Electric vehicle trend in the State of Washington

****

Students: Maryam Boujdaa - Vatosoa Razafiniary / 5 ISS 2022
Dataset source: Electric Vehicle Population Data
https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2
Github repository access: https://github.com/Vatosoa285/BigData_WashingtonEV.git

Introduction

To give a new impetus to the energy transition, a new law on the tax credit for electric vehicles was passed by the US Senate on Sunday, August 14, 2022. This law provides a boost of up to $7,500 to American consumers provided that the electric car is manufactured in the United States. Given this context, providing an overview of the current trend in the use of electric vehicles in the US could be interesting. We have found a dataset that shows the Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) that are currently registered through Washington State Department of Licensing (DOL). Based on that, we will conduct a small-scale inventory in the State of Washington which is one of the most populous states in the western United States, with approximately 7.7 million people in 2021.

I. General description of the dataset

We have planned this descriptive section to appropriate dataset useful information for further analyses and also to allow the reader to immerse himself in the subject.

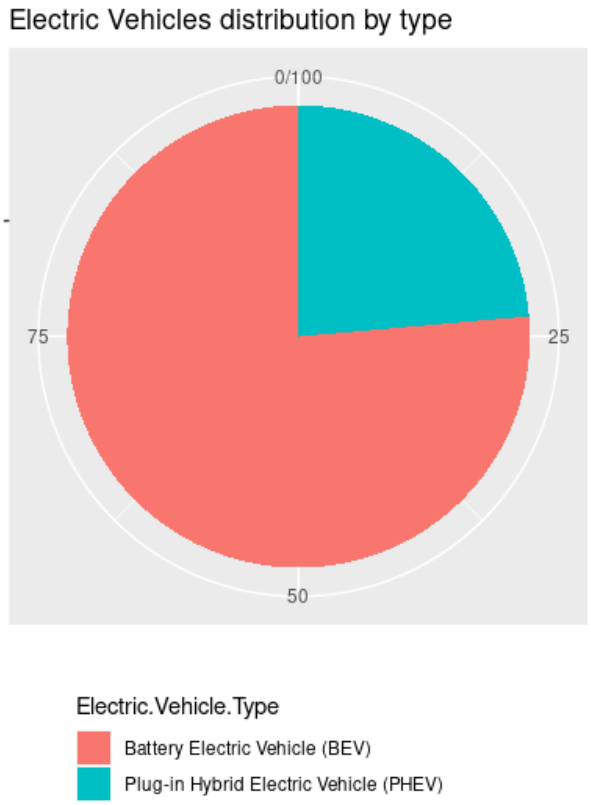

fig1. Electric Vehicles Distribution by type

I.1 Among Electric Vehicles: BEVs versus PHEVs

As previously introduced, the electric vehicles registered in the dataset can be categorized into two main groups:

- Battery Electric Vehicle (BEV): also referred as an All-Electric Vehicle(AEV),it is entirely powered by electricity stored in its battery pack(s). It is charged by plugging it into an electric power source, such as a charging station or a wall outlet, and uses the stored electricity to power an electric motor. It is more efficient compared to plug-in hybrids. This type represents 76.4% that is to say more than three quarters of the 112634 vehicles in the dataset.

- Plug-in Hybrid Electric Vehicles (PHEV): it uses both an internal combustion engine (gasoline or diesel) and a battery (or more) charged from an external socket (it has a plug). The vehicle's battery can be charged with electricity rather than the engine.

I.2 Vehicles Model Year and CAFV eligibility

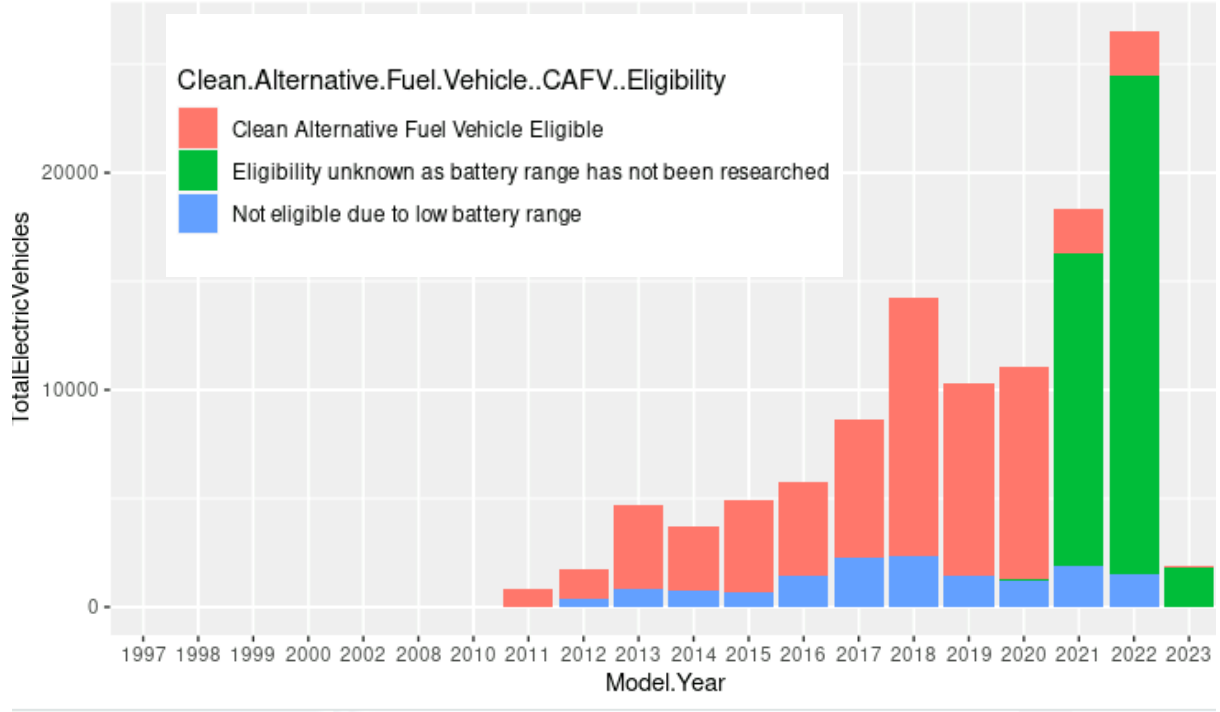

fig2. Electric Vehicles CAFL eligibility by Model Year

The figure above shows the distribution according to their eligibility for the CAFV of electric vehicles belonging to a given model year. The electric vehicles in the dataset have their model years included in the Model_Year_Interval = [2011,2023]
What is CAFV eligibility ?
"Clean Alternative Fuel Vehicle (CAFV) Eligibility is based on the fuel requirement and electric-only range requirement as outlined in RCW 82.08.809 and RCW 82.12.809 to be eligible for Alternative Fuel Vehicles retail sales and Washington State use tax exemptions. **Sales or leases of these vehicles must occur on or after 8/1/2019** and **meet the purchase price requirements** to be eligible for Alternative Fuel Vehicles retail sales and Washington State use tax exemptions."
We note that for model years between 2011 and 2020, more than two-thirds of electric vehicles are eligible for the CAFV. For model years between 2021 and 2022, by taking the majority of electric vehicles whose eligibility for CVAC is unknown out of the equation, this trend tends to decline.

II. Analysis of electric vehicle distribution by city in Washington

The Washington State counts 641 cities. It is also the seventh Richest States in the U.S.

II.1 Electric vehicles density versus Population density

Before embarking on the analysis of the density of electric vehicles by city of Washington, let us focus a little on the urban demographic and traffic. There is usually a direct link between the population density of a city and its traffic. The more a city is populated, the more likely it is that there will be a large number of vehicles on the roads and streets of that city. It is important to note that the relationship between population density and car traffic can vary from city to city and depend on many other factors, such as the availability of public transport, urban planning and the travel habits of residents. In reflecting on the lines of analysis for this dataset, we wondered if there would be a greater chance of a higher concentration of electric vehicles in the most populated cities of Washington. As the demographic parameter is not

included in the dataset, we used this ranking of Washington Cities by population from the 2021 American Community Survey: https://www.washington-demographics.com/cities_by_population to conduct our analysis. We compared the two figures below:

Rank	City	Population
1	Seattle	726,054
2	Spokane	225,709
3	Tacoma	217,332
4	Vancouver	188,331
5	Bellevue	149,365
6	Kent	134,890
7	Everett	110,438
8	Renton	105,313
9	Spokane Valley	102,178
10	Federal Way	99,792

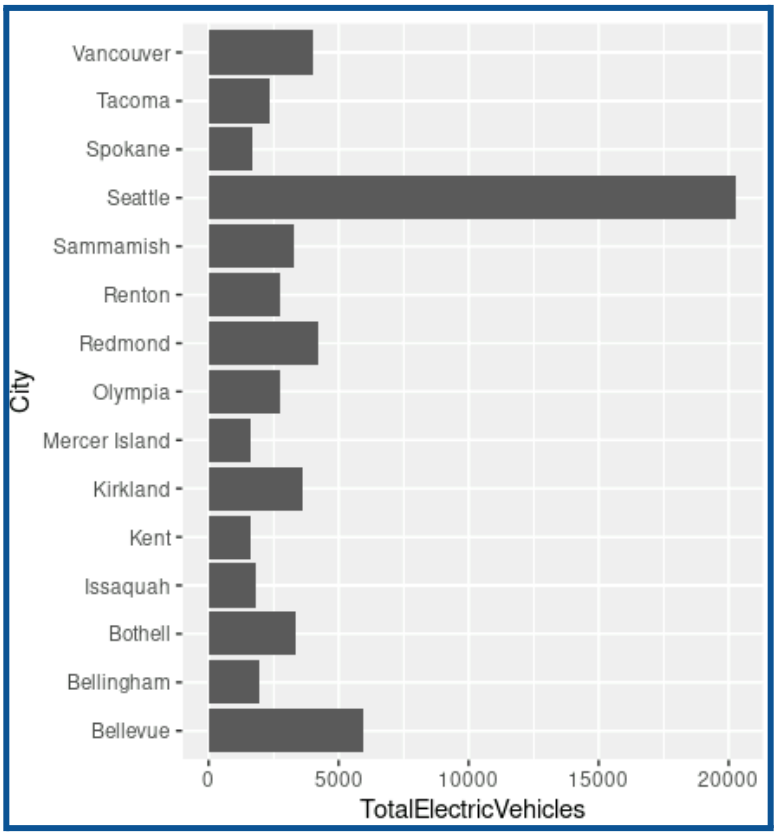

fig3.a **fig3.b**

fig3. Comparison between the top 10 Washington most populated cities (fig3.a) and the top 15 cities with the highest population of electric vehicles (fig3.b)

Observations:

- Among Washington's 10 most populous cities, 7 are in the top 15 cities with the highest population of electric vehicles.
- Seattle which is by far the most populated city of Washington is also fig3.b top 1 with its 20305 total electric vehicles.

II.1 Electric vehicle population versus Electric Utility population

There is a parameter "Electric Utility" in the dataset that mentions the electric power retail service territories serving the address of the registered vehicle. All ownership types for areas in Washington are included: federal, investor owned, municipal, political subdivision, and cooperative. If the address for the registered vehicle falls into an area with overlapping electric power retail service territories then a single pipe | delimits utilities of same TYPE and a double pipe || delimits utilities of different types. Vehicle address and Homeland Infrastructure Foundation Level Database (HIFLD) (https://gii.dhs.gov/HIFLD) Retail_Service_Territories feature layer were combined using a geographic information system to assign values for this field. Blanks occur for vehicles with addresses outside of Washington or for addresses falling into areas in Washington not containing a mapped electric power retail service territory in the source data. We looked at this parameter in the expectation of finding a correlation (linearity for example)

with the number of electric vehicles recorded in a city. We were maybe a little too simplistic and idealistic as we found after analysis that:

- Cities with access to the same number of Electricity Utility (EU) are heterogeneous in terms of the number of electric vehicles registered there. You can see this from fig4 where each (vertical) bar indicates the number of electric vehicles that have access to the same number of Electricity Utility. For each bar, the horizontal streaks delineate a city and the height between 2 neighboring streaks allows to deduce the number of vehicles registered within a city.
- To our astonishment, and you have surely noticed it as well: Seattle, the city most populated with electric vehicles has access to five EUs against eight EUs for Tacoma which registers 2379 electric vehicles.
- Among Washington's 641 cities: 506 have access to 1 EU, 94 cities to 2 EUs, 20 cities to 3 EUs, 5 cities to 4EUs, 3 cities to 6 EUs and 1 city to EUs (fig5)
- To refine our analysis, we would have liked to have access for example to information on the capacity of each EU in terms of charging stations present, their rate of use by users in regarding other alternatives, the level of bias in the source data for the EUs census.

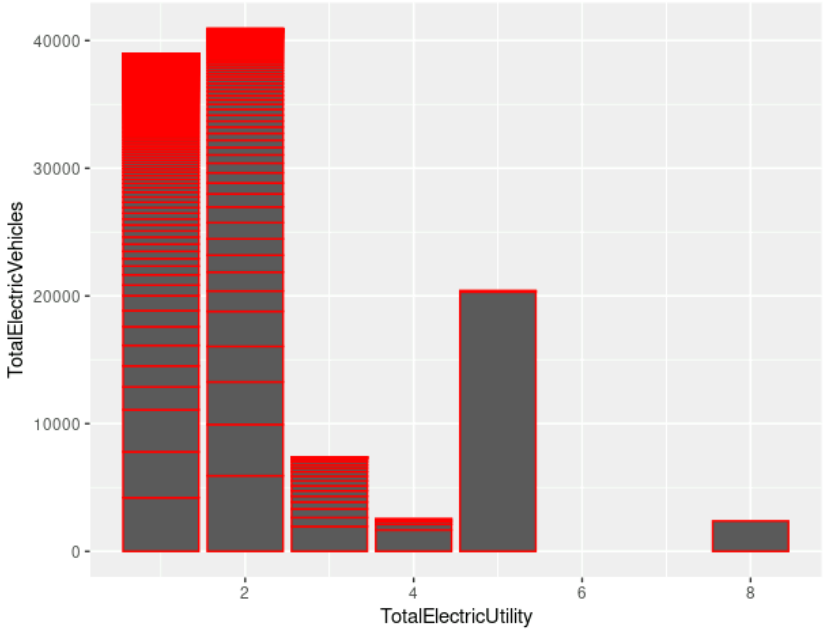

fig4. Characterization of cities having access to the same equipment number

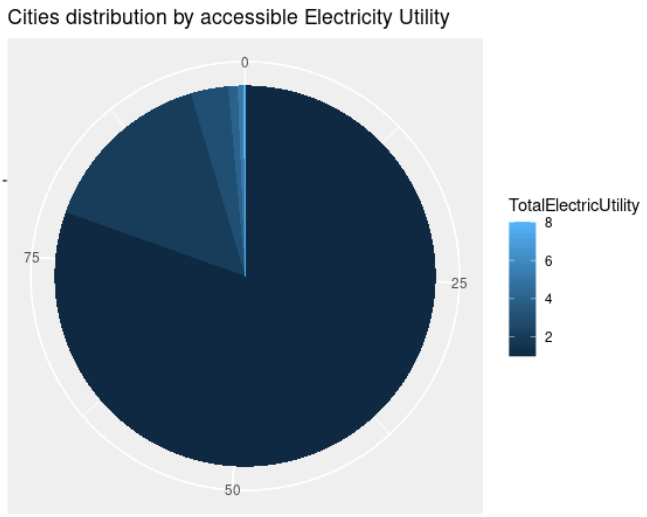

fig5. Cities distribution by number of accessible Electricity Utility

III. Is Tesla the most represented brand of electric vehicle in Washington?

Did you know that Tesla is capable of producing more than a million cars a year coming through its Gigafactories spread over three continents?[source : *Où sont fabriqués les voitures électriques Tesla*, caroom.fr]. With its 4 Gigafactories located in the United States, Tesla applies a strategy of specialization in the manufacturing process of its electric vehicles:

- Nevada Gigafactory handles the production of electric motors, batteries and powertrains
- New York Gigafactory produces the Solar Roof, solar panels and electrical components for Supercharger charging stations.
- Fremont Gigafactory manages the production of the Tesla Model S, Model 3, Model X and Model Y

- Gigafactory Texas is currently only handling the Tesla Model Y SUV and will be handling other new models in 2023

With our dataset, we can see how Tesla electric vehicles are represented in Washington.

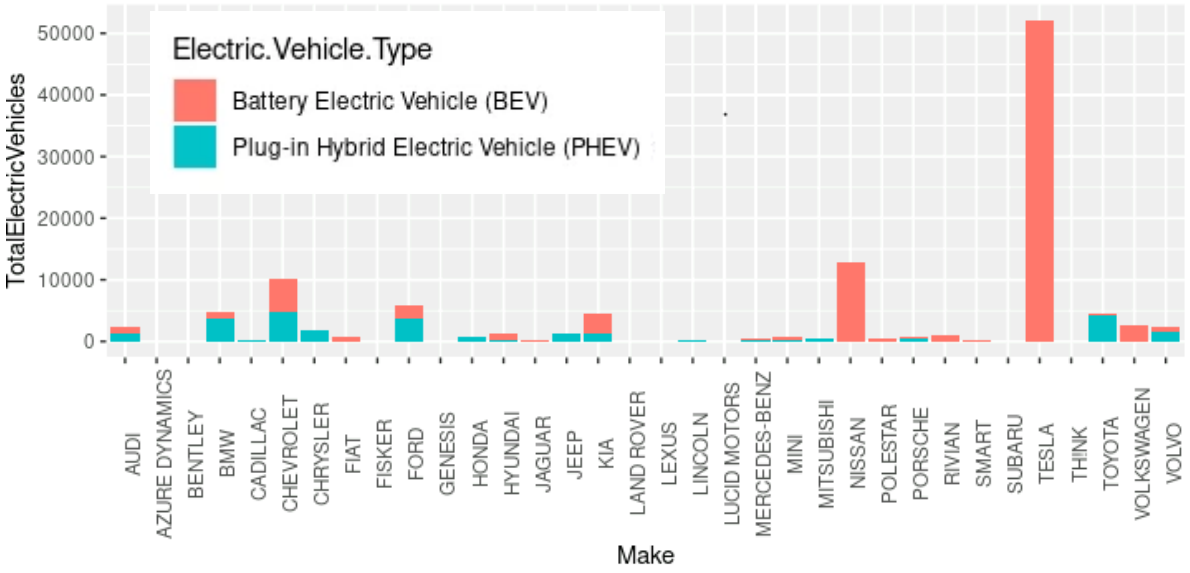

fig6. distribution of the number of electric vehicles and their type by make in Washington

Observations:

- Tesla represents a 46.2% share of electric vehicles in Washington with its 52078 BEVs
- Although PHEVs represent 23.6% of electric vehicles in Washington, this share is shared among 22 brands.On the other hand, BEVs share is shared among 25 brands.
- The two most represented brands : Tesla and Nissan (Japanese make) are both specialized in BEVs. Chevrolet (American brand) in the third place has its share fairly well distributed between the two types of electric vehicles

Do you remember about the law that provides a boost of up to $7,500 to American consumers provided that the electric car is manufactured in the United States (cf. introduction) ? It could be interesting to follow in the coming years the evolution of the distribution of electric vehicles between brands and the rate of beneficial owners of this boost

Conclusion

This exercise was an opportunity for us to apply our R knowledge and develop new skills in data manipulation and visualization of results. Concretely, we were able to analyze the “ Washington Electric Vehicle Population ”dataset by going through:

- the dataset search step,
- familiarizing ourselves with it by displaying the variables, calculating averages, plotting graphs,
- the selection of analysis axes from the dataset proposals or our personal questions,
- the search for the type of graphic display that would be most suitable for an analysis axis
- the interpretation of the results and the dataset limits

We hope you found this study interesting and rewarding. If you ever plan to move to Washington, want to buy an electric vehicle, hesitate between BEV and PHEV and would like to benefit from CAFV, you know who to contact.

****