In [2]:

```
# Import libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Attach the data
ev_data = pd.read_csv('C:\\Users\\sanus\\OneDrive\\Desktop\\Portfolio Projects\\Dat

# Load the data from a CSV file into a DataFrame
#df = pd.read_csv("C:\\Users\\sanus\\OneDrive\\Desktop\\RGU COURSES\\PROJECT\\datas

# First few rows of the Data
print(ev_data.head())

# Summary
print(ev_data.describe())

# Missing values
print(ev_data.isnull().sum())
```

```
   VIN (1-10)    County     City State  Postal Code  Model Year   Make  \
0  WAUTPBFF4H      King  Seattle    WA      98126.0        2017   AUDI
1  WAUUPBFF2J  Thurston  Olympia    WA      98502.0        2018   AUDI
2  5YJSA1E22H  Thurston    Lacey    WA      98516.0        2017  TESLA
3  1C4JJXP62M  Thurston   Tenino    WA      98589.0        2021   JEEP
4  5YJ3E1EC9L    Yakima   Yakima    WA      98902.0        2020  TESLA

      Model                   Electric Vehicle Type  \
0        A3  Plug-in Hybrid Electric Vehicle (PHEV)
1        A3  Plug-in Hybrid Electric Vehicle (PHEV)
2   MODEL S          Battery Electric Vehicle (BEV)
3  WRANGLER  Plug-in Hybrid Electric Vehicle (PHEV)
4   MODEL 3          Battery Electric Vehicle (BEV)

  Clean Alternative Fuel Vehicle (CAFV) Eligibility  Electric Range  \
0             Not eligible due to low battery range              16
1             Not eligible due to low battery range              16
2           Clean Alternative Fuel Vehicle Eligible             210
3             Not eligible due to low battery range              25
4           Clean Alternative Fuel Vehicle Eligible             308

   Base MSRP  Legislative District  DOL Vehicle ID  \
0          0                  34.0       235085336
1          0                  22.0       237896795
2          0                  22.0       154498865
3          0                  20.0       154525493
4          0                  14.0       225996361

                Vehicle Location  \
0    POINT (-122.374105 47.54468)
1   POINT (-122.943445 47.059252)
2    POINT (-122.78083 47.083975)
3    POINT (-122.85403 46.856085)
4  POINT (-120.524012 46.5973939)

                             Electric Utility  2020 Census Tract
0  CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)       5.303301e+10
1                       PUGET SOUND ENERGY INC       5.306701e+10
2                       PUGET SOUND ENERGY INC       5.306701e+10
3                       PUGET SOUND ENERGY INC       5.306701e+10
4                                    PACIFICORP       5.307700e+10
         Postal Code     Model Year  Electric Range      Base MSRP  \
count  181455.000000  181458.000000   181458.000000  181458.000000
mean    98174.050718    2020.581793       57.826665    1040.236749
std      2414.241968       2.991140       91.396074    8228.989085
min      1545.000000    1997.000000        0.000000       0.000000
25%     98052.000000    2019.000000        0.000000       0.000000
50%     98122.000000    2022.000000        0.000000       0.000000
75%     98370.000000    2023.000000       75.000000       0.000000
max     99577.000000    2024.000000      337.000000  845000.000000

       Legislative District  DOL Vehicle ID  2020 Census Tract
count         181060.000000    1.814580e+05       1.814550e+05
mean              29.106904    2.214128e+08       5.297575e+10
std               14.892342    7.528561e+07       1.594876e+09
min                1.000000    4.385000e+03       1.001020e+09
25%               18.000000    1.830687e+08       5.303301e+10
50%               33.000000    2.289155e+08       5.303303e+10
75%               42.000000    2.561320e+08       5.305307e+10
max               49.000000    4.792548e+08       5.603300e+10
VIN (1-10)                                             0
County                                                 3
City                                                   3
State                                                  0
```

```
Postal Code                                            3
Model Year                                             0
Make                                                   0
Model                                                  0
Electric Vehicle Type                                  0
Clean Alternative Fuel Vehicle (CAFV) Eligibility      0
Electric Range                                         0
Base MSRP                                              0
Legislative District                                 398
DOL Vehicle ID                                         0
Vehicle Location                                       8
Electric Utility                                       3
2020 Census Tract                                      3
dtype: int64
```

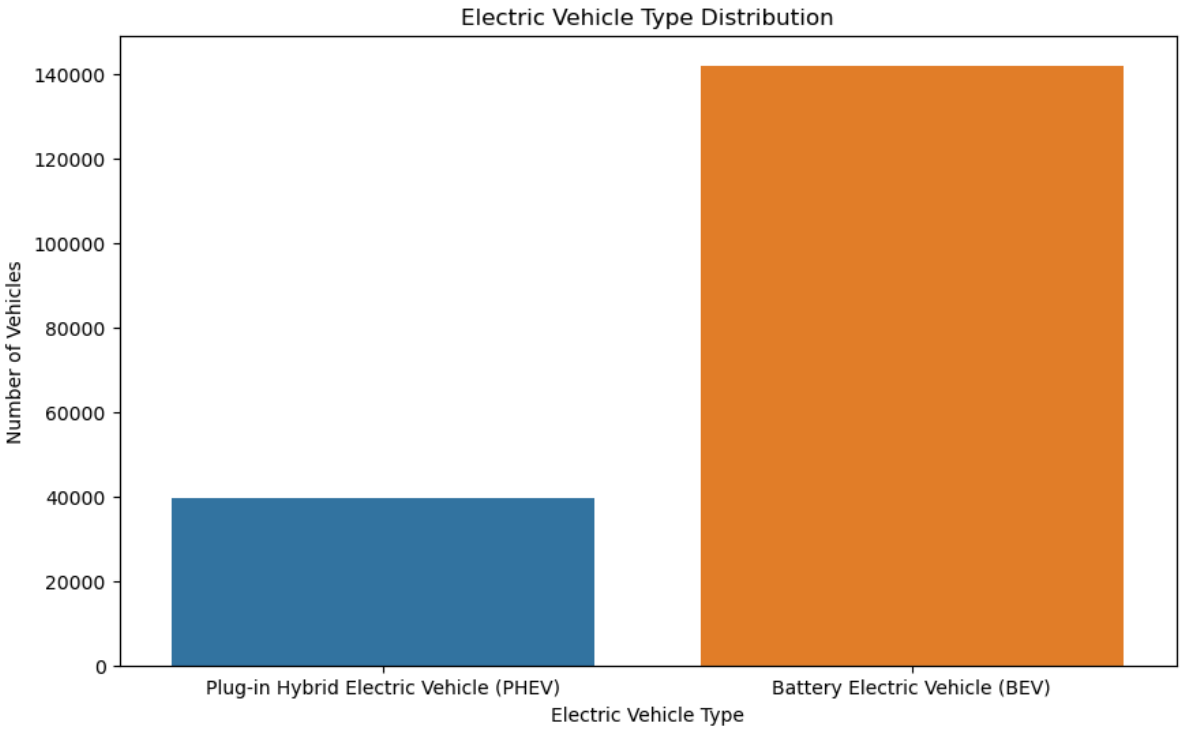
This dataset shows the Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) that are currently registered through Washington State Department of Licensing (DOL).

Dataset source : https://catalog.data.gov/dataset/electric-vehicle-population-data

In [3]:
```
# Number of Electric Vehicle Type
ev_type_counts = ev_data['Electric Vehicle Type'].value_counts()
print(ev_type_counts)

# Electric Vehicle Type Distribution
plt.figure(figsize=(10, 6))
sns.countplot(x='Electric Vehicle Type', data=ev_data)
plt.title('Electric Vehicle Type Distribution')
plt.xlabel('Electric Vehicle Type')
plt.ylabel('Number of Vehicles')
plt.savefig('electric_vehicle_type_distribution.png')  # Save the plot as PNG fi
plt.show()
```

```
Battery Electric Vehicle (BEV)            141973
Plug-in Hybrid Electric Vehicle (PHEV)     39485
Name: Electric Vehicle Type, dtype: int64
```



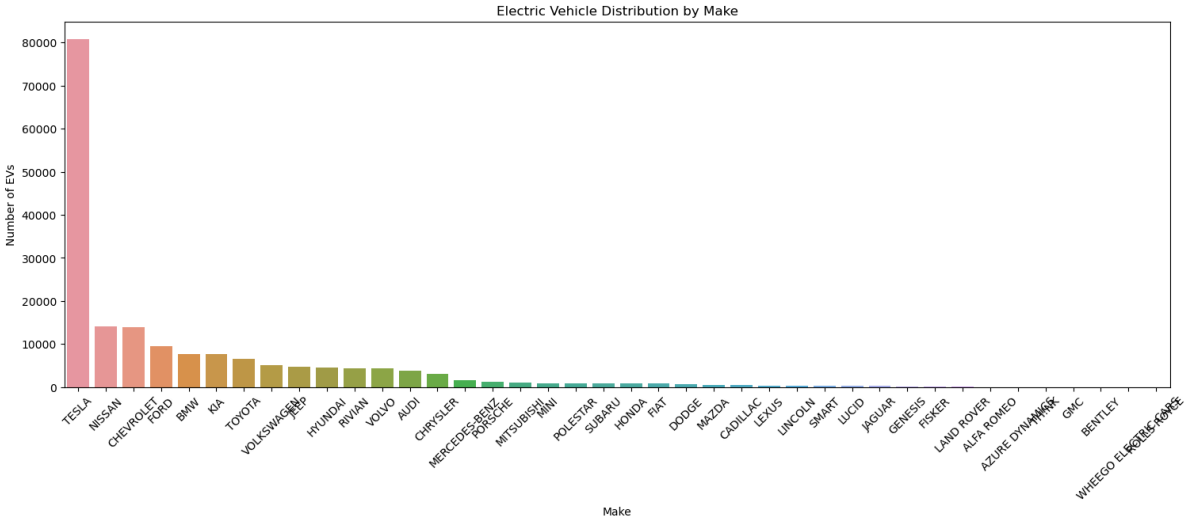
Electric Vehicle Type Distribution

The number of Battery Electric Vehicles of 141,973 is significantly higher than the number of Plug-in Hybrid Electric Vehicles which is 39,485. This suggests a stronger adoption or preference for fully electric vehicles over hybrid electric vehicles. The higher number of BEVs might also indicate growing consumer confidence in electric vehicle technology, infrastructure improvements (such as more charging stations), and potential policy or incentive impacts favoring BEVs in Washington State.

In [4]:
```
# Electric Vehicle Make
ev_type_counts = ev_data['Make'].value_counts()
print(ev_type_counts)

# Electric Vehicle Distribution by Make
plt.figure(figsize=(18, 6))
sns.countplot(x='Make', data=ev_data, order=ev_data['Make'].value_counts().index)
plt.title('Electric Vehicle Distribution by Make')
plt.xlabel('Make')
plt.ylabel('Number of EVs')
plt.savefig('electric_vehicle_type_make.png')  # Save the plot as PNG fi
plt.xticks(rotation=45)
plt.show()
```

```
TESLA                  80819
NISSAN                 14037
CHEVROLET              13864
FORD                    9527
BMW                     7680
KIA                     7642
TOYOTA                  6519
VOLKSWAGEN              5163
JEEP                    4690
HYUNDAI                 4561
RIVIAN                  4425
VOLVO                   4288
AUDI                    3738
CHRYSLER                3059
MERCEDES-BENZ           1647
PORSCHE                 1158
MITSUBISHI               980
MINI                     925
POLESTAR                 895
SUBARU                   838
HONDA                    836
FIAT                     783
DODGE                    608
MAZDA                    506
CADILLAC                 434
LEXUS                    398
LINCOLN                  270
SMART                    269
LUCID                    238
JAGUAR                   236
GENESIS                  190
FISKER                   112
LAND ROVER                58
ALFA ROMEO                42
AZURE DYNAMICS             8
TH!NK                      5
GMC                        3
BENTLEY                    3
WHEEGO ELECTRIC CARS       3
ROLLS ROYCE                1
Name: Make, dtype: int64
```



Electric Vehicle Distribution by Make

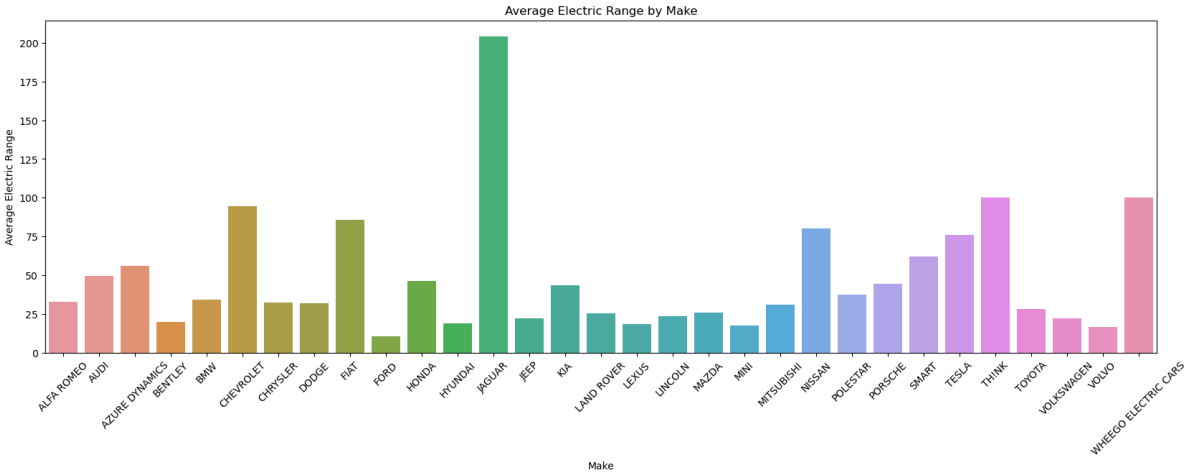
The overwhelming number of Tesla registrations (80,819) indicates Tesla's strong market leadership and brand dominance in the electric vehicle sector. The presence of numerous manufacturers with varying counts of electric vehicles shows a diverse and competitive market, with both established automakers and new entrants contributing to the growth of electric vehicles. The inclusion of high-end brands like Mercedes-Benz, Porsche, and Lucid highlights the growing trend of luxury electric vehicles.

In [5]:
```
 #Average electric range by make
avg_range_by_make = ev_data.groupby('Make')['Electric Range'].mean().reset_index()
print(avg_range_by_make)

# Average electric range >= 10
filtered_avg_range_by_make = avg_range_by_make[avg_range_by_make['Electric Range']

# Ploting the average electric range by make >= 10
plt.figure(figsize=(20, 6))
sns.barplot(x='Make', y='Electric Range', data=filtered_avg_range_by_make)
plt.title('Average Electric Range by Make')
plt.xlabel('Make')
plt.ylabel('Average Electric Range')
plt.xticks(rotation=45)
plt.savefig('electric_vehicle_range.png')  # Save the plot as PNG file
plt.show()
```

	Make	Electric Range
0	ALFA ROMEO	33.000000
1	AUDI	49.442215
2	AZURE DYNAMICS	56.000000
3	BENTLEY	19.666667
4	BMW	34.204818
5	CADILLAC	7.488479
6	CHEVROLET	94.745961
7	CHRYSLER	32.208892
8	DODGE	32.000000
9	FIAT	85.632184
10	FISKER	3.241071
11	FORD	10.405899
12	GENESIS	0.000000
13	GMC	0.000000
14	HONDA	46.208134
15	HYUNDAI	19.054813
16	JAGUAR	204.254237
17	JEEP	22.353305
18	KIA	43.729129
19	LAND ROVER	25.482759
20	LEXUS	18.665829
21	LINCOLN	23.462963
22	LUCID	0.000000
23	MAZDA	25.743083
24	MERCEDES-BENZ	9.254402
25	MINI	17.697297
26	MITSUBISHI	30.866327
27	NISSAN	79.999145
28	POLESTAR	37.488268
29	PORSCHE	44.446459
30	RIVIAN	0.000000
31	ROLLS ROYCE	0.000000
32	SMART	62.304833
33	SUBARU	1.338902
34	TESLA	76.013957
35	TH!NK	100.000000
36	TOYOTA	28.226262
37	VOLKSWAGEN	22.293240
38	VOLVO	16.406716
39	WHEEGO ELECTRIC CARS	100.000000



Average Electric Range by Make

There is significant variability in the average electric range across different makes, indicating a diverse market with different strategies and technologies. Brands like Jaguar and Chevrolet stand out for their higher average ranges, indicating a focus on long-range capabilities.

Makes like TH!NK and Wheego Electric Cars show high ranges despite their niche status, which is notable.

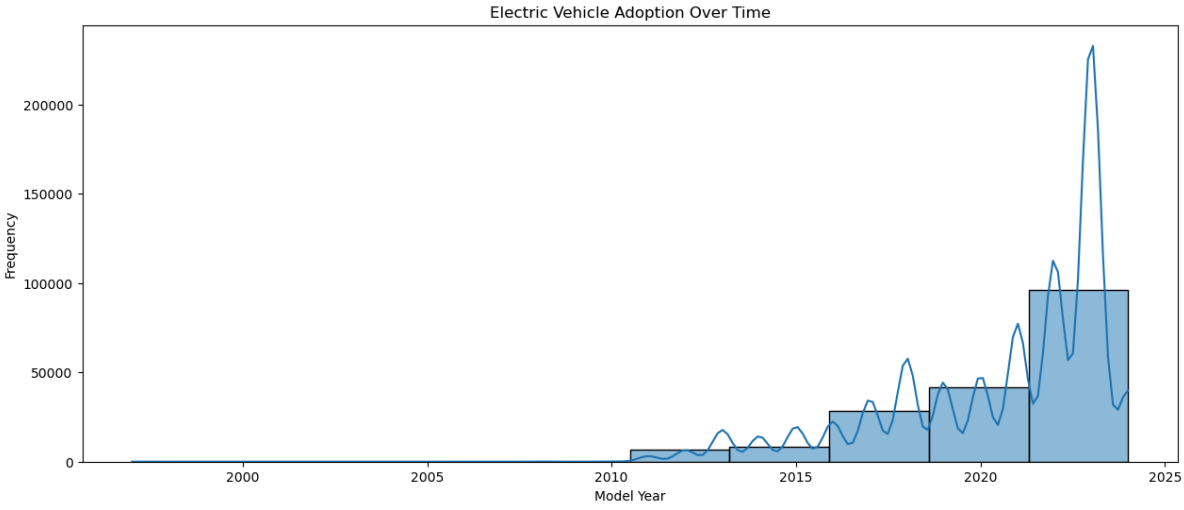
In [6]:
```
# Electric Vehicle Adoption Over Time
import warnings

# Suppress specific FutureWarning related to pandas
warnings.simplefilter(action='ignore', category=FutureWarning)

# Count the number of vehicles by model year
vehicles_by_year = ev_data['Model Year'].value_counts().sort_index()
print(vehicles_by_year)

plt.figure(figsize=(15, 6))
sns.histplot(ev_data['Model Year'], bins=10, kde=True)
plt.title('Electric Vehicle Adoption Over Time')
plt.xlabel('Model Year')
plt.ylabel('Frequency')
plt.savefig('electric_vehicle_adoption.png')  # Save the plot as PNG fi
plt.show()
```

```
1997        1
1998        1
1999        5
2000        7
2002        2
2003        1
2008       20
2010       23
2011      770
2012     1603
2013     4375
2014     3502
2015     4821
2016     5524
2017     8591
2018    14291
2019    10922
2020    11851
2021    19034
2022    27922
2023    58393
2024     9799
Name: Model Year, dtype: int64
```



Electric Vehicle Adoption Over Time'

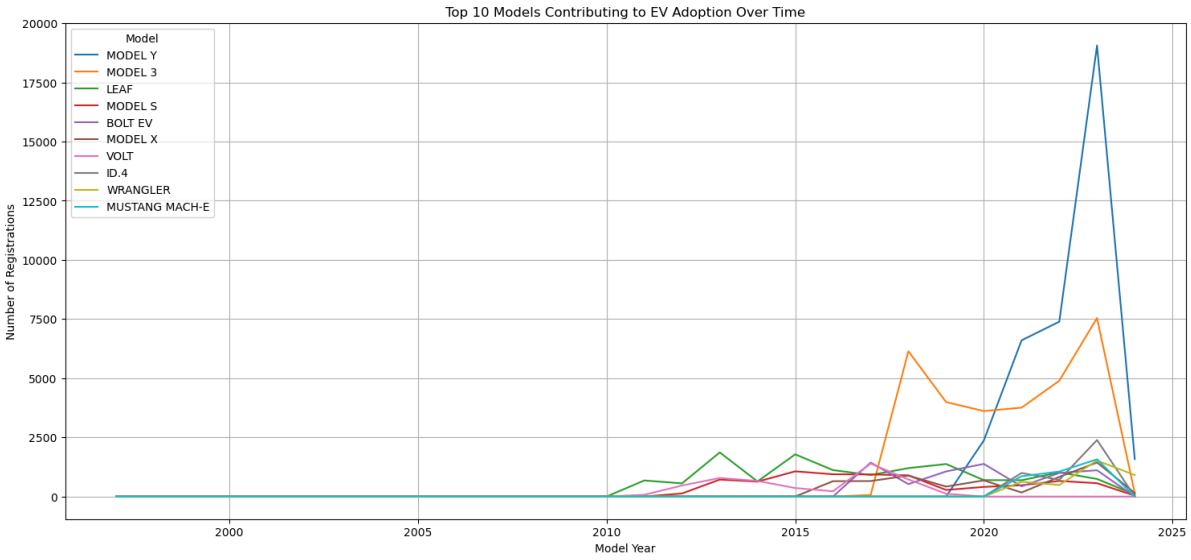
The adoption of electric vehicles has grown exponentially, especially from 2011 onwards, indicating a clear trend towards EVs becoming a dominant mode of transportation. The sharp rise in registrations from 2017 onwards suggests significant improvements in EV technology, making them more viable for a larger segment of consumers. Policy measures, incentives, and subsidies likely played a crucial role in accelerating adoption, especially in the recent years (2021-2023). The variety and availability of electric vehicle models have increased, catering to diverse consumer needs, from affordable options to luxury EVs.

In [7]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Count the number of vehicles by model year and model
model_counts = ev_data.groupby(['Model Year', 'Model']).size().unstack().fillna(0)

# Plot the top models contributing to spikes over the years
top_models = model_counts.sum().nlargest(10).index  # Select top 10 models

model_counts[top_models].plot(kind='line', figsize=(18, 8))
plt.title('Top 10 Models Contributing to EV Adoption Over Time')
plt.xlabel('Model Year')
plt.ylabel('Number of Registrations')
plt.legend(title='Model')
plt.grid(True)
plt.show()
```



Impact of Specific Models

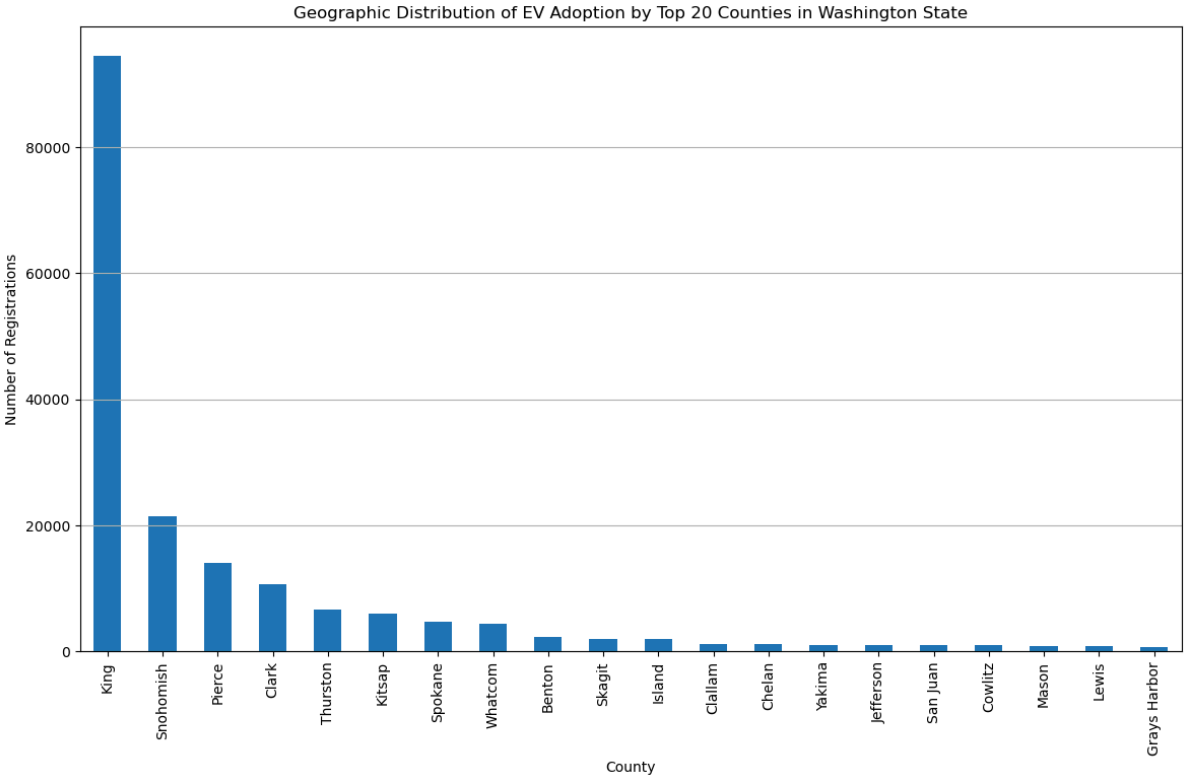
Tesla models (Model Y, Model 3, Model S, and Model X) dominate the top spots, indicating Tesla's strong market position and consumer preference for their vehicles. Manufacturers like Nissan, Chevrolet, Volkswagen, Jeep, and Ford, showing a broad acceptance and competition in the electric vehicle market. Models like the Tesla Model Y, Model 3, and Nissan Leaf suggest a consumer preference for compact and mid-sized electric vehicles.

In [8]:
```
# Count the number of vehicles by county
county_counts = ev_data['County'].value_counts().nlargest(20)  # Get the top 20 cou
print(county_counts)

# Plot the geographic distribution by county
plt.figure(figsize=(14, 8))
county_counts.plot(kind='bar')
```

```
plt.title('Geographic Distribution of EV Adoption by Top 20 Counties in Washington
plt.xlabel('County')
plt.ylabel('Number of Registrations')
plt.xticks(rotation=90)
plt.grid(axis='y')
plt.show()
```

```
King            94460
Snohomish       21439
Pierce          14043
Clark           10675
Thurston         6600
Kitsap           5956
Spokane          4671
Whatcom          4331
Benton           2183
Skagit           1968
Island           1921
Clallam          1079
Chelan           1078
Yakima           1034
Jefferson         996
San Juan          947
Cowlitz           935
Mason             840
Lewis             767
Grays Harbor      648
Name: County, dtype: int64
```



Geographic Distribution of EV Adoption by Top 20 Counties in Washington State

Urban counties like King, Snohomish, and Pierce show significantly higher adoption rates compared to rural counties, likely due to better infrastructure, higher income levels, and greater environmental awareness. Proximity to environmentally conscious urban centers (like Portland, OR) seems to positively influence neighboring counties' adoption rates. Counties with lower numbers still show potential for growth as awareness and infrastructure for EVs improve statewide.

In [11]:
```
import pdfkit

# Path to the wkhtmltopdf executable
config = pdfkit.configuration(wkhtmltopdf=r'C:\Program Files\wkhtmltopdf\bin\wkhtml

# Correctly formatted paths to your HTML file and the output PDF file
html_file = r'C:\\Users\\sanus\\OneDrive\\Desktop\\Portfolio Projects\\Data Project
pdf_file = r'C:\\Users\\sanus\\OneDrive\\Desktop\\Portfolio Projects\\Data Projects

# Verify that the HTML file exists
import os
if not os.path.exists(html_file):
    print(f"No such file: {html_file}")
else:
    # Convert the HTML file to a PDF
    pdfkit.from_file(html_file, pdf_file, configuration=config)
    print(f"PDF successfully created at: {pdf_file}")
```

```
No such file: C:\\Users\\sanus\\OneDrive\\Desktop\\Portfolio Projects\\Data Projec
ts\\Electric Vehicle Population\\electric-vehicle-analysis-in-washington-state.htm
l
```

In [ ]: