10]:
```
my_data.head()
```

Out[10]:

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	Cle Alternat F Vehi (CAI Eligibil
2	1N4AZ0CP8D	Snohomish	Marysville	WA	98271.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Cle Alternat F Vehi Eligi
3	WBY8P8C58K	Kitsap	Bremerton	WA	98337.0	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Cle Alternat F Vehi Eligi
4	5YJ3E1EA7K	Snohomish	Edmonds	WA	98026.0	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Cle Alternat F Vehi Eligi
5	1G1FZ6S07L	Walla Walla	Walla Walla	WA	99362.0	2020	CHEVROLET	BOLT EV	Battery Electric Vehicle (BEV)	Cle Alternat F Vehi Eligi
6	KNDCC3LG1L	Snohomish	Everett	WA	98204.0	2020	KIA	NIRO	Battery Electric Vehicle (BEV)	Cle Alternat F Vehi Eligi

In [11]:
```
my_data.drop(['VIN (1-10)','Postal Code','Base MSRP','Legislative District','DOL Vehic
```

```
C:\Users\jniku\AppData\Local\Temp\ipykernel_18556\4142337717.py:1: SettingWithCopyWar
ning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
er_guide/indexing.html#returning-a-view-versus-a-copy
  my_data.drop(['VIN (1-10)','Postal Code','Base MSRP','Legislative District','DOL Ve
hicle ID','Electric Utility','2020 Census Tract'],axis=1,inplace=True)
```

In [12]:
```
my_data.head()
```

Out[12]:

	County	City	State	Model Year	Make	Model	Electric Vehicle Type	Clean Alternative Fuel Vehicle (CAFV) Eligibility	Electric Range	Vehicl Locatio
2	Snohomish	Marysville	WA	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	75	POIN (-122.1938 48.15353
3	Kitsap	Bremerton	WA	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Clean Alternative Fuel Vehicle Eligible	126	POIN (-122.6274 47.565
4	Snohomish	Edmonds	WA	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	220	POIN (-122.3176 47.87166
5	Walla Walla	Walla Walla	WA	2020	CHEVROLET	BOLT EV	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	259	POIN (-118.3426 46.07068
6	Snohomish	Everett	WA	2020	KIA	NIRO	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	239	POIN (-122.2552 47.90456

In [13]:
```
my_data.isna().sum()
```

Out[13]:
```
County                                             0
City                                               0
State                                              0
Model Year                                         0
Make                                               0
Model                                              0
Electric Vehicle Type                              0
Clean Alternative Fuel Vehicle (CAFV) Eligibility  0
Electric Range                                     0
Vehicle Location                                   0
dtype: int64
```

In [14]:
```
my_data = my_data.dropna()
```

In [15]:
```
my_data.head()
```

Out[15]:

	County	City	State	Model Year	Make	Model	Electric Vehicle Type	Clean Alternative Fuel Vehicle (CAFV) Eligibility	Electric Range	Vehicl Locatio
2	Snohomish	Marysville	WA	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	75	POIN (-122.1938 48.15353
3	Kitsap	Bremerton	WA	2019	BMW	I3	Plug-in Hybrid Electric Vehicle (PHEV)	Clean Alternative Fuel Vehicle Eligible	126	POIN (-122.6274 47.565
4	Snohomish	Edmonds	WA	2019	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	220	POIN (-122.3176 47.87166
5	Walla Walla	Walla Walla	WA	2020	CHEVROLET	BOLT EV	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	259	POIN (-118.3426 46.07068
6	Snohomish	Everett	WA	2020	KIA	NIRO	Battery Electric Vehicle (BEV)	Clean Alternative Fuel Vehicle Eligible	239	POIN (-122.2552 47.90456

In [16]:
```
my_data.isna().sum()
```

Out[16]:
```
County                                               0
City                                                 0
State                                                0
Model Year                                           0
Make                                                 0
Model                                                0
Electric Vehicle Type                                0
Clean Alternative Fuel Vehicle (CAFV) Eligibility    0
Electric Range                                       0
Vehicle Location                                     0
dtype: int64
```

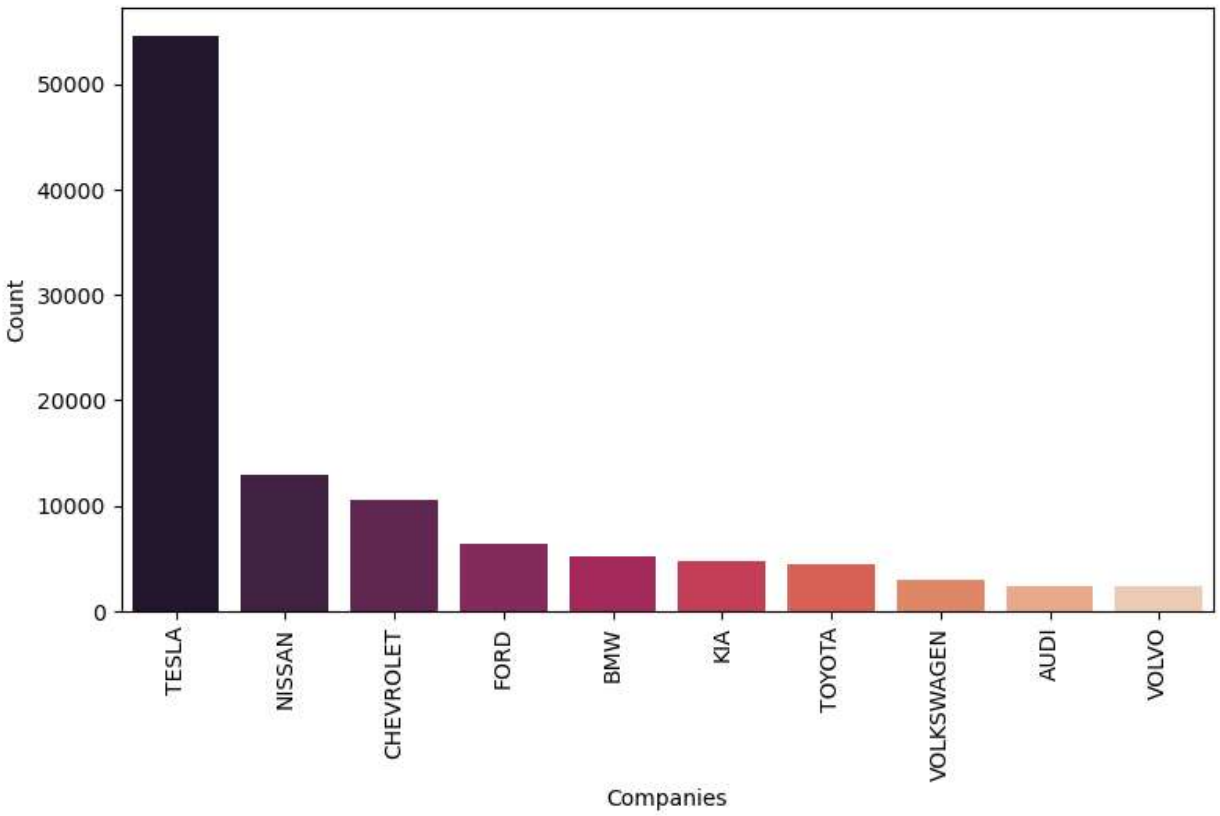
In [17]:
```
import seaborn as sns
import matplotlib.pyplot as plt
import plotly.express as px
```

In [18]:
```
#top company to make electric vehicles which are in use
Companies = my_data.groupby('Make').count().sort_values(by='City',ascending=False)['Ci
```

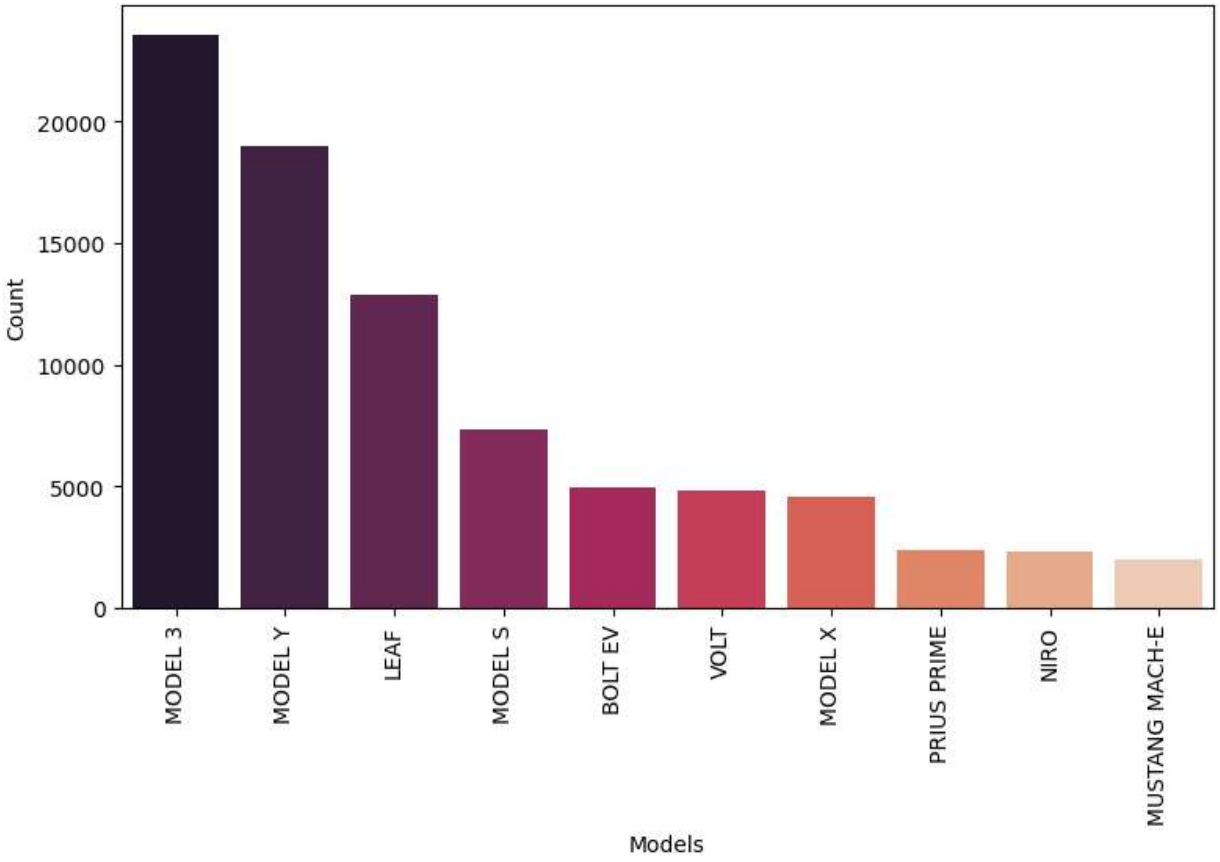


```
upby('Make').count().sort_values(by='City',ascending=False)['City'
```

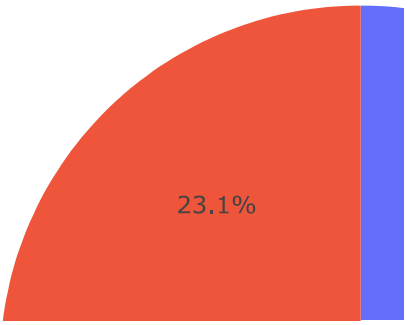
```
plt.figure(figsize=(9,5))
sns.barplot(x=list(Companies)[:10],y=values[:10],palette='rocket')
plt.xticks(rotation='90')
plt.xlabel('Companies')
plt.ylabel('Count')
plt.show()
```



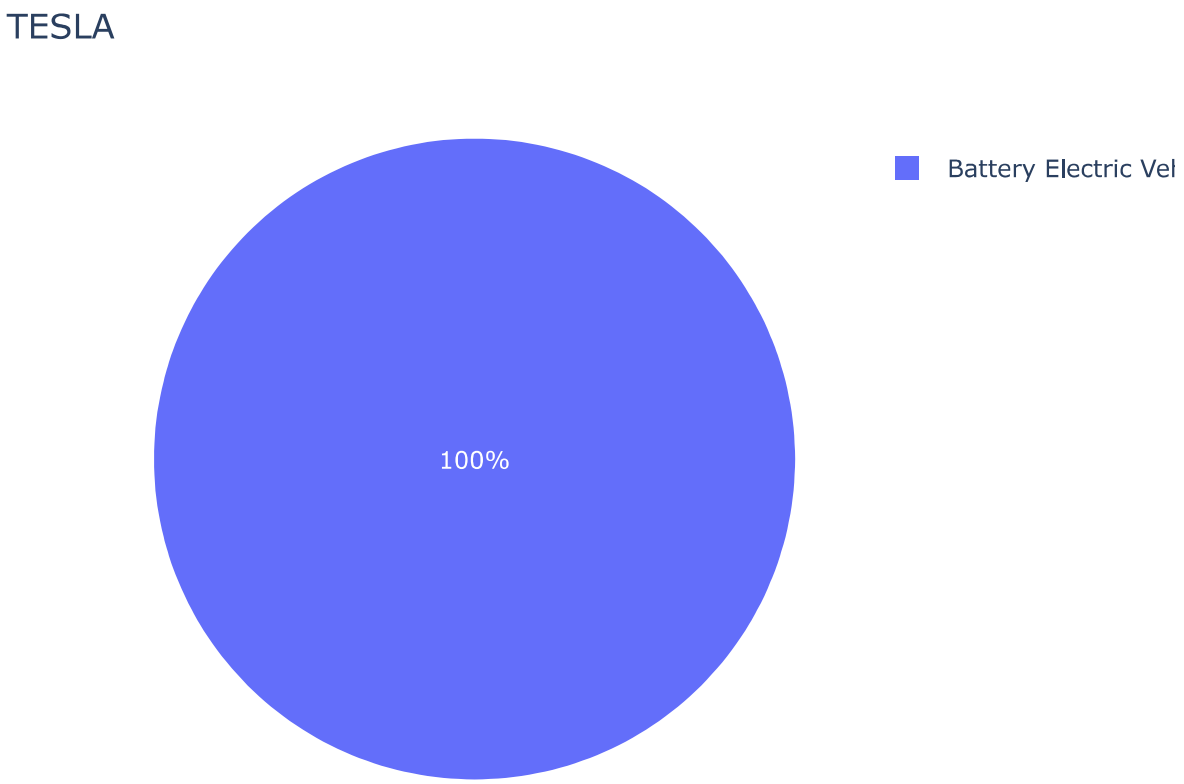
In [19]:
```
# Different company models which are in use

Models = my_data.groupby('Model').count().sort_values(by='City',ascending=False)['City
values = my_data.groupby('Model').count().sort_values(by='City',ascending=False)['City


plt.figure(figsize=(9,5))
sns.barplot(x=list(Models)[:10],y=values[:10], palette='rocket')
plt.xticks(rotation='90')
plt.xlabel('Models')
plt.ylabel('Count')
plt.show()
```



In [20]:
```
#contribution of electric vehicle type

Vehicle_type = list(my_data.groupby('Electric Vehicle Type').count()['County'].index)
values = my_data.groupby('Electric Vehicle Type').count()['County'].values

px.pie(names=Vehicle_type,values=values,height=500)
```



In [21]:
```
# top 10 companies making electric vehicle type

top_10_companies = list(Companies)[:10]
for index,i in enumerate(top_10_companies):
    data = my_data[my_data['Make']==i]
    labels = list(data.groupby('Electric Vehicle Type').count()['City'].index)
    values = list(data.groupby('Electric Vehicle Type').count()['City'].values)
    fig = px.pie(names=labels,values=values,width=700,height=500,title=str(i))
    fig.show()
```



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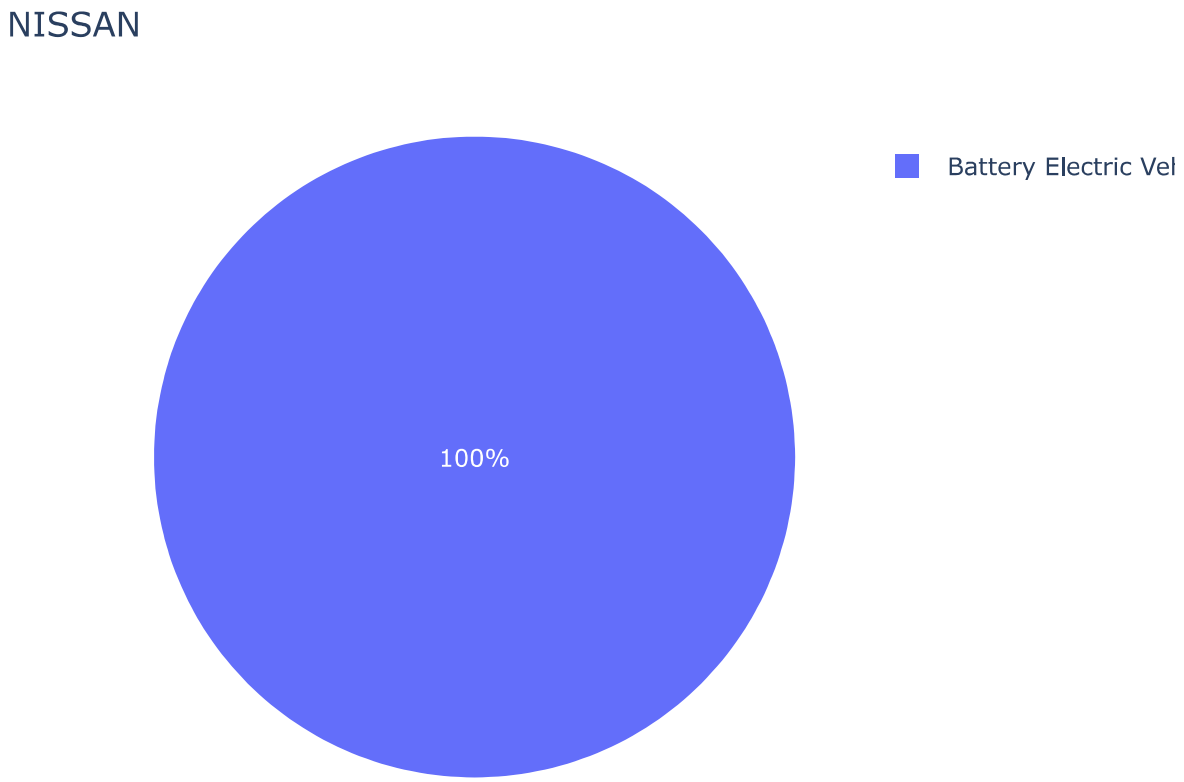

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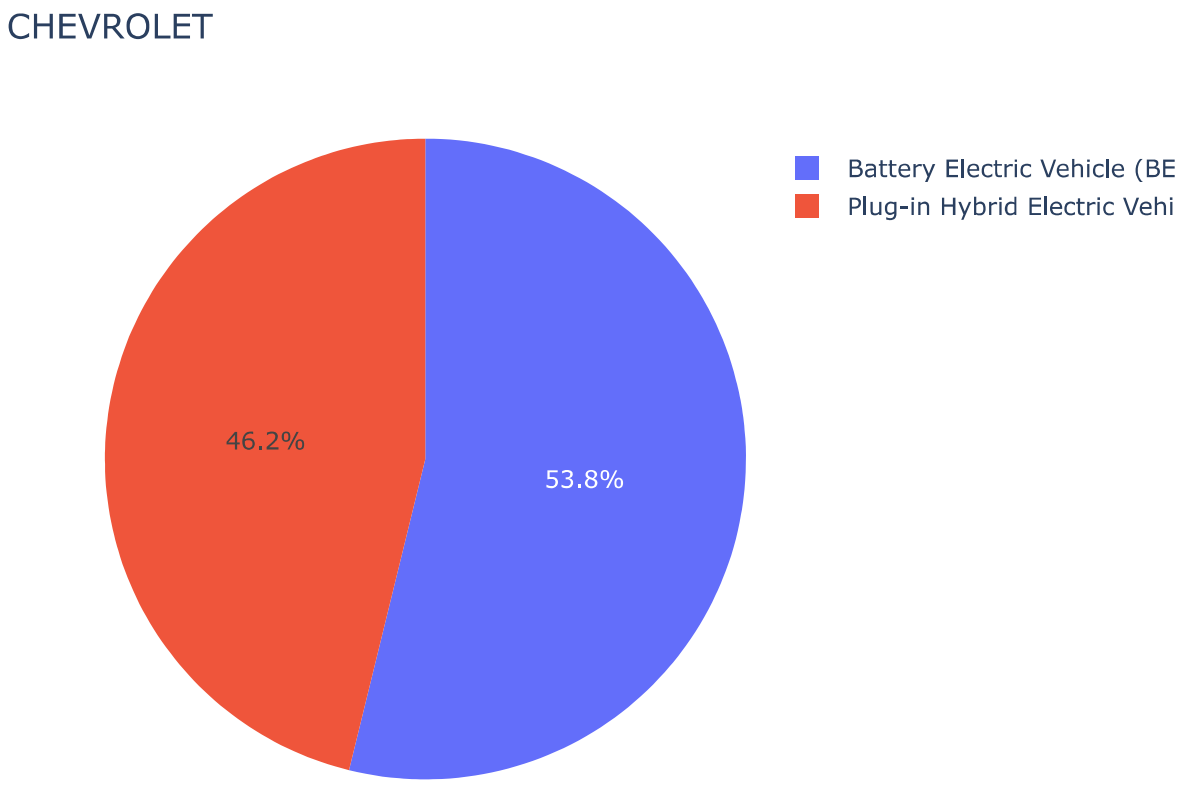

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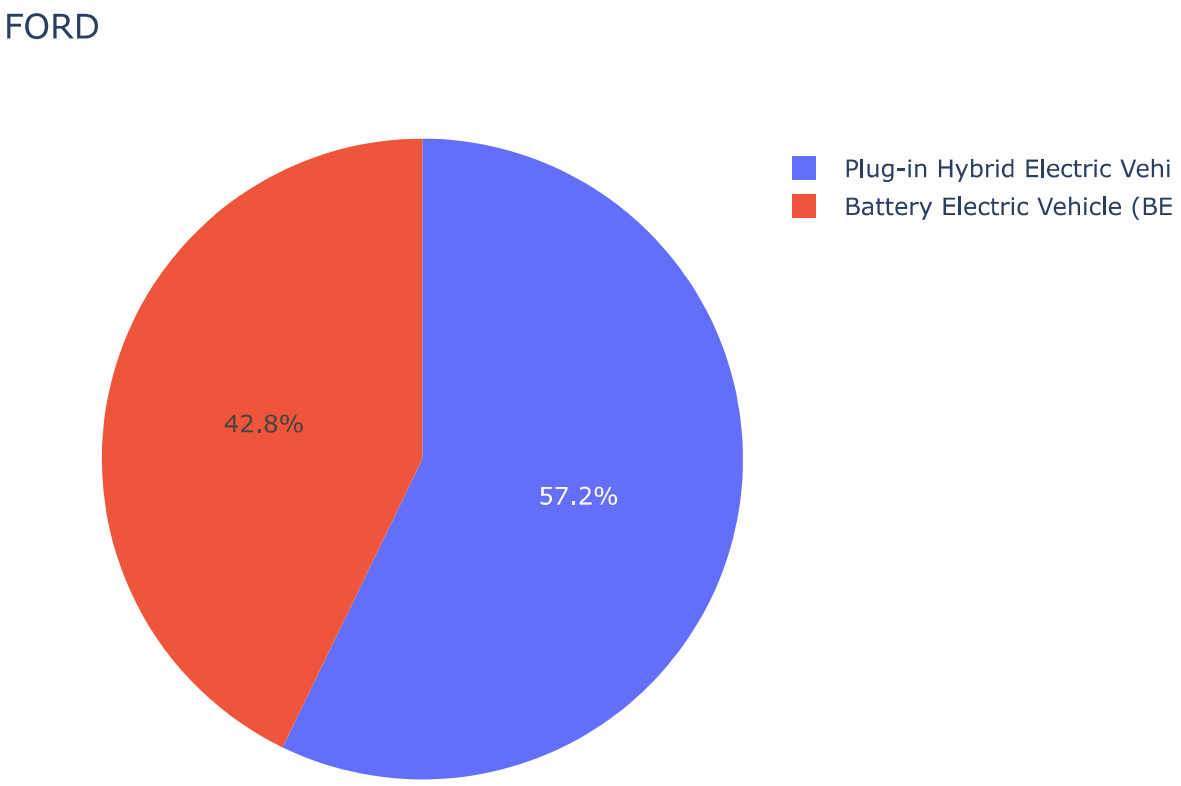

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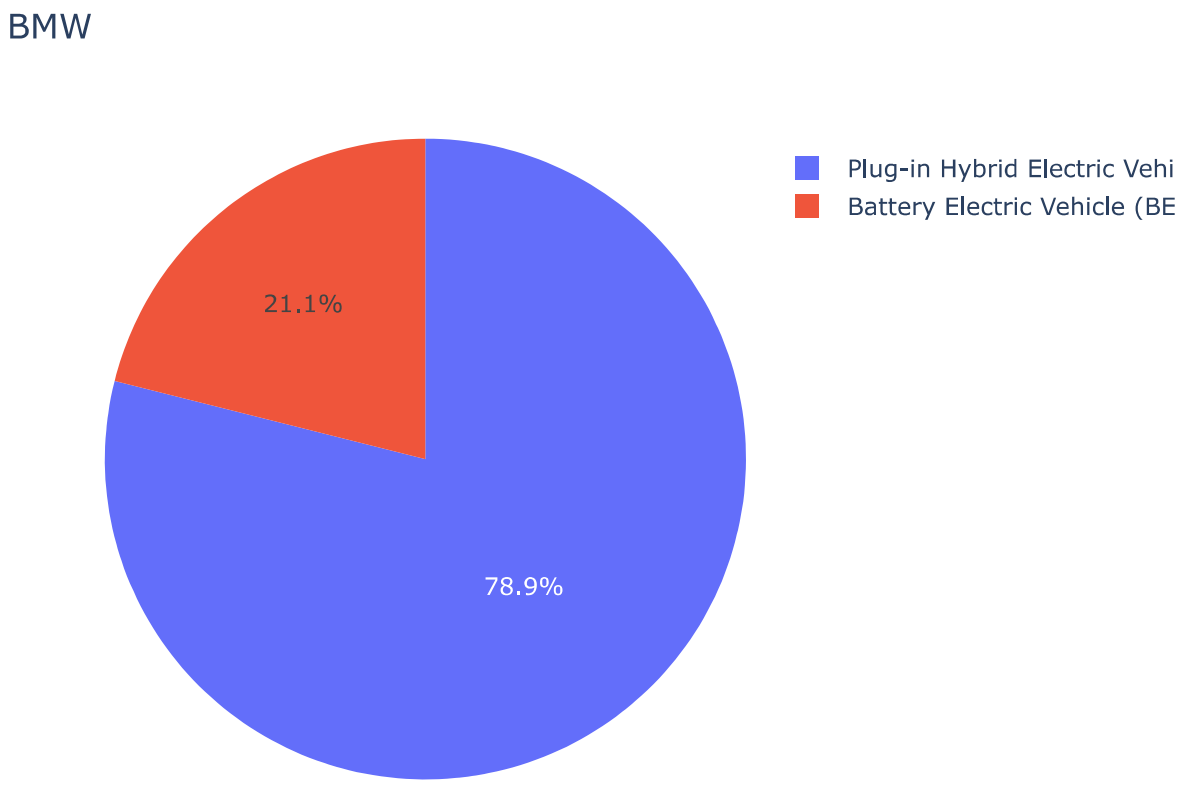

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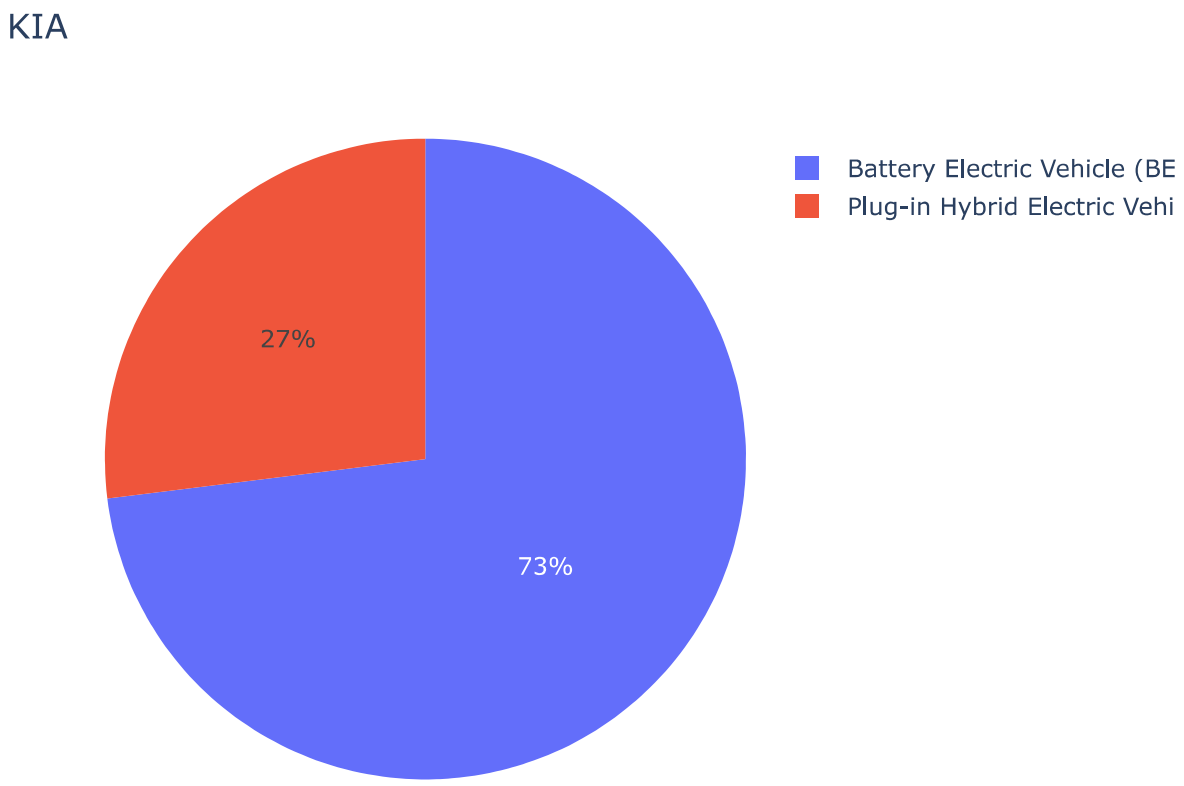

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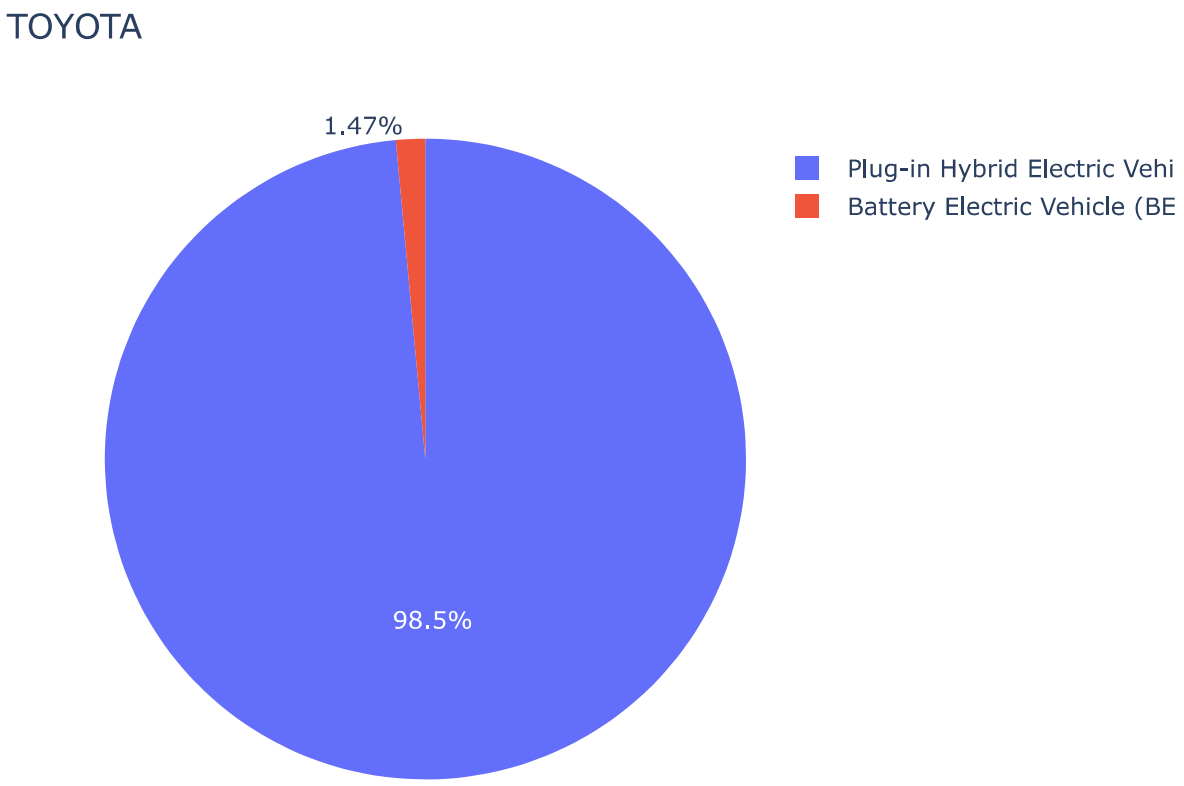

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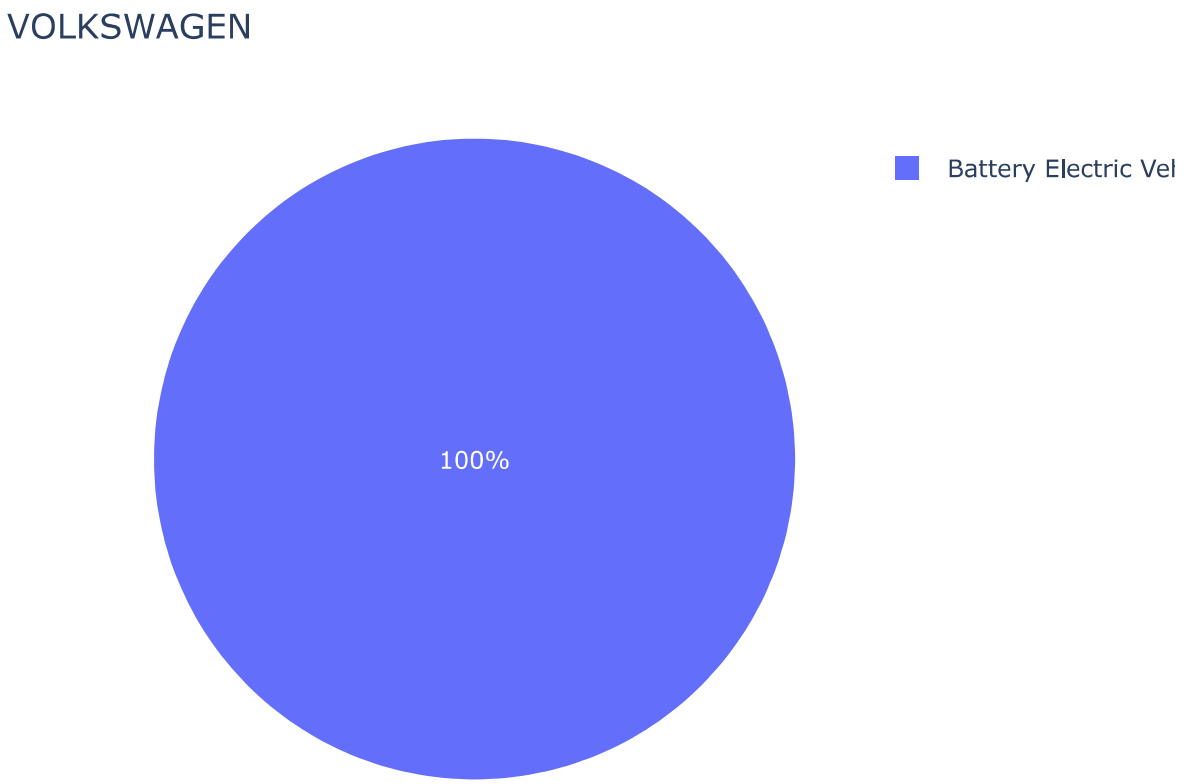

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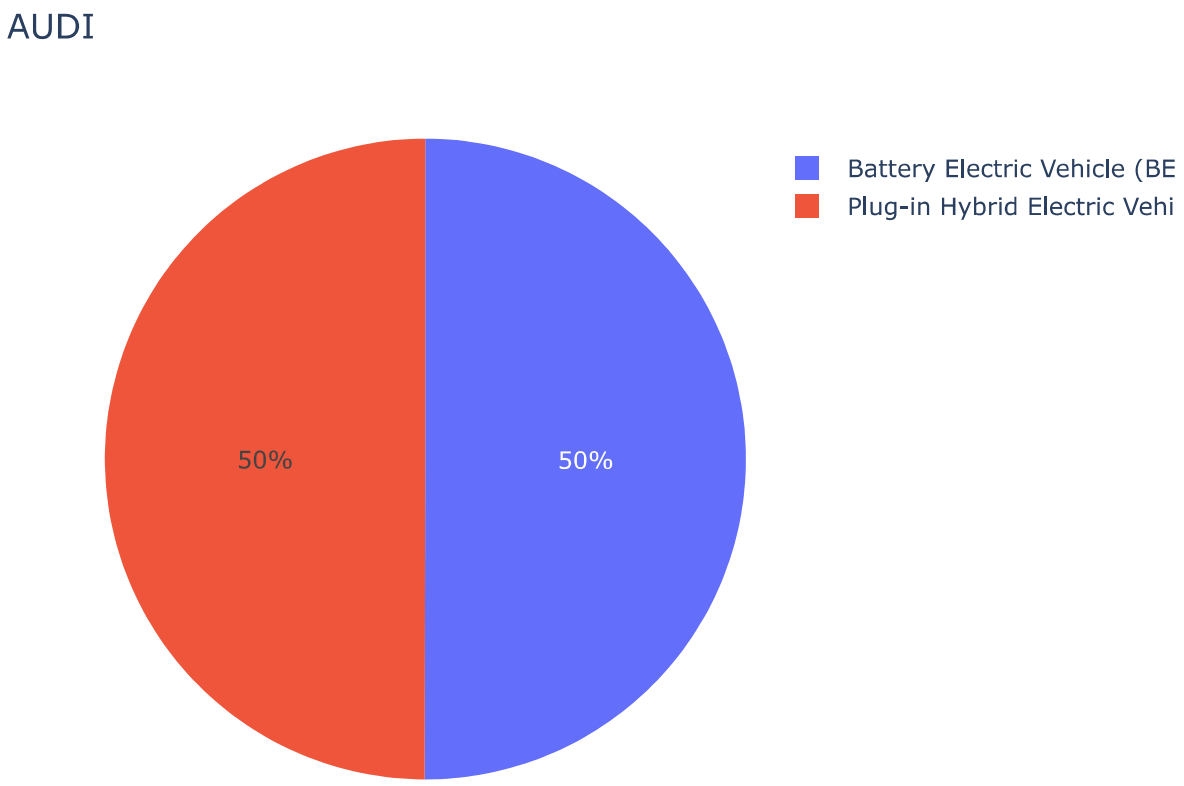

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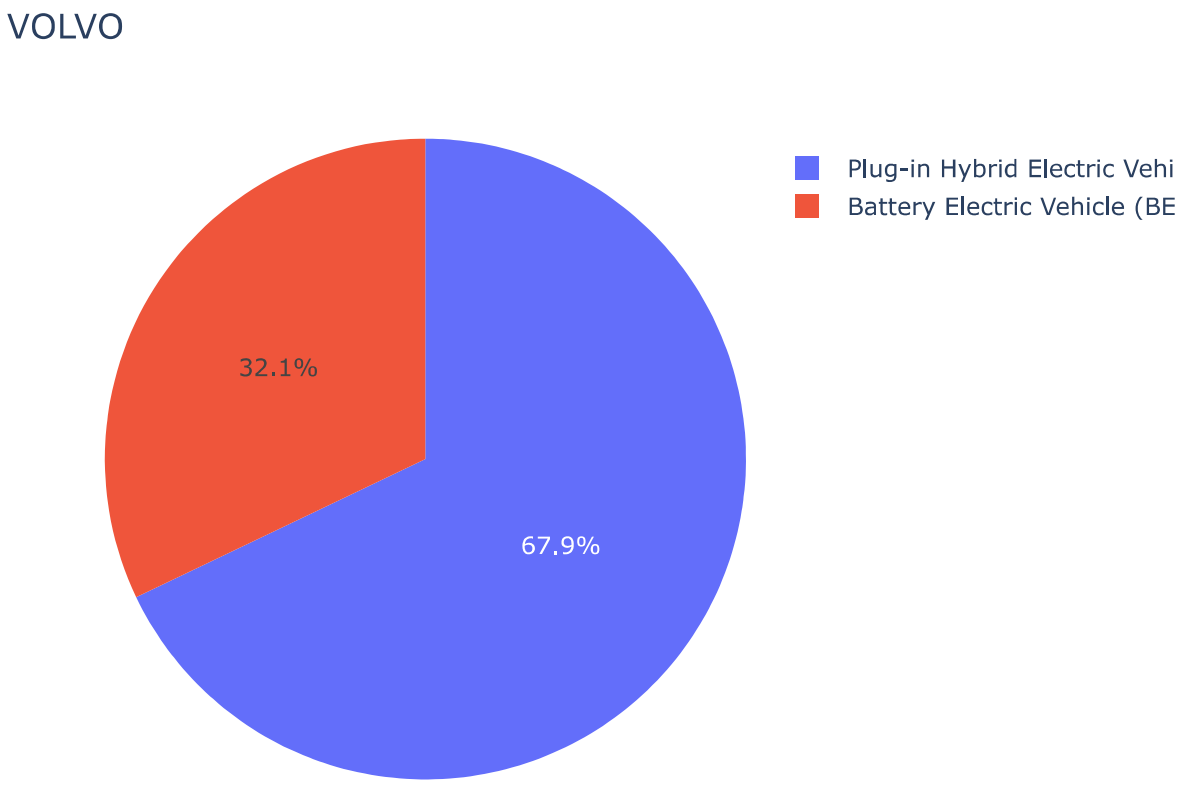
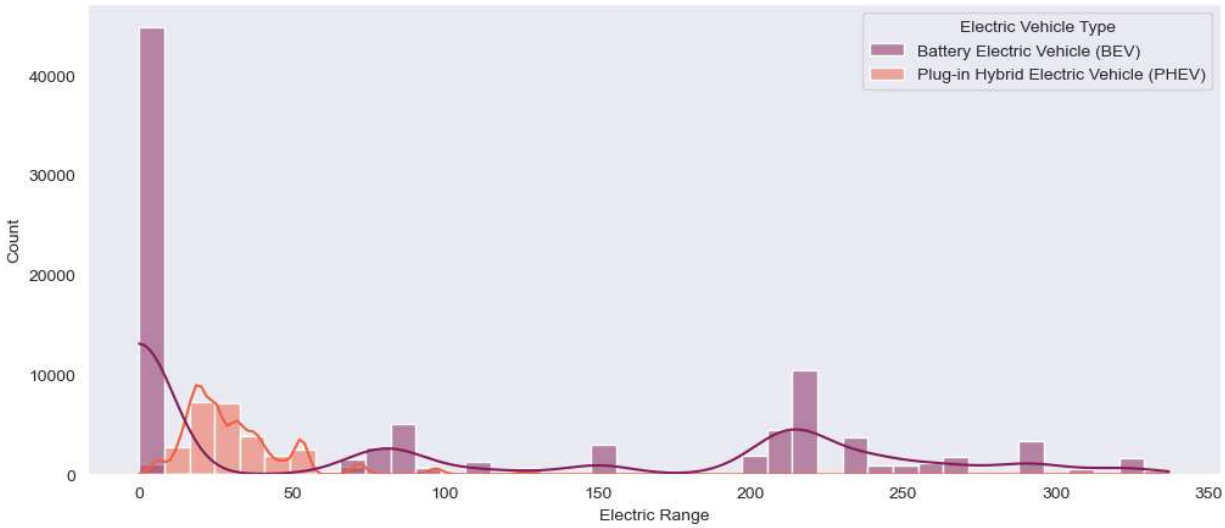


In [22]:
```
#Electric range of different vehicle type
plt.figure(figsize=(12,5))
sns.set_style(style='dark')
sns.histplot(x = 'Electric Range',data=my_data,kde=True,hue='Electric Vehicle Type',pa
```

Out[22]:
```
<AxesSubplot:xlabel='Electric Range', ylabel='Count'>
```



Correlations

In [23]:
```
top_10_vehicles = list(my_data.groupby('Model').count().sort_values(by='City',ascendir
```

In [24]:
```
top_10_range =  my_data.sort_values(by='Electric Range',ascending=False)['Model'].unic
```

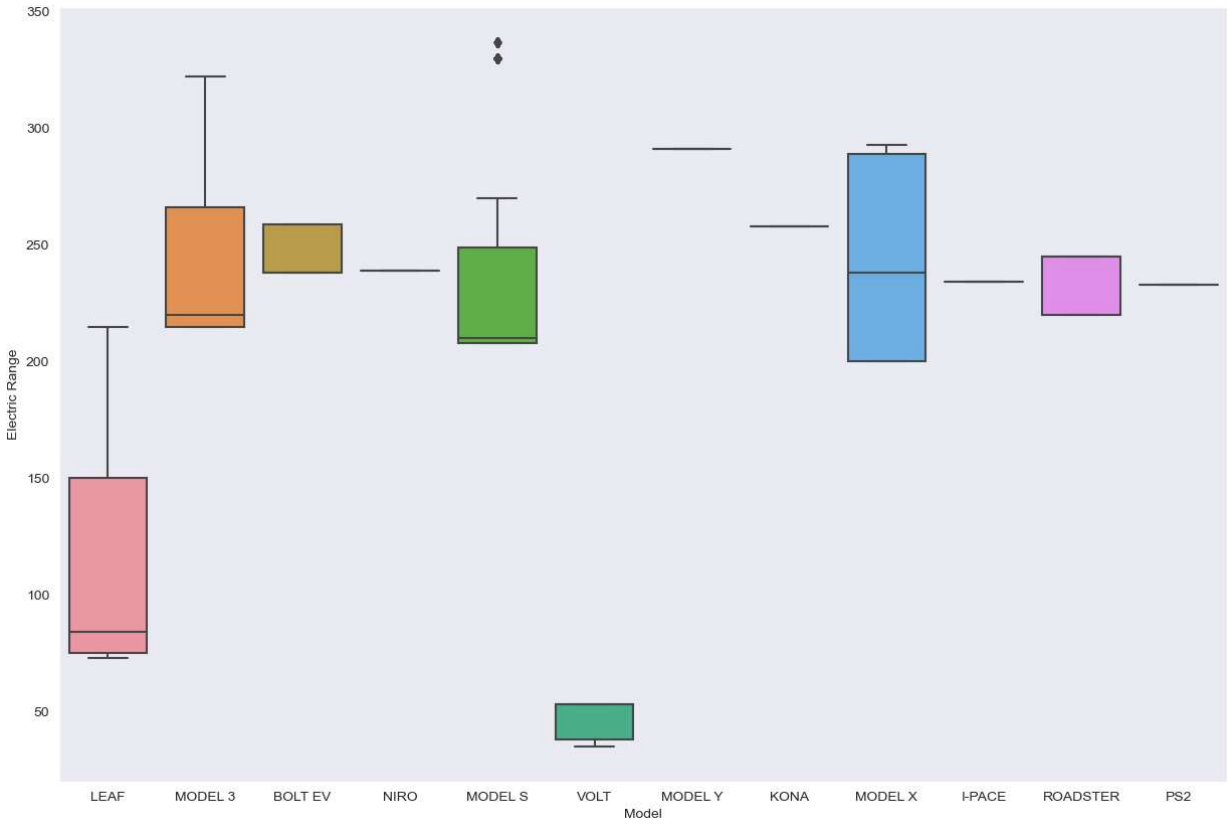
In [25]:
```
top_data = my_data[(my_data['Model'].isin(top_10_vehicles)) | (my_data['Model'].isin(t
```

In [26]:
```
top_data['Clean Alternative Fuel Vehicle (CAFV) Eligibility'].unique()
```

Out[26]:
```
array(['Clean Alternative Fuel Vehicle Eligible',
       'Eligibility unknown as battery range has not been researched',
       'Not eligible due to low battery range'], dtype=object)
```

In [27]:
```
top_data = top_data[(top_data['Clean Alternative Fuel Vehicle (CAFV) Eligibility'] !=
```

In [28]:
```
plt.figure(figsize=(15,10))
sns.boxplot(x="Model",y="Electric Range",data=top_data)
#plt.xticks(rotation=45)
plt.show()
```



In [29]:
```
plt.figure(figsize=(15,10))
sns.boxplot(x="Make",y="Electric Range",data=top_data)
#plt.xticks(rotation=45)
plt.show()
```

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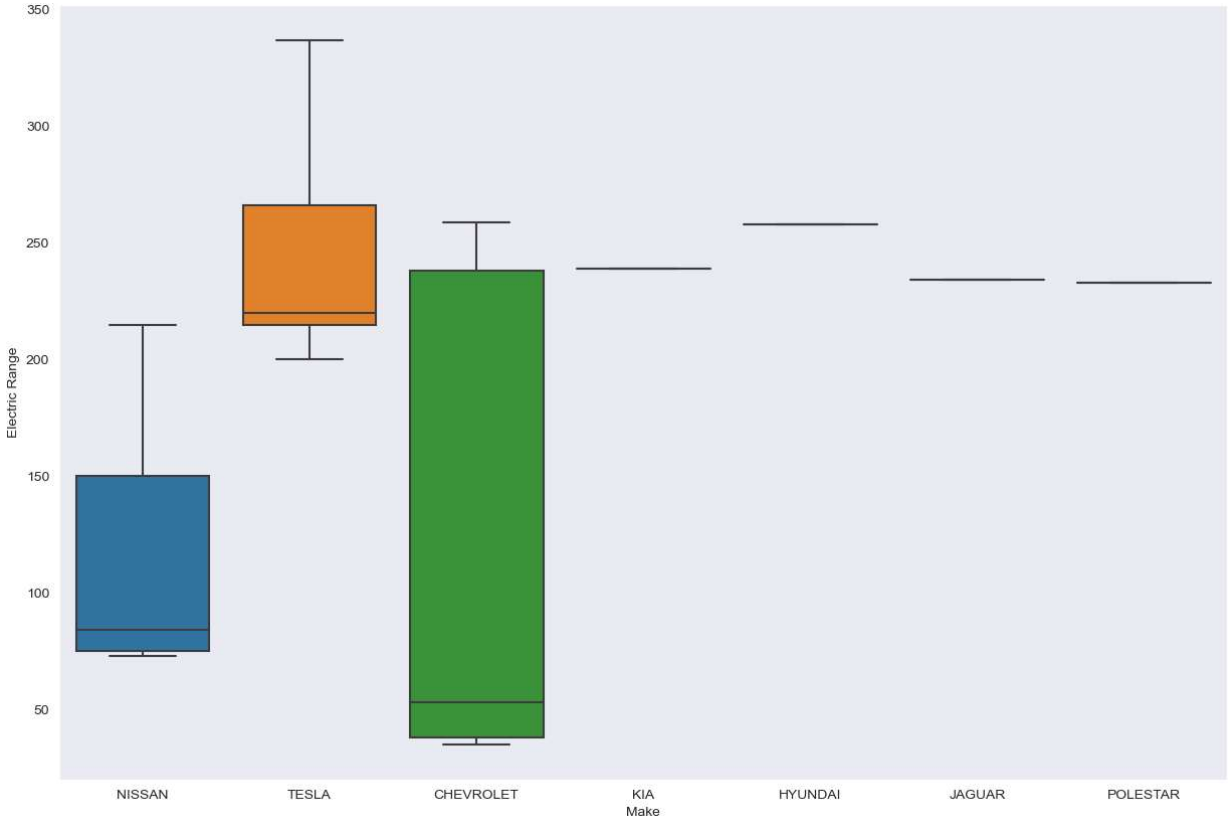
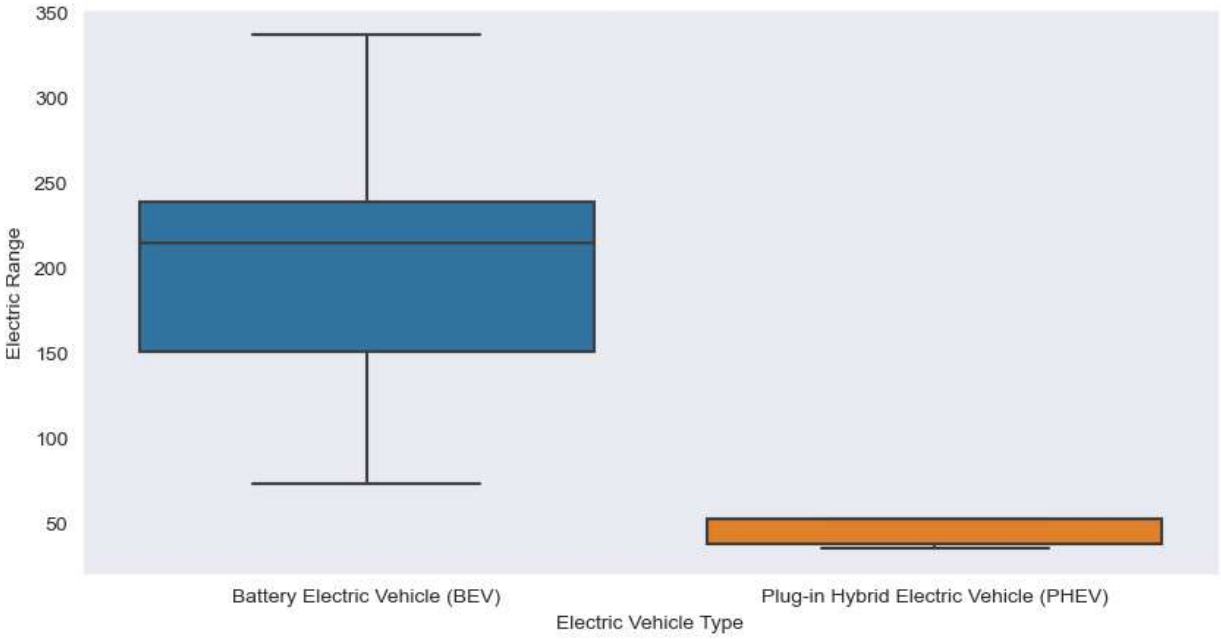


In [30]:
```
plt.figure(figsize=(10,5))
sns.boxplot(x="Electric Vehicle Type",y="Electric Range",data=top_data)
#plt.xticks(rotation=45)
plt.show()
```



In [31]:
```
g = sns.FacetGrid(top_data, col='Make',sharey=False)
g.map(sns.scatterplot, 'Model Year', 'Electric Range',alpha=0.5)
```

Out[31]:
```
<seaborn.axisgrid.FacetGrid at 0x1f42a2ef040>
```

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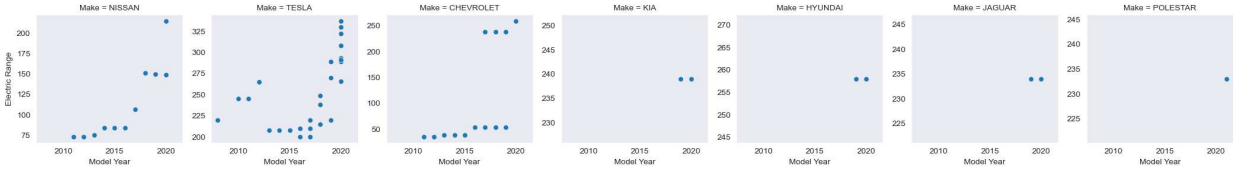
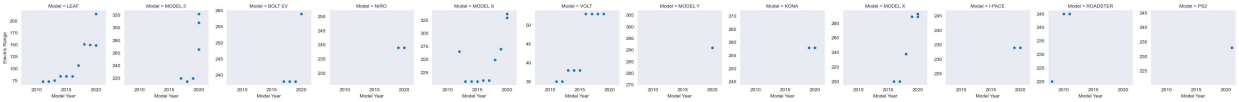


In [32]:
```
g = sns.FacetGrid(top_data, col='Model',sharey=False)
g.map(sns.scatterplot, 'Model Year', 'Electric Range',alpha=0.5)
```

Out[32]:
```
<seaborn.axisgrid.FacetGrid at 0x1f42c201e80>
```



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