

# Electric Vehicle Population Data

## DATA DESCRIPTION

The dataset features Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) registered with the Washington State Department of Licensing (DOL). It includes 112,634 rows with 17 variables, each detailed below:

1. **VIN (1-10):** First 10 characters of the unique Vehicle Identification Number (VIN).
2. **County:** Name of the county where the vehicle is registered or located.
3. **City:** City where the vehicle is registered or located.
4. **State:** U.S. state abbreviation where the vehicle is registered.
5. **Postal Code:** ZIP code of the vehicle's registration or location.
6. **Model Year:** Year the vehicle model was manufactured.
7. **Make:** Manufacturer or brand of the vehicle (e.g., TOYOTA, CHEVROLET).
8. **Model:** Specific model name of the vehicle (e.g., RAV4 PRIME, VOLT).
9. **Electric Vehicle Type:** Type of electric vehicle (BEV or PHEV).
10. **CAFV Eligibility:** Indicates if the vehicle qualifies as a clean alternative fuel vehicle.
11. **Electric Range:** Distance the vehicle can travel on electric power alone (in miles).
12. **Base MSRP:** Manufacturer's Suggested Retail Price (excluding options or fees).
13. **Legislative District:** Legislative district where the vehicle is registered.
14. **DOL Vehicle ID:** Unique identifier for the vehicle from the Department of Licensing.
15. **Vehicle Location:** Geographical coordinates (longitude and latitude) of the vehicle.
16. **Electric Utility:** Name of the utility company providing power to the vehicle.
17. **2020 Census Tract:** Census tract from the 2020 U.S. Census where the vehicle is located.

## EXPLORATORY DATA ANALYSIS

This section will provide an overview of the data and highlight key observations, followed by data cleaning, univariate and bivariate analyses. Additionally, it will include visualizations using a Choropleth map and a Racing Bar Plot, both created with Plotly.

### Data Overview (Initial Inspection)

1. Data Preview - *head()*
2. Data Dimension - *shape*
3. Data Summary - *info()*
4. Summary Statistics - *describe()*
5. Data Columns – *columns*

### Observation

- The dataset comprises of 17 variables and 112634 records.
- Missing Values:
  1. Model
  2. Legislative District
  3. Vehicle Location
  4. Electric Utility
- Fix Column Data Types:
  1. Postal Code
  2. Legislative District
- Add New Columns:
  1. Price Range
  2. Electric Range

### 3. Latitude & Longitude

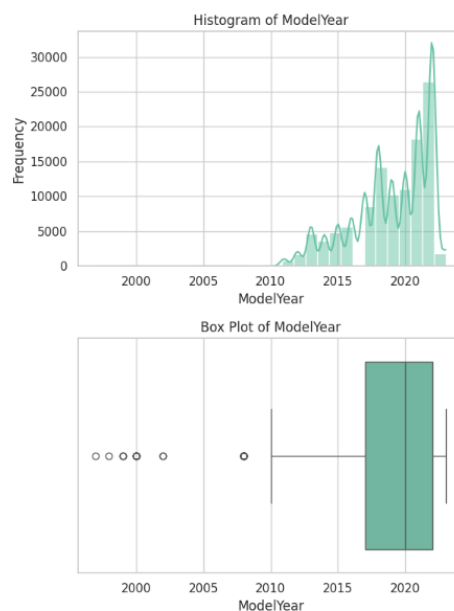
- Standardize Column Names and values by stripping any extra space and converting them to title case.

## Data Cleaning

1. Standardizing Column Names
2. Missing Values
3. Fix Column Data Types
4. Add New Columns

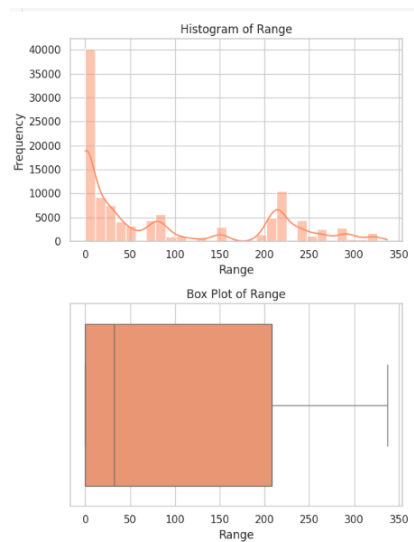
## Data Analysis

### 1. Model Year



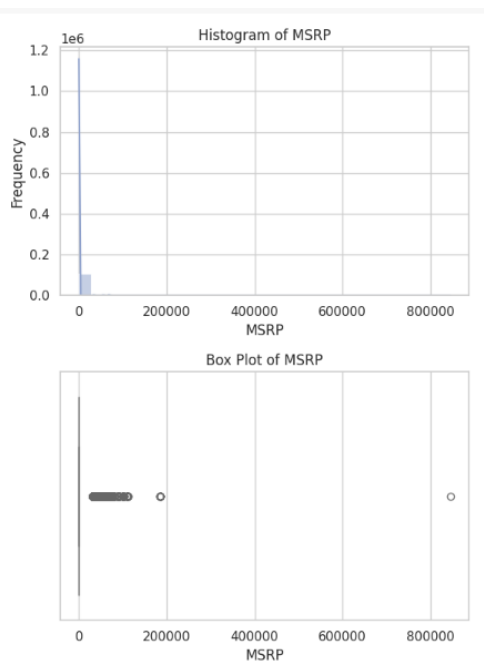
- Shows the distribution and spread of vehicle model years
- Most vehicles are from recent years (2015-2020), indicating a dataset dominated by newer models.
- There are a few older models (outliers before 2010), but the bulk of the data is concentrated around 2015-2020.

## 2. Range



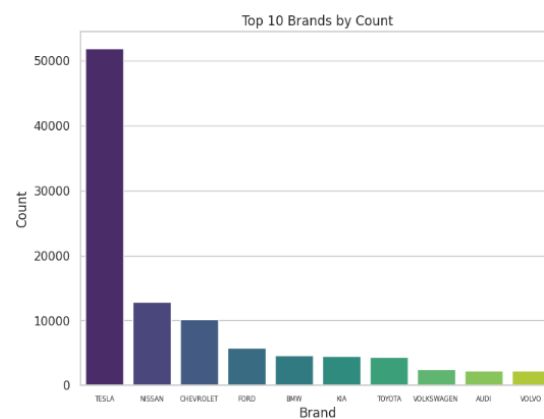
- Displays the frequency and spread of vehicle ranges
- The majority of vehicles have a range below 100 miles, with very few having ranges above 200 miles.
- Most vehicles have ranges between 0-200 miles, with a few high-range vehicles as outliers.

## 3. MSRP



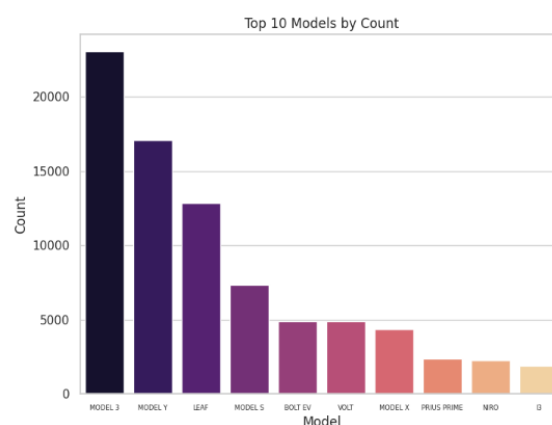
- Shows the distribution of MSRP values
- Most vehicles are priced very low, with very few high-priced vehicles, suggesting a mix of budget and premium models.
- The majority of vehicles are low-priced, with extreme outliers indicating luxury vehicles.

#### 4. Brand



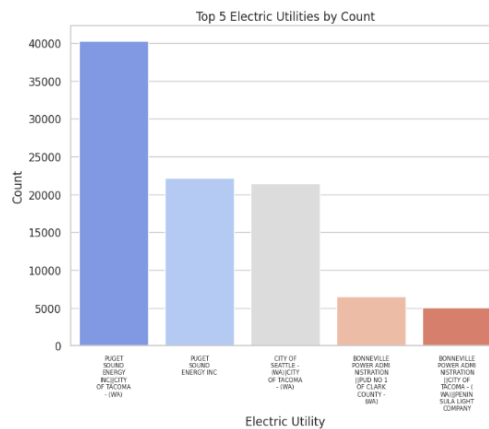
- Tesla dominates the dataset with 56,906 cars, significantly more than other brands.
- Nissan follows with 12,912 cars, and Chevrolet with 10,797 cars. The rest, including Ford, BMW, and Volvo, have much smaller counts, with Volvo being the least represented at 2,324 cars.

#### 6. Model



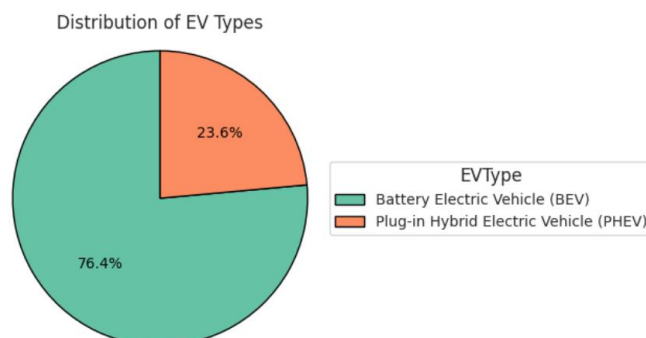
- Tesla's Model 3 is the most popular, with over 20,000 cars.
- The next most common models are Tesla's Model Y and Nissan's LEAF, each with significant counts.
- Models like the Bolt EV, Volt, and Model X have moderate representation, while the Niro and i3 have the lowest counts among the top 10.

## 6. Electric Utility



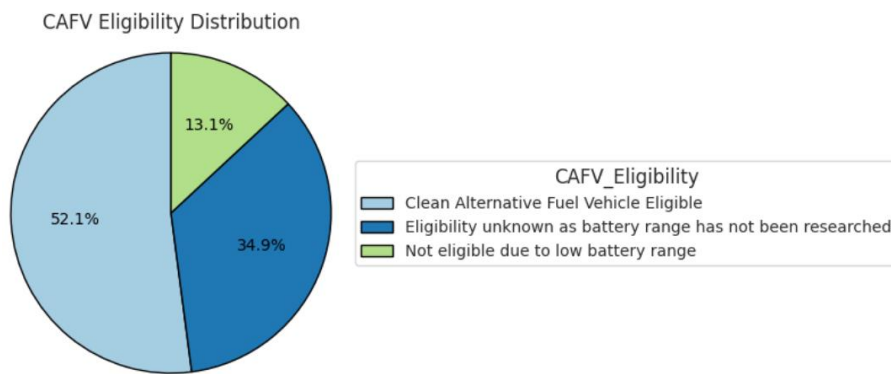
- PUGET SOUND ENERGY INC powers the largest number of electric cars in the dataset, with almost 40,000 vehicles.
- The next most frequent utility provider is CITY OF SEATTLE with over 20,000 cars.
- Other utility companies are also represented, but they account for significantly fewer electric vehicles.

## 7. EV Types



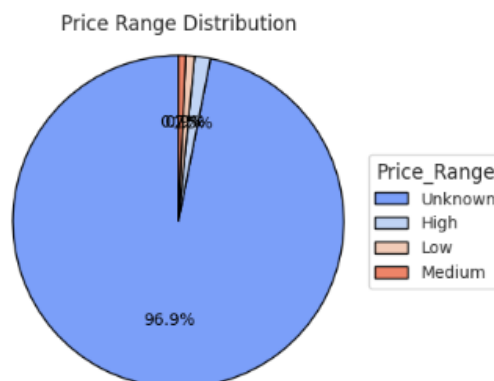
- The majority of electric vehicles (76.4%) are Battery Electric Vehicles (BEVs), while Plug-in Hybrid Electric Vehicles (PHEVs) account for 23.6%.
- BEVs dominate the dataset, indicating a stronger preference for fully electric vehicles compared to hybrid models.

## 8. CAFV Eligibility



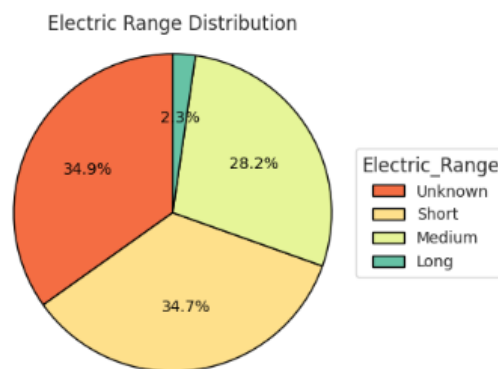
- About 52.1% of vehicles are eligible for Clean Alternative Fuel Vehicle programs, signalling a push toward environmentally friendly vehicle.
- A significant portion (34.9%) has an unknown battery range, highlighting the need for more comprehensive data collection on battery capabilities.
- Around 13.1% are not eligible due to low battery range, suggesting room for improvement in battery technology to enhance EV adoption.

## 9. Price Range



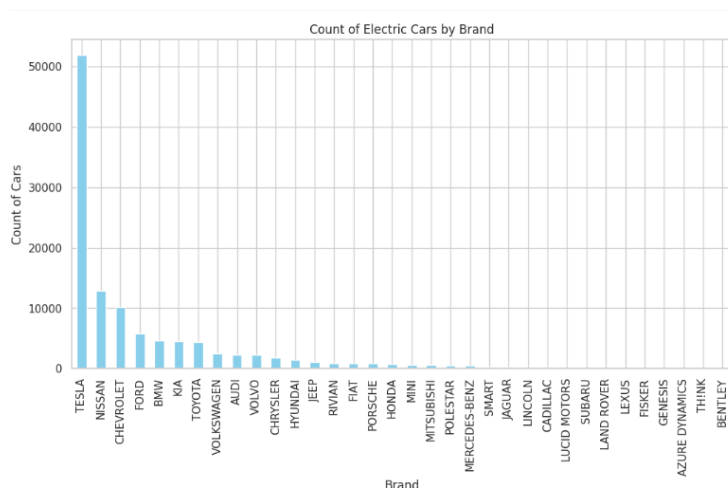
- A vast majority (96.9%) of electric vehicles have an unknown price range, likely because many have a 'Base MSRP' value of 0.
- Only a small percentage of vehicles have defined price ranges, with 1,653 classified as 'High,' 971 as 'Low,' and 758 as 'Medium.' These categories are determined by the 'Base MSRP' values.

## 10. Electric Range



- The largest portion (34.9%) of the data is classified as "Unknown," followed by "Short" ranges (34.7%), "Medium" ranges (28.2%), and a small portion of "Long" ranges (2.3%).
- Most vehicles have either short or unknown electric ranges, while long-range vehicles make up a very small percentage.

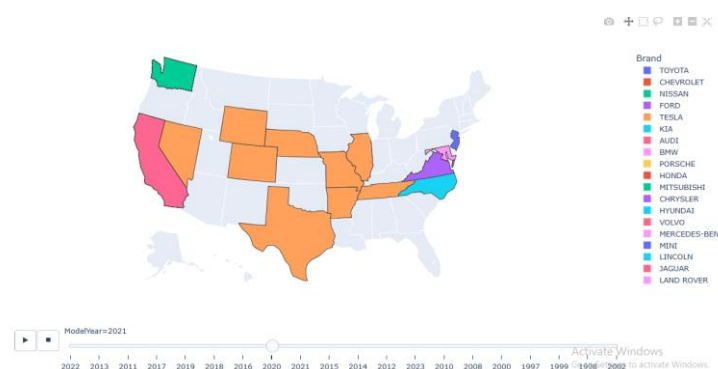
## 11. Vehicles Per Brand



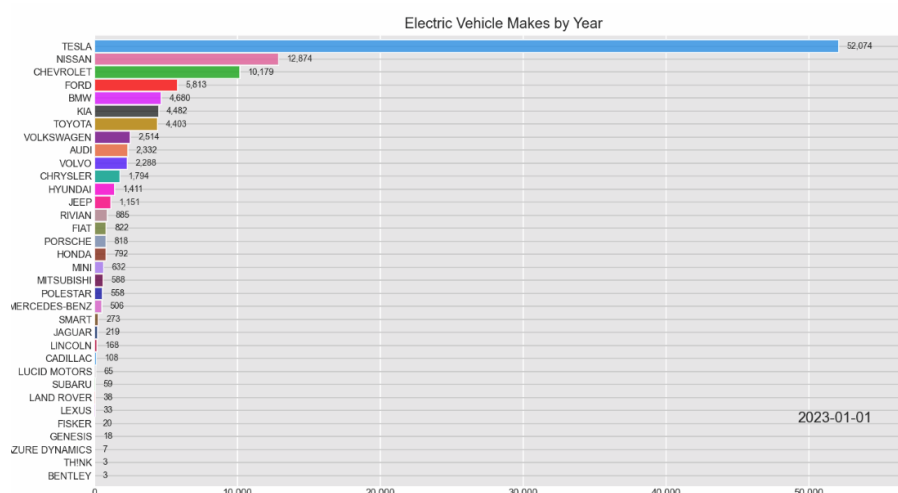


- Tesla dominates the electric car market with the highest count, significantly outpacing all other brands.
- Nissan, Chevrolet, and Ford follow as the next largest contributors but with much smaller counts compared to Tesla.
- The majority of the brands shown have much lower counts of electric cars, forming a long tail of the distribution.
- Luxury brands such as Porsche, Mercedes-Benz, and Jaguar have relatively low electric car counts.
- Emerging brands like Rivian and Lucid Motors show smaller numbers, indicating a still-developing presence in the market.

## 12. Distribution of Electric Vehicles by Location (Choropleth)



## 13. Annual Evolution of Electric Vehicle Makes and Their Counts (Racing Bar Plot)



## CONCLUSION

- **Recent Trends in Electric Vehicles:** The dataset primarily comprises newer electric vehicles, with most models from 2015 to 2020, highlighting a growing trend towards the adoption of contemporary EV technology.
- **Dominance of Tesla:** Tesla significantly leads the electric vehicle market, with over 50,000 cars, far surpassing other brands like Nissan and Chevrolet, indicating its strong brand presence and consumer preference.
- **Range and Pricing Characteristics:** A majority of vehicles have a limited range of under 100 miles and are priced quite low, suggesting that while affordable models are widely available, there is also a notable presence of high-end vehicles, evidenced by extreme outliers in pricing.
- **Electric Utility Providers:** Puget Sound Energy Inc. is the primary electricity provider for the largest share of electric vehicles, with a notable contribution from the City of Seattle, reflecting regional trends in EV infrastructure.
- **Diversity in EV Types and Features:** The data highlights a strong preference for Battery Electric Vehicles (BEVs) over Plug-in Hybrid Electric Vehicles (PHEVs), with many vehicles qualifying for Clean Alternative Fuel Vehicle programs. This emphasizes the ongoing need for comprehensive data collection on battery capabilities, which will be essential as the electric vehicle market continues to grow.