ELECTRIC VEHICLE DATA ANALYSIS

Dataset used: Electric_Vehicle_Population_Data.csv

Problem Statement:

The rapid evolution of the electric vehicle (EV) market, including Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs), presents a unique opportunity to analyse trends and insights that are critical for understanding the current and future landscape of this growing industry. This project aims to explore and visualize key performance indicators (KPIs) that provide a comprehensive overview of the market size, growth, technological advancements, and geographical distribution of electric vehicles.

Key questions to be addressed include:

➤ What is the total number of electric vehicles (both BEVs and PHEVs) in the dataset, and how has this number evolved over time?

➤ What is the average electric range of these vehicles, and what does it indicate about the progress in EV technology?

➤ How do BEVs compare to PHEVs in terms of market share, and what does this reveal about consumer preferences?

➤ Which states have the highest concentration of electric vehicles, and how does this distribution relate to regional policies or incentives?

➤ Which vehicle makes and models dominate the electric vehicle market, and what trends can be observed in terms of consumer preferences?

Through a series of visualizations, this project will provide insights into these questions, helping stakeholders understand the dynamics of the EV market and identify opportunities for growth and innovation.

Fields of Dataset:

- Vehicle ID: A unique identifier for each vehicle.

- Model Year: The year the vehicle model was released.

- Make: The manufacturer or brand of the vehicle.

- Model: The specific model of the vehicle.

- Vehicle Type: Specifies whether the vehicle is a BEV or PHEV.

- Electric Range: The range the vehicle can travel on electric power alone (in miles).

- CAFV Eligibility: Indicates whether the vehicle is eligible for Clean Alternative Fuel Vehicle (CAFV) incentives.

- State: The state in which the vehicle is registered, providing geographical context.

KPI'S

1.Total Vehicles:
Understand the overall landscape of electric vehicles, encompassing both BEVs and PHEVs, to assess the market's size and growth.

2. Average Electric Range:
Determine the average electric range of the electric vehicles in the dataset to gauge the technological advancements and efficiency of the EVs.

3. Total BEV Vehicles and % of Total BEV Vehicles:
Identify and analyze the total number of Battery Electric Vehicles (BEVs) in the dataset.
Calculate the percentage of BEVs relative to the total number of electric vehicles, providing insights into the dominance of fully electric models.

### 4. Total PHEV Vehicles and % of Total PHEV Vehicles:
Identify and analyze the total number of Plug-in Hybrid Electric Vehicles (PHEVs) in the dataset.
Calculate the percentage of PHEVs relative to the total number of electric vehicles, offering insights into the market share of plug-in hybrid models.

a) Total Vehicles by Model Year (From 2010 Onwards)

Objective:

The objective of this line chart is to visualize the yearly distribution of electric vehicles, offering a clear perspective on how the market has evolved over time and helping stakeholders understand the trajectory of EV adoption from 2011 to 2024.
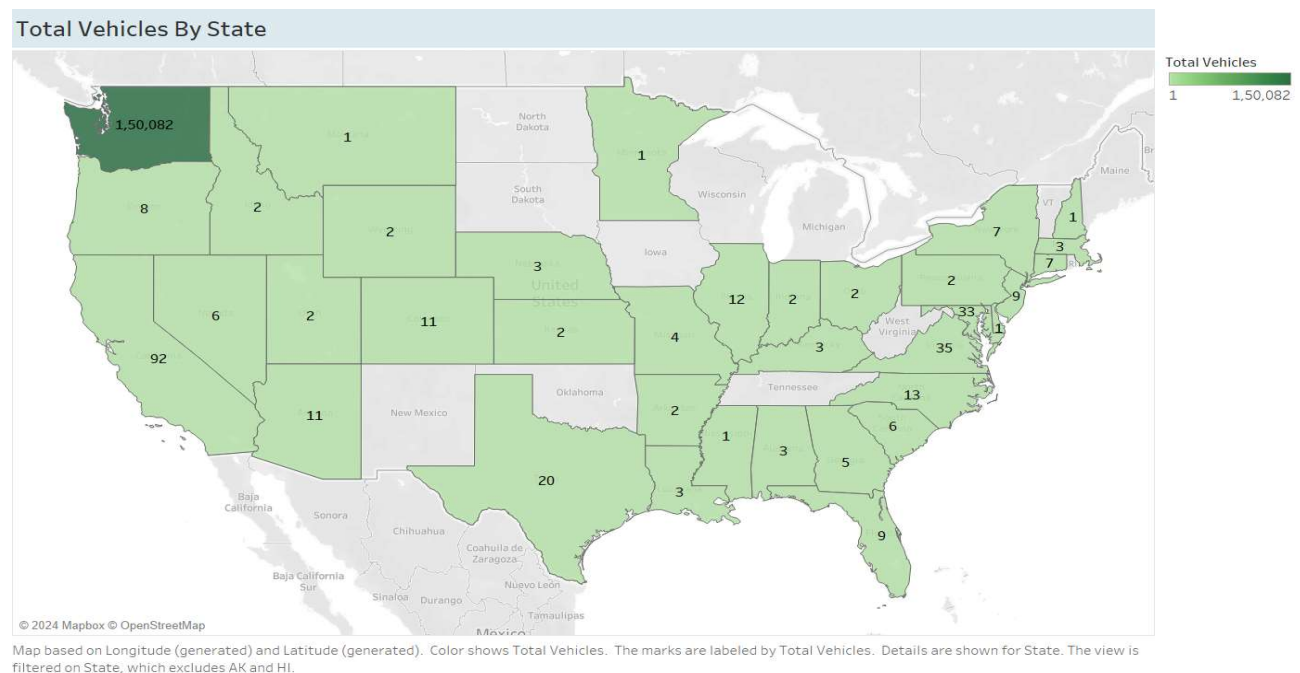
Total Vehicles By Model Year

The trends of Total Vehicles and Total Vehicles for Model Year.
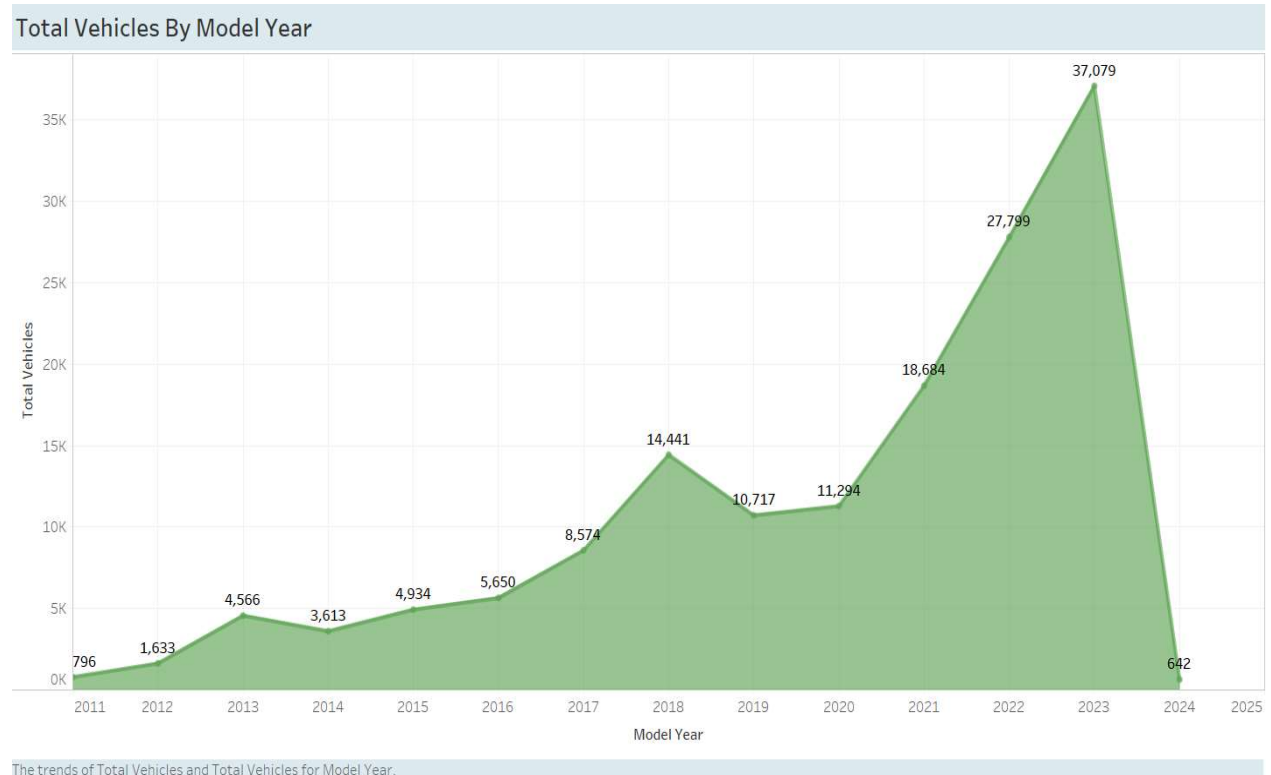
Key Insights:

➢ Steady Growth Until 2018: There is a noticeable increase in the number of EVs from 2011, with a steady upward trend, peaking in 2018 at 14,441 vehicles. This indicates growing consumer interest and possibly the impact of early government incentives.

➢ Fluctuations Post-2018: After 2018, the number of vehicles decreased in 2019 but recovered in 2021, with another significant peak in 2023 at 37,079 vehicles.

➢ 2023 as a Peak Year: The highest number of vehicles was recorded in 2023, showing a substantial increase compared to previous years.

b) Total Vehicles by State

Objective:
This map will analyse the geographical distribution of electric vehicles across different states, allowing for the identification of regions with higher adoption rates.

Map based on Longitude (generated) and Latitude (generated). Color shows Total Vehicles. The marks are labeled by Total Vehicles. Details are shown for State. The view is filtered on State, which excludes AK and HI.

Key Insights

➢ **High Concentration in Washington State**:
Washington state stands out with a significantly higher number of electric vehicles (150,082), far surpassing other states. This indicates a strong adoption rate, likely driven by favourable state policies, incentives, and a strong interest in clean energy among residents.
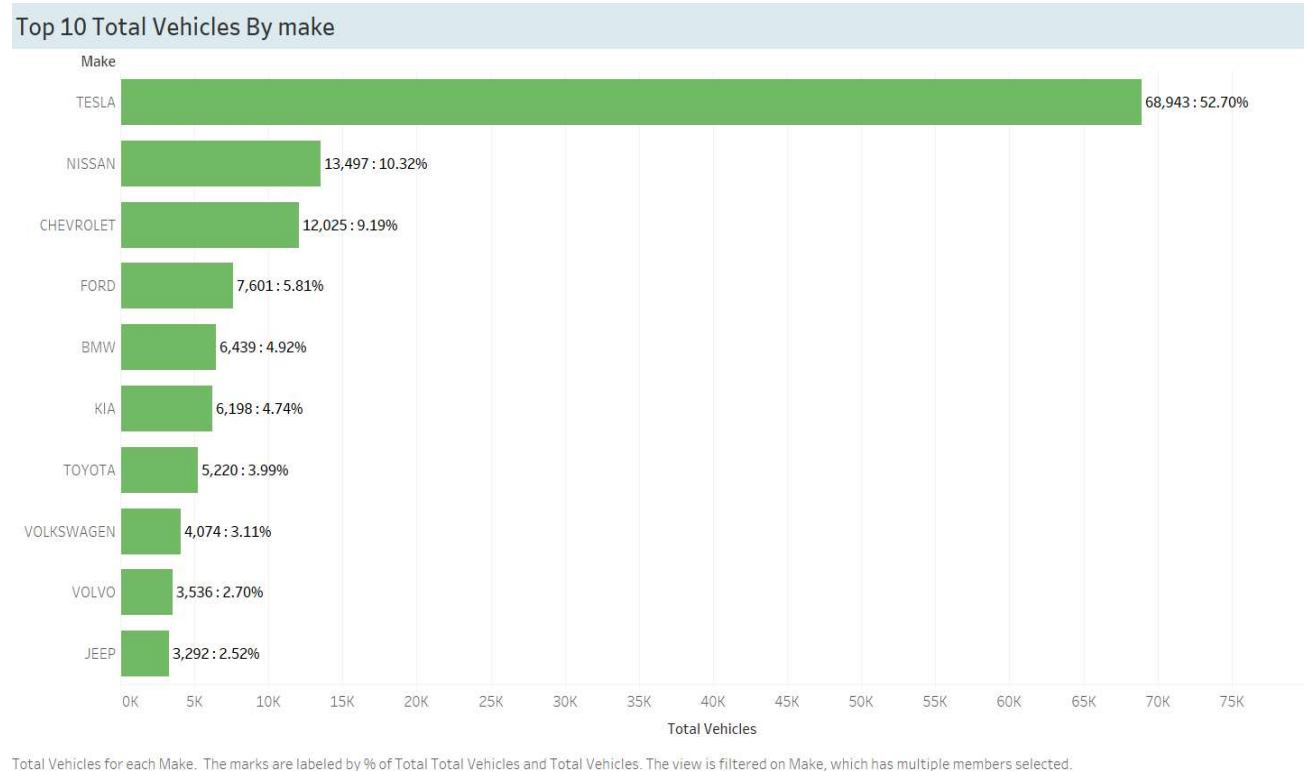
➢ **Sparse Distribution Across Central and Southern States**:
Many central and southern states have very low numbers of electric vehicles, often in single digits. This suggests that EV adoption is still in its nascent stages in these regions.

c) Top 10 Total Vehicles by Make

Objective:

Highlight the top 10 electric vehicle manufacturers based on the total number of vehicles, providing insights into the market dominance of specific brands
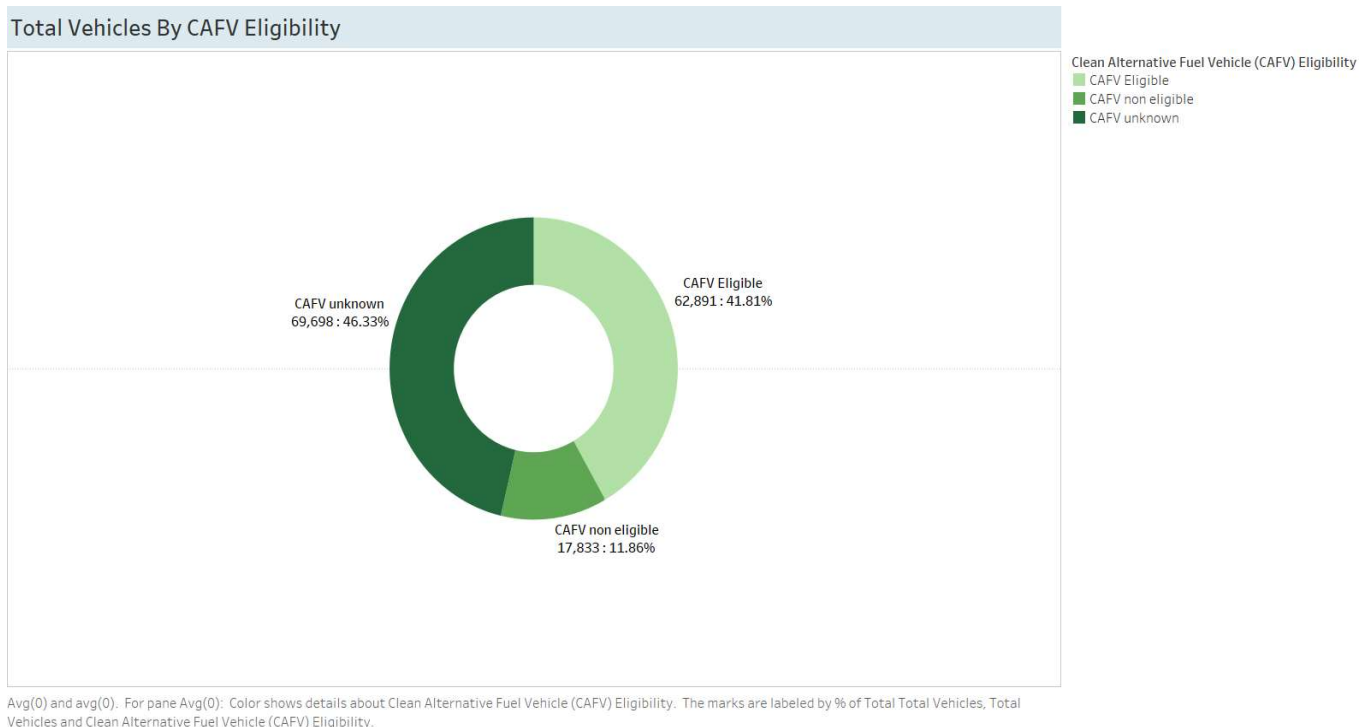
Top 10 Total Vehicles By make

Make	
TESLA	68,943 : 52.70%
NISSAN	13,497 : 10.32%
CHEVROLET	12,025 : 9.19%
FORD	7,601 : 5.81%
BMW	6,439 : 4.92%
KIA	6,198 : 4.74%
TOYOTA	5,220 : 3.99%
VOLKSWAGEN	4,074 : 3.11%
VOLVO	3,536 : 2.70%
JEEP	3,292 : 2.52%

Total Vehicles

Total Vehicles for each Make. The marks are labeled by % of Total Total Vehicles and Total Vehicles. The view is filtered on Make, which has multiple members selected.

Key Insights

➢ Tesla's Dominance:
Tesla leads the market with a commanding 52.70% share, representing 68,943 vehicles. This clearly highlights Tesla's dominance in the electric vehicle market, likely due to its early entry, brand reputation, and strong focus on electric vehicles.

➢ Other Major Players:
Nissan and Chevrolet are the next significant players, with 10.32% (13,497 vehicles) and 9.19% (12,025 vehicles) of the market, respectively.

d) Total Vehicles by CAFV Eligibility

Objective

Illustrate the proportion of electric vehicles that are eligible for Clean Alternative Fuel Vehicle (CAFV) incentives, aiding in understanding the impact of incentives on vehicle adoption using Donut chart.

Total Vehicles By CAFV Eligibility

Clean Alternative Fuel Vehicle (CAFV) Eligibility
- CAFV Eligible
- CAFV non eligible
- CAFV unknown

CAFV unknown
69,698 : 46.33%

CAFV Eligible
62,891 : 41.81%

CAFV non eligible
17,833 : 11.86%

Avg(0) and avg(0). For pane Avg(0): Color shows details about Clean Alternative Fuel Vehicle (CAFV) Eligibility. The marks are labeled by % of Total Total Vehicles, Total Vehicles and Clean Alternative Fuel Vehicle (CAFV) Eligibility.

Key Insights:

➢ **CAFV Eligible Vehicles**: The largest segment, representing 41.18% of the total vehicles, consists of 6,991 units. This indicates a significant portion of vehicles are eligible for clean alternative fuel, contributing positively to environmental sustainability.

➢ **CAFV Ineligible Vehicles**: The next largest segment, making up 46.11% of the total, includes 7,827 units. This shows that nearly half of the vehicles are not eligible for clean alternative fuel.

➢ **CAFV Unknown Status**: The smallest segment, comprising 12.06% of the total with 2,048 units, represents vehicles with unknown CAFV status.

e) Top 10 Total Vehicles by Model

Objective

Highlight the top 10 electric vehicle models based on the total number of vehicles, offering insights into consumer preferences and popular models in the market.

Total Vehicles By Model

| Model	Make	Electric Vehicle Type	Total Vehicles	% of Total Total Vehicles along Table (Down)
MODEL Y	TESLA	Battery Electric Veh..	28,502	18.95%
MODEL 3	TESLA	Battery Electric Veh..	27,709	18.42%
LEAF	NISSAN	Battery Electric Veh..	13,187	8.77%
MODEL S	TESLA	Battery Electric Veh..	7,611	5.06%
BOLT EV	CHEVROLET	Battery Electric Veh..	5,733	3.81%
MODEL X	TESLA	Battery Electric Veh..	5,114	3.40%
VOLT	CHEVROLET	Plug-in Hybrid Electr..	4,890	3.25%
ID.4	VOLKSWAGEN	Battery Electric Veh..	2,999	1.99%
NIRO	KIA	Battery Electric Veh..	1,854	1.23%
		Plug-in Hybrid Electr..	1,022	0.68%
PACIFICA	CHRYSLER	Plug-in Hybrid Electr..	2,642	1.76%
WRANGLER	JEEP	Plug-in Hybrid Electr..	2,629	1.75%
MUSTANG MACH-E	FORD	Battery Electric Veh..	2,619	1.74%
PRIUS PRIME	TOYOTA	Plug-in Hybrid Electr..	2,527	1.68%
X5	BMW	Plug-in Hybrid Electr..	2,068	1.37%
I3	BMW	Battery Electric Veh..	592	0.39%
		Plug-in Hybrid Electr..	1,325	0.88%
FUSION	FORD	Plug-in Hybrid Electr..	1,829	1.22%
EV6	KIA	Battery Electric Veh..	1,644	1.09%
IONIQ 5	HYUNDAI	Battery Electric Veh..	1,638	1.09%
C-MAX	FORD	Plug-in Hybrid Electr..	1,546	1.03%
RAV4 PRIME	TOYOTA	Plug-in Hybrid Electr..	1,525	1.01%
R1T	RIVIAN	Battery Electric Veh..	1,357	0.90%
XC90	VOLVO	Plug-in Hybrid Electr..	1,233	0.82%
BOLT EUV	CHEVROLET	Battery Electric Veh..	1,153	0.77%
E-GOLF	VOLKSWAGEN	Battery Electric Veh..	1,075	0.71%
E-TRON	AUDI	Battery Electric Veh..	979	0.65%
XC60	VOLVO	Plug-in Hybrid Electr..	949	0.63%
PRIUS PLUG-IN	TOYOTA	Plug-in Hybrid Electr..	942	0.63%
XC40	VOLVO	Battery Electric Veh..	840	0.56%
R1S	RIVIAN	Battery Electric Veh..	812	0.54%
500	FIAT	Battery Electric Veh..	806	0.54%
CLARITY	HONDA	Plug-in Hybrid Electr..	801	0.53%

AGG(Total Vehicles)

1 — 28,502

Key Insights

➢ Top Vehicle Models: The model with the highest total number of vehicles is the Tesla Model Y, followed closely by the Tesla Model 3. This indicates Tesla's strong presence in the market.

➢ Diverse Manufacturers: While Tesla has multiple models in the top list, other manufacturers like Nissan, Chevrolet, and Volkswagen also have significant representation, showing a diverse range of manufacturers contributing to the EV market.

f) Top 10 BEV Vehicles by Make and Model

Objective

The tree map is used to analyse the total number of Battery Electric Vehicles (BEVs) for the top 10 models.
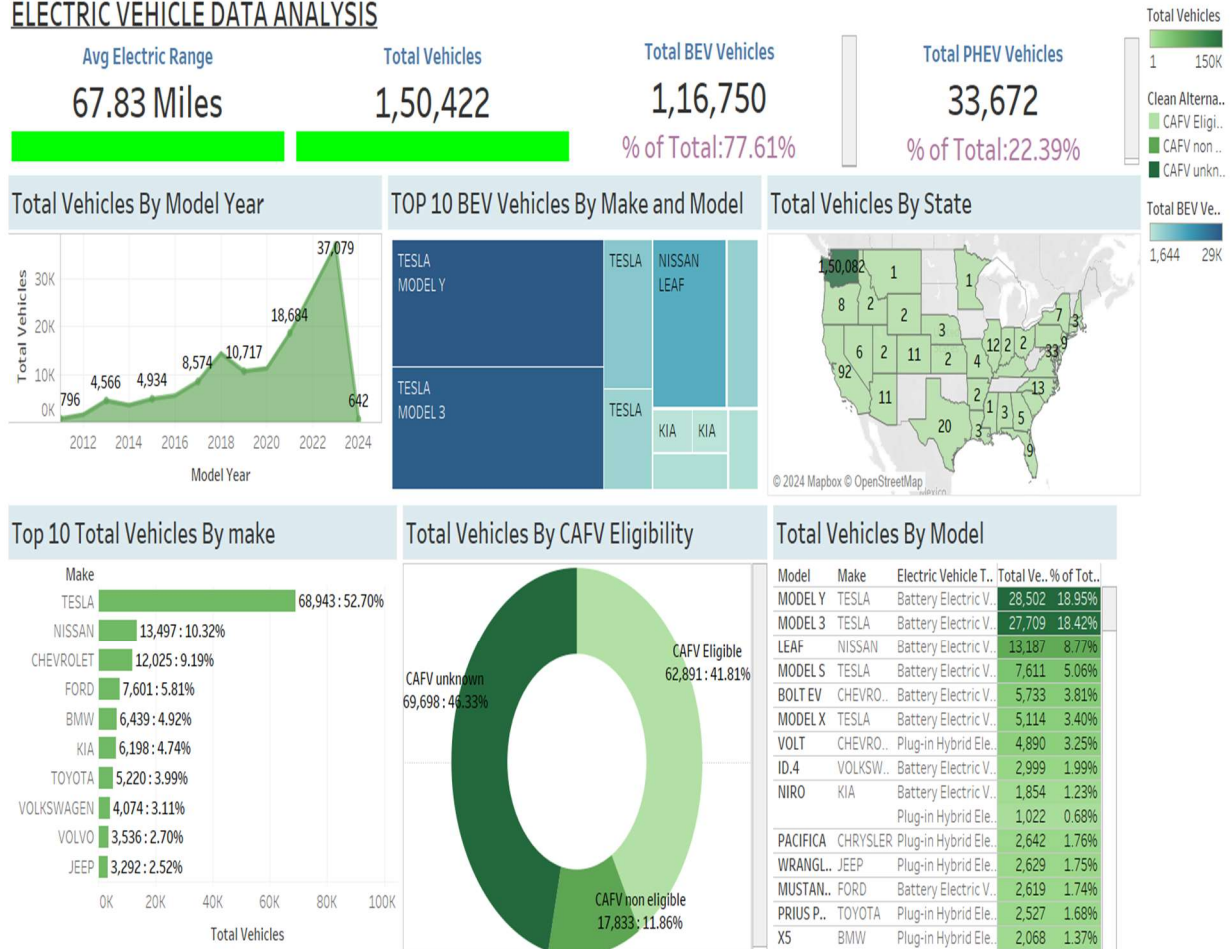

TOP 10 BEV Vehicles By Make and Model
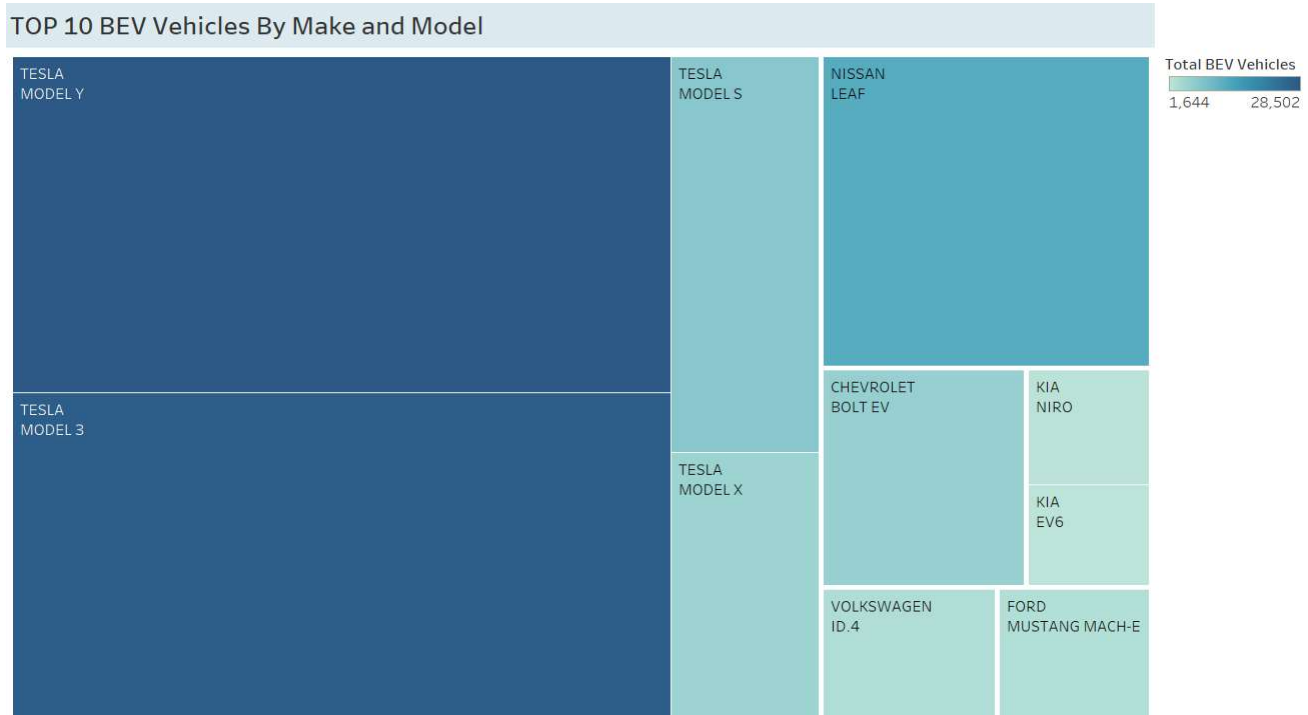
Make and Model. Color shows Total BEV Vehicles. Size shows Total BEV Vehicles. The marks are labeled by Make and Model. The view is filtered on Model, which has multiple members selected.

Key Insights

➢ Dominance of Tesla: Tesla models (Model Y, Model 3, Model S, and Model X) dominate the chart, with the Tesla Model Y having the highest number of total BEV vehicles.

➢ Market Trends: The presence of multiple Tesla models suggests a strong market preference for Tesla vehicles. Additionally, the inclusion of models like the Kia NIRO EV and Ford MUSTANG Mach-E indicates growing interest in BEVs from other manufacturers.

DASHBOARD

The dashboard "ELECTRIC VEHICLE DATA ANALYSIS" provides a comprehensive overview of electric vehicle statistics. Here are the key insights:

➢ **Total Vehicles**: The dashboard displays a total of 150,422 electric vehicles, with 116,750 BEVs (Battery Electric Vehicles) and 33,672 PHEVs (Plug-in Hybrid Electric Vehicles).

➢ **Average Electric Range**: The average electric range is 67.83 miles.

➢ **Top Models**: Tesla models dominate the top 10 BEV vehicles, with the Tesla Model Y leading.

➢ **Model Year Distribution**: The total vehicles are categorized by model year, showing trends in vehicle adoption over time.

➤ **State Distribution**: The percentage of total vehicles by state is displayed, indicating higher adoption rates in certain states.

➤ **CAFV Eligibility**: The dashboard includes data on Clean Alternative Fuel Vehicle (CAFV) eligibility, with 77.61% of vehicles being eligible.

CONCLUSION

➤ The ELECTRIC VEHICLE DATA ANALYSIS Project provides a comprehensive overview of the electric vehicle market, highlighting key trends and insights.

➤ Tesla dominates the market with its models, particularly the Model Y and Model 3, leading in total vehicle count.

➤ The average electric range of 67.83 miles indicates the practicality of these vehicles for daily use.

➤ The data shows a strong preference for BEVs over PHEVs, with 77.61% of vehicles being CAFV eligible, reflecting a positive trend towards environmental sustainability.

➤ The distribution of vehicles by model year and state reveals adoption patterns, with certain states showing higher rates of electric vehicle usage.

➤ The diverse range of manufacturers, including Nissan, Chevrolet, Kia, Volkswagen, and Ford, indicates a competitive market.

➤ Overall, the analysis underscores the growing adoption of electric vehicles and the significant role of Tesla in driving this trend, while also highlighting areas for potential growth and policy focus.