Washington State EV Population Analysis

Analysis on data of electric vehicles in the state of Washington

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Table of Contents

Overview

This analysis involves a dataset containing information on Washington state's electric vehicle ownership. In particular, it includes connecting characteristics to each registered EV like which city and county the vehicle resides in, the model year, as well as the make and model of each car. Additionally, data on each city's population is combined with the dataset as supporting data for questions.

Problem Statement & Research Questions

As electric vehicle brands like Tesla continue to grow as a household name in the United States, there are many questions to how their popularity and use will hold up as time goes on.

For starters:
- How many EVs are in Washington?
- And what kind of EVs are there and who are the main manufacturers battling for market share in the state?
- With many automakers jumping on the EV bandwagon, how do EV exclusive makers compare to the rest of the competition?

Furthermore:
- Is a relationship between the population of a city and the amount of EV vehicles?
- Does a higher population mean a higher amount of EV vehicles?
- Does a higher population mean a lower population to EV vehicle ratio?

Lastly:
- Is there a relationship between the amount of Tesla ownership and population?
- Or between city population and population-to-Tesla ownership ratio?

Data Collection/Cleaning

The electric vehicle data was downloaded from Data.gov as a csv file and imported into Excel. It was last updated in July 2023, which is when the creation of this analysis was made. There were no blanks or error cells so there was little to no cleaning to be done. I converted it into a table and added it to the data model to be imported and used in Power Pivot. The population data was imported from worldpopulationreview.com. The website states that the data is current as of 2023 but no exact date was given. This dataset too had no errors or blank cells so little to no cleaning was done. I converted it into a table and used XLOOKUP to quickly transfer the data to the Washington EV table based on each row's city.

Data Exploration

The dataset from Data.gov provides many fields related to each vehicle, but the focus was on the city, type of vehicle, and the automakers. Some fields seem to not be useful for analysis including VIN number (1-10) and a column titled "2020 Census Tract." Other columns like model of the car and the county would be useful in other analysis routes but this will be discussed in the "Future Direction for Further Analysis" section at the end. Additionally, the dataset contains some extraneous data on EV ownership outside of Washington, so this was quickly filtered out.

General Information

Washington state currently has about 136,000 electric vehicles which contain EV exclusive brands like Tesla, Rivian, and Polestar as well as big-name automakers such as Hyundai, BMW, and Ford. Although some large brands have made their mark on the automotive market share for the past decades now, how do they hold up against currently in Washington in the EV market? As seen in figure 1, Tesla tops the list at 62,000 EV vehicles. The "other" category includes automakers such as Hyundai, Volkswagen, Audi, and Honda whose market shares are much lower individually than their competitors. It is notable the second highest, Nissan, is 50,000 vehicles less than Tesla. Additionally, the newer EV exclusive automakers like Rivian, Polestar, and Lucid only have 2,700 vehicles in Washington.

Make	# of Vehicles
TESLA	62,247
OTHER	23,851
NISSAN	12,925
CHEVROLET	11,262
FORD	6,911
BMW	5,952
KIA	5,546
TOYOTA	4,825
RIVIAN/POLESTAR/LUCID	2,774

Figure 1: Maker Table

Additionally, the distribution of market share in the EV market in Washington can be seen in the next two figures (figure 2 and figure 3) displaying the same categories but as a bar and pie chart.
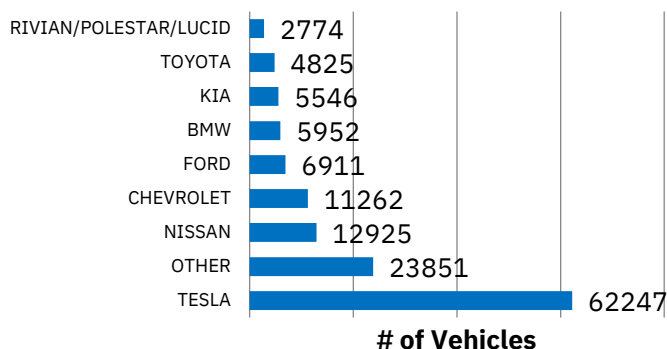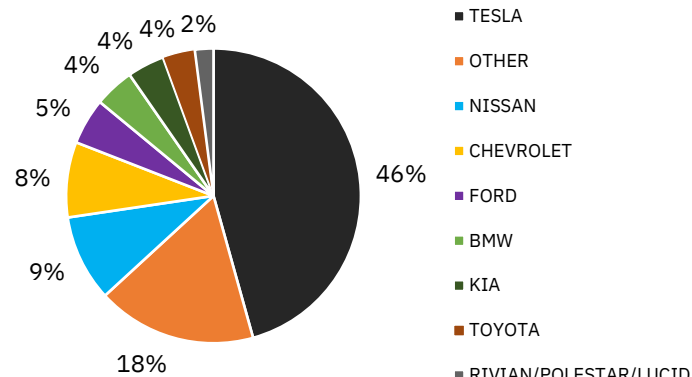

Figure 2: Maker Bar

Figure 3: Maker Pie

Both show the large market share Tesla currently has in Washington while other automakers are still pushing and marketing their own EV vehicles. It also displays the small share the combination of Rivian, Polestar, and Lucid have on the market. Although they are still new, can their vehicles break through into the market and match other automakers' success?

Furthermore, not all EV vehicles compositions are the same. They are split into two categories: Battery Electric vehicles or BEV (solely electric powered) and Plug-in Hybrid Electric Vehicle or PHEV (gas and electric vehicles). The data shows about 104,000 of the EVs are BEVs and 31,000 are PHEVs or "hybrids." This means that full-electric vehicles make up 77 percent of the market and 23 percent are hybrids (figure 4).
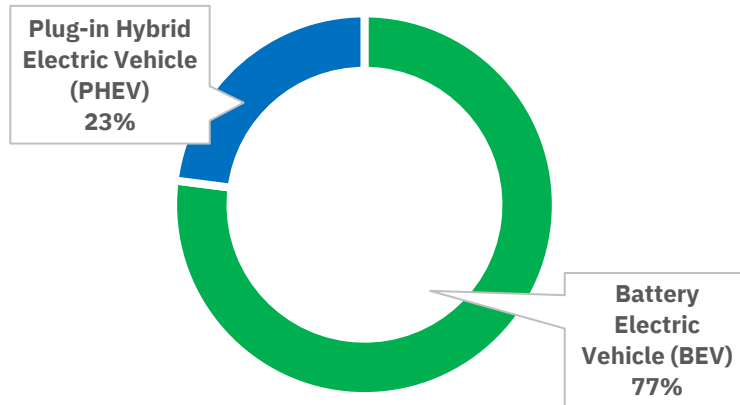
Figure 4: PHEV vs BEV

Population vs # of EV Vehicles

The capital city of Seattle currently holds about 72,000 people, while the next largest city, Spokane contains almost 23,000 people. Does the more people in a city constitute a higher amount of EV cars? According to a scatter chart (figure 5), there seems to be a positive relationship between population and # of EV vehicles, but this could be skewed due to Seattle being an outlier to the other cities. The trendline reveals that for every additional EV in a Washington city, there are 28 more people living in the city.
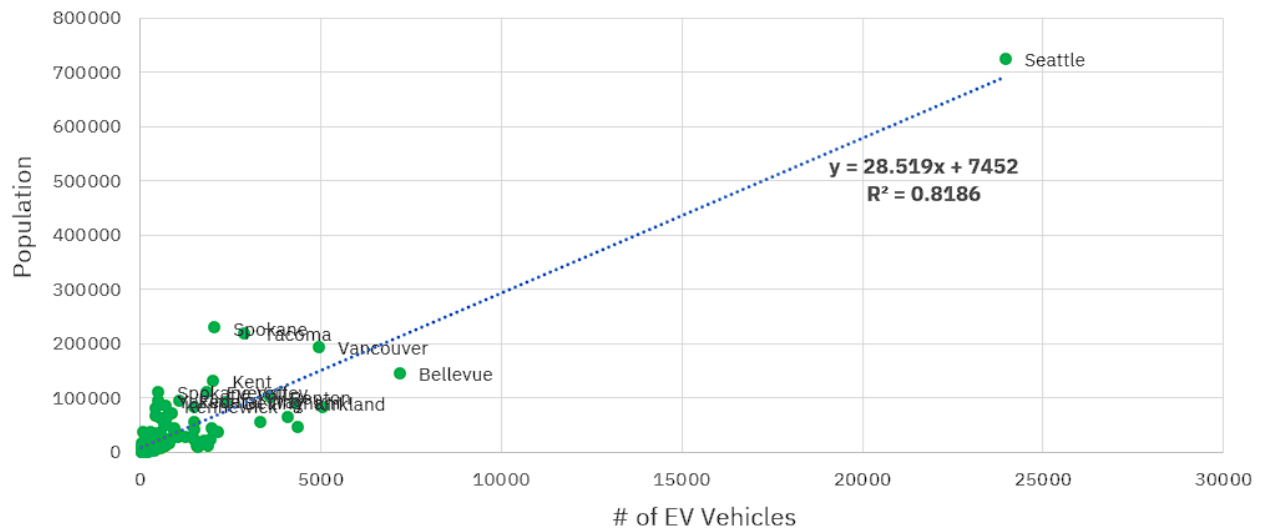

Figure 5: # of EV Vehicles vs Population (with Seattle)

A look at this same chart but without Seattle shows a direct relationship as well, but the slope is less steep, and more outliers show up (figure 6). Spokane and Tacoma are highly populated cities with populations greater than 200,000 but only have less than 3,000 EV vehicles. On the other hand, Bothell only has a population of around 50,000 and contains 4,000 EVs. The trendline creates a slope revealing, on average, there are 24 people for every EV vehicle in each city.
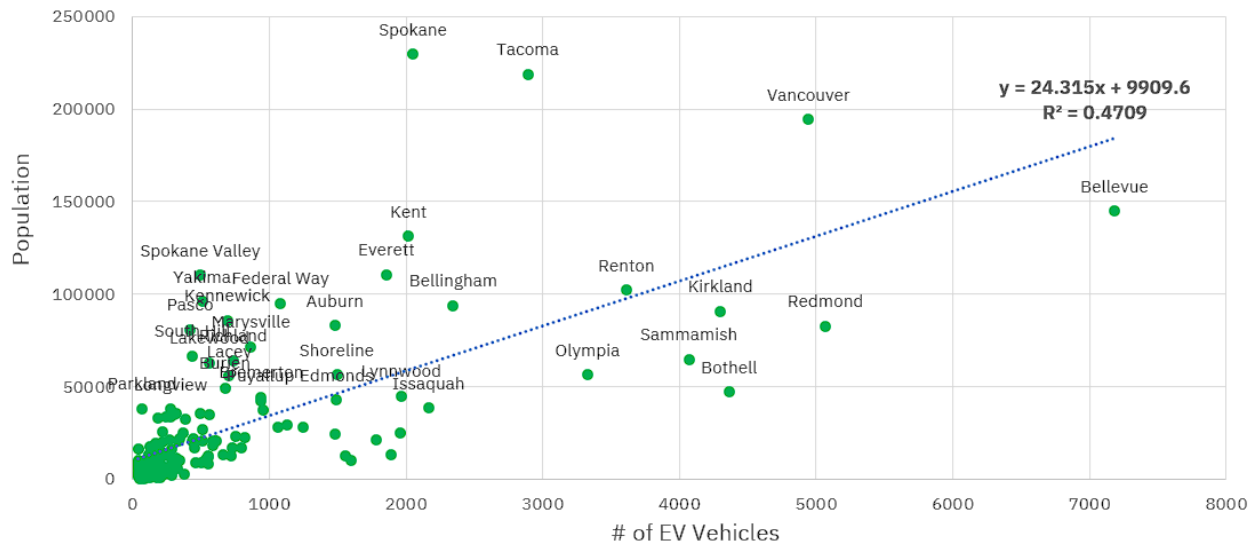

Figure 6: # of EV Vehicles vs Population (without Seattle)

Population vs # of Tesla Vehicles

As seen before, Tesla takes around 45 percent of the EV market in Washington. Does this EV maker powerhouse perform better in different states? Displayed in figure 7 is a scatter chart comparing the amount of Tesla vehicles to the population in each city. A positive relationship is shown meaning the more Tesla owners there are in a city the higher its population. Seattle, again, is an outlier not only because of its larger population, but also the number of Tesla owners within the city. Additionally, the trendline shows for every 59 people in each city there is one Tesla vehicle, a 21-slope increase compared to the EV trendline with Seattle.
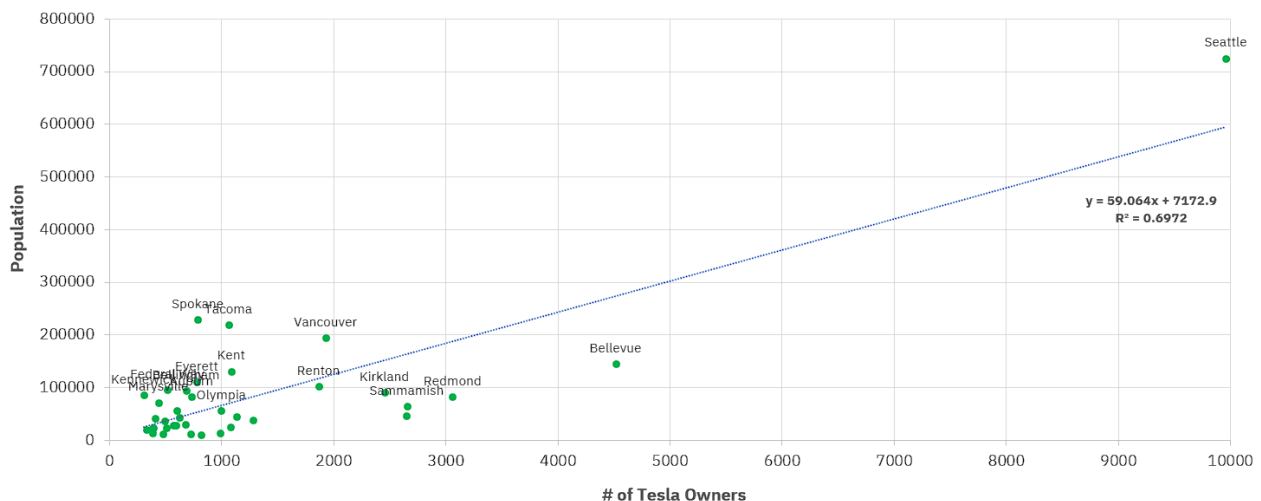

Figure 7: # of Tesla Owners vs Population (with Seattle)

A look at the same scatter plot without Seattle reveals a couple interesting pieces (figure 8). Notably, Spokane, Tacoma, and even Vancouver, although having a larger population have a moderate amount of Tesla vehicles, below 2,000 vehicles. Besides the fact that Spokane, Tacoma, and Vancouver have become clearer outliers in the relationship, the middle cluster in this scatter plot around Renton, Kirkland and Redmond is missing one city when comparing it to figure 6. Olympia (circled red) falls into the large batch cluster due to its lack of Tesla ownership compared to its general EV numbers.
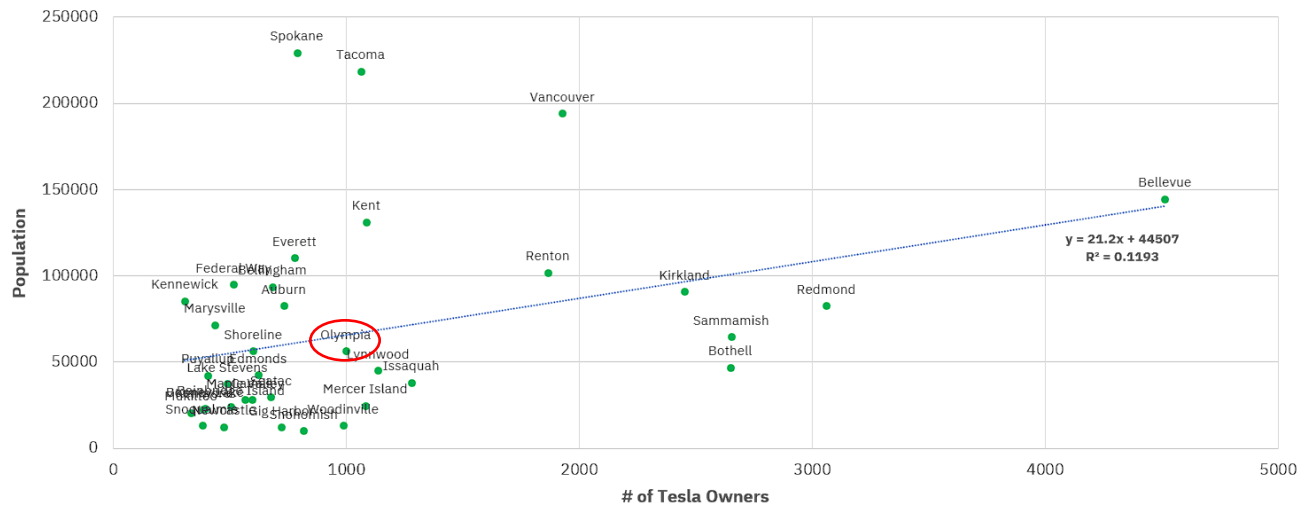

Figure 8: # of Tesla Owners vs Population (without Seattle)

City Ratios

A metric for measuring the magnitude of electric vehicles on a population is using ratios comparing population to the number of vehicles. First, the table to the right shows each city along with the population-to-number of EVs (figure 9). It shows the top thirty cities sorted from the most inhabited city, Seattle, and descends. The third column titled "Ratio Indicator" is a metric indicator which checks if the ratio is within certain ranges. The metric is "green" if the ratio is greater than the average of 55. From 55 to 37 indicates a "yellow" and below 37 is "red." Here, green is regarded as cities who have more people per EV and red means a city who has closer to a one-to-one ratio between person to EV. As seen in the previous scatter plot on figure 6, Spokane and Tacoma can contribute their green indicator to having higher populations but less EV cars. Spokane Valley, having a ratio of 222 people per EV, has the highest ratio and is eighth in population. Seattle, being the most inhabited city, has a 30 persons per EV ratio. Lastly, Bothell has 11 persons to each EV, the lowest of the top 30 populated states.

City	Population/# of EV	Ratio Indicator
Seattle	30	🔴
Spokane	112	🟢
Tacoma	76	🟢
Vancouver	39	🟡
Bellevue	20	🔴
Kent	65	🟢
Everett	60	🟢
Spokane Valley	222	🟢
Renton	28	🔴
Yakima	189	🟢
Federal Way	88	🟢
Bellingham	40	🟡
Kirkland	21	🔴
Kennewick	124	🟢
Auburn	56	🟢
Redmond	16	🔴
Pasco	192	🟢
Marysville	83	🟢
South Hill	152	🟢
Sammamish	16	🔴
Richland	87	🟢
Lakewood	112	🟢
Olympia	17	🔴
Shoreline	38	🟡
Lacey	79	🟢
Burien	73	🟢
Bothell	11	🔴
Lynnwood	23	🔴
Bremerton	47	🟡
Edmonds	29	🔴

Figure 9: Population-to-# of EV Table

Looking exclusively at Tesla ownership, the ratio indicator changes its ranges since the average population-to-# of Tesla vehicles changes (figure 10). The green indicator here represents ratios greater than 173 persons per Tesla. Yellow changes to a range of 173 to 113 persons and red is ratios below 113. In this table, the highest ratio is Spokane Valley with 656 people for every Tesla vehicle. Spokane and Tacoma still have higher than average ratios when considering their populations. The lowest ratio is Bothell with 18 people for every Tesla. Seattle, having the highest population, has a ratio of 73 people per Tesla owner.

City	Population/# of Tesla	Ratio Indicator
Seattle	73	🔴
Spokane	292	🟢
Tacoma	206	🟢
Vancouver	101	🔴
Bellevue	32	🔴
Kent	121	🟡
Everett	142	🟡
Spokane Valley	656	🟢
Renton	55	🔴
Yakima	444	🟢
Federal Way	184	🟢
Bellingham	137	🟡
Kirkland	37	🔴
Kennewick	280	🟢
Auburn	113	🟡
Redmond	27	🔴
Pasco	403	🟢
Marysville	165	🟡
South Hill	339	🟢
Sammamish	24	🔴
Richland	217	🟢
Lakewood	337	🟢
Olympia	57	🔴
Shoreline	94	🔴
Lacey	195	🟢
Burien	170	🟡
Bothell	18	🔴
Lynnwood	40	🔴
Bremerton	151	🟡
Edmonds	69	🔴

Figure 10: Population-to-# of Tesla Table

Analyzing the Findings

Washington state holds a diverse catalog of automakers, but the EV market is full of competition. There are automakers who are still getting their flow in the market like young EV brands like Rivian, Polestar, and Lucid who, combined, hold just two percent of the market. Big name brands like Nissan, Chevy, and Ford are making their mark with just under 10 percent market share, but the competition has yet to match Tesla who, alone, takes up 46 percent of the market. Without time-based data on the market share of each automaker in Washington, there is no tell on how the trend will look for the future. But it is safe to say Washington prefers to buy Tesla vehicles when it comes to EVs. This also becomes evident in the distribution between Plug-in Hybrid vehicles and Battery Electric vehicles. 77 percent are fully electric, meaning this includes all of Tesla's lineup as well as other automakers who are rolling our fully electric vehicles.

When plotting the number of EVs against the population of each state, Seattle sets itself as an outlier that skews the distribution and trendlines. But, with or without Seattle as a data point, there is evidence of a positive relationship between # of EV vehicles and population due to the positive slope of the regression line. Some cities stray away from the expected like Spokane and Tacoma, who seem to not prefer EVs as much compared to others in its population range like Vancouver. A point to make is the value of the R-Squared of each plot; the scatter plot with Seattle shows a high 0.8 R-Squared value, showing a strong relationship. When Seattle is removed, the R-Squared lowers to 0.47. Although the confidence is lower, the data points, slope, and trendline show a positive relationship between the amount of EVs and city population.

Now looking exclusively at the most owned EV brand, Tesla, Seattle sets itself far from the rest, having almost 10,000 Tesla vehicles. Without Seattle, Spokane, Tacoma, and now Vancouver is in a cluster where they do not have as much Tesla owners given the population. Olympia drops from the middle cluster around Renton, Kirkland, and Redmond down into the big cluster with the less populated cities, changing from a larger amount of EV owners to few Tesla owners. Additionally, R-Squared needs to be considered. With the plot including Seattle, it shows an almost 0.7 relationship which is enough to show a strong relationship. Without Seattle, though, the R-Squared is not 0.11, which

shows a weak relationship between the points. Thus, this graph should only focus on the clusters of points made rather than the relationship between the points.

Lastly, the city ratios of population to vehicles show how many EVs there are for each person and includes an indicator. The first table reveals Seattle's 30 person to each EV ratio. Seattle, being dependent on bustling city routes, rather than longer highway and freeway drives across rural areas, shows the preference to electric vehicles. Additionally, more dense areas in bigger cities like Seattle means a larger availability of charging stations. When looking at Tesla exclusively, the table does not change much. Seattle has a Tesla owner for every 73 people while Spokane Valley has one Tesla for every 656 people in the city.

Future Implications and Research

On the original dataset alone, investigation into different fields like the model of cars. There could be insights on the models that a certain automaker is selling more of or less in certain cities or counties. Tesla could be selling more of a certain model in counties or cities where there are more SUV type vehicles being owned.

Data that can be imported is median household income averages for each state or county in Washington. There could be an analysis on if a higher income county or city has a higher amount of EVs compared to others. Also, if the lower the population-to-number of EVs ratio, does this mean a higher median household income? Additionally, data on how EV vehicle ownership is in other states like California, Florida, Oregon, and New York to compare metrics can help justify how EVs are occupying the automotive industry nationwide.

Washington state currently holds an EV vehicle for each 56 people, showing a large devotion to EVs, hybrid or fully electric. But there is no data on the history of each vehicle being entered into the state, so trends based on time are unable to be found. Data on the registration of different EV vehicles will help build a time-series analysis on how EVs are impacting the state as well as different cities and counties. Additionally, this type of data will help show the dominance of certain automaker brands across years. It will raise more questions like "Is X automaker increasing or decreasing their market share in the Washington EV market?" or "When did X automaker peak in ownership in Washington and why?"

Sources

Washington EV Population Data: https://catalog.data.gov/dataset/electric-vehicle-population-data

Washington City Population Data: https://worldpopulationreview.com/states/cities/washington