

Washington State EV Population Analysis

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 or Research Question(s)

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.

Answering Questions

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.

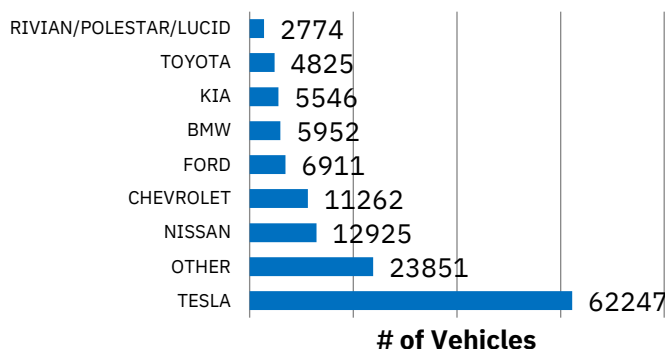


Figure 2: Maker Bar

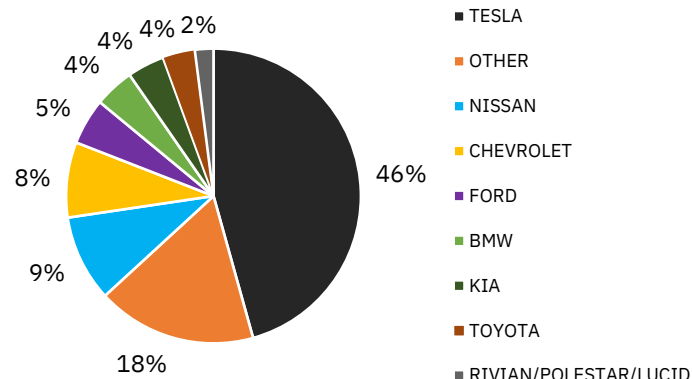


Figure 3: Maker Pie

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).

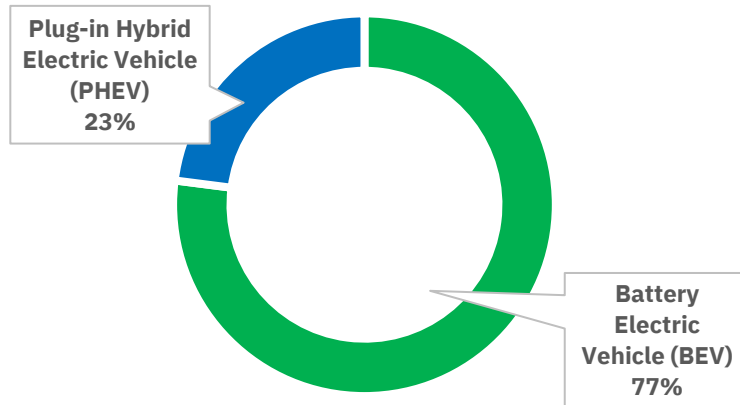


Figure 4: PHEV vs BEV

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.

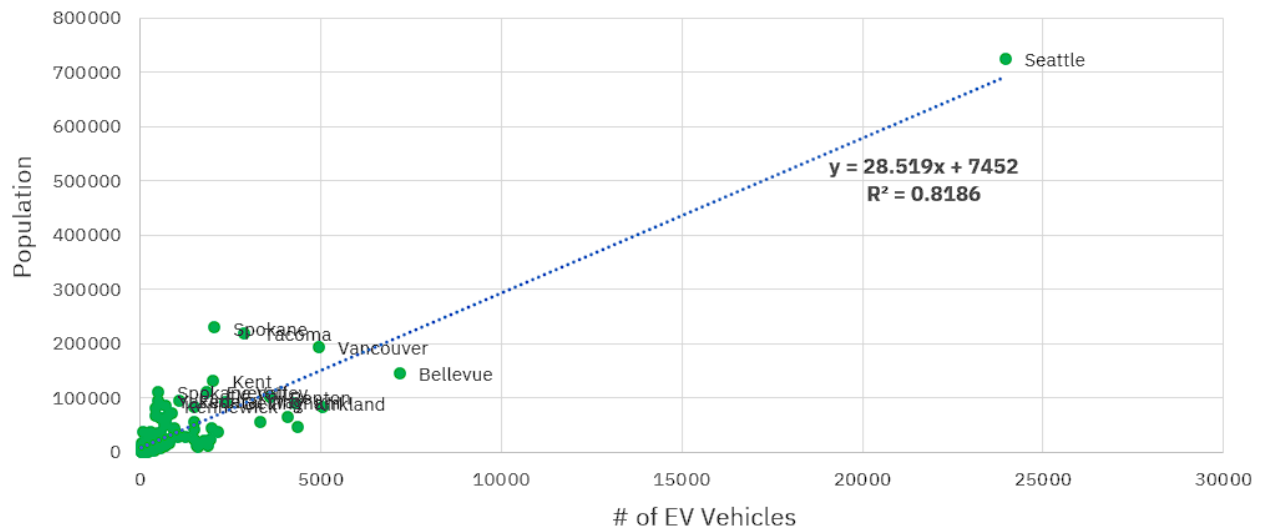


Figure 5: # of EV Vehicles vs Population (with Seattle)

The scatter plot displays the relationship between the number of EV Vehicles (x-axis) and Population (y-axis) for various Washington cities. The x-axis ranges from 0 to 8000, and the y-axis ranges from 0 to 250,000. A blue regression line is shown with the equation $y = 24.315x + 9909.6$ and $R^2 = 0.4709$. The data points are green circles, with larger cities labeled.

City	# of EV Vehicles (approx.)	Population (approx.)
Spokane	2000	230,000
Tacoma	2800	220,000
Vancouver	4800	195,000
Bellevue	7200	145,000
Kent	2000	130,000
Everett	1800	110,000
Bellingham	2200	95,000
Renton	3500	105,000
Kirkland	4200	90,000
Redmond	5000	85,000
Spokane Valley	500	110,000
Yakima	600	105,000
Federal Way	1200	100,000
Kennick	800	95,000
Passo	400	90,000
Marysville	1000	85,000
Squig	300	75,000
Lakeview	500	70,000
Lacey	600	65,000
Burien	700	60,000
Shoreline	1500	55,000
Edmonds	1200	50,000
Lynnwood	1800	45,000
Issaquah	2200	40,000
Olympia	3200	55,000
Sammamish	4000	65,000
Bothell	4200	45,000
Parkview	200	35,000
Langley	300	30,000
Everett	800	25,000
Edmonds	1000	20,000
Shoreline	1200	15,000
Issaquah	1500	10,000
Spokane Valley	500	5,000
Yakima	600	4,000
Federal Way	1200	3,000
Kennick	800	2,000
Passo	400	1,000
Marysville	1000	500
Squig	300	200
Lakeview	500	100
Lacey	600	50
Burien	700	20
Shoreline	1500	10
Edmonds	1200	5
Lynnwood	1800	2
Issaquah	2200	1
Olympia	3200	0
Sammamish	4000	0
Bothell	4200	0
Parkview	200	0
Langley	300	0
Everett	800	0
Edmonds	1000	0
Shoreline	1200	0
Issaquah	1500	0
Spokane Valley	500	0
Yakima	600	0
Federal Way	1200	0
Kennick	800	0
Passo	400	0
Marysville	1000	0
Squig	300	0
Lakeview	500	0
Lacey	600	0
Burien	700	0
Shoreline	1500	0
Edmonds	1200	0
Lynnwood	1800	0
Issaquah	2200	0
Olympia	3200	0
Sammamish	4000	0
Bothell	4200	0
Parkview	200	0
Langley	300	0
Everett	800	0
Edmonds	1000	0
Shoreline	1200	0
Issaquah	1500	0
Spokane Valley	500	0
Yakima	600	0
Federal Way	1200	0
Kennick	800	0
Passo	400	0
Marysville	1000	0
Squig	300	0
Lakeview	500	0
Lacey	600	0
Burien	700	0
Shoreline	1500	0
Edmonds	1200	0
Lynnwood	1800	0
Issaquah	2200	0
Olympia	3200	0
Sammamish	4000	0
Bothell	4200	0
Parkview	200	0
Langley	300	0
Everett	800	0
Edmonds	1000	0
Shoreline	1200	0
Issaquah	1500	0
Spokane Valley	500	0
Yakima	600	0
Federal Way	1200	0
Kennick	800	0
Passo	400	0
Marysville	1000	0
Squig	300	0
Lakeview	500	0
Lacey	600	0
Burien	700	0
Shoreline	1500	0
Edmonds	1200	0
Lynnwood	1800	

Population vs # of Tesla Vehicles

Scatter plot showing the relationship between the number of Tesla owners (X-axis) and population (Y-axis) for various Washington cities. The regression line equation is $y = 59.064x + 7172.9$ with $R^2 = 0.6972$.

City	# of Tesla Owners (approx.)	Population (approx.)
Seattle	9800	730000
Bellevue	4500	140000
Vancouver	1900	190000
Renton	1800	100000
Kirkland	2600	100000
Redmond	3000	80000
Sammamish	2700	40000
Spokane	800	230000
Tacoma	1100	220000
Everett	900	120000
Marysville	500	80000
Olympia	800	80000
Federal Way	600	70000
Kent	1000	60000

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.

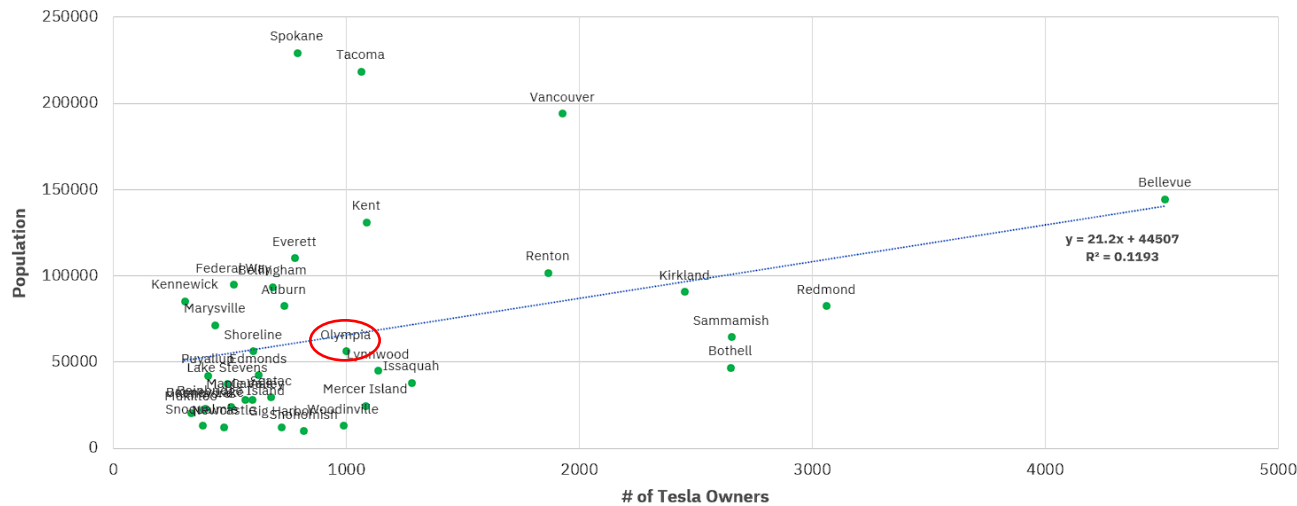


Figure 8: # of Tesla Owners vs Population (without Seattle)

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	Red
Spokane	112	Green
Tacoma	76	Green
Vancouver	39	Yellow
Bellevue	20	Red
Kent	65	Green
Everett	60	Green
Spokane Valley	222	Green
Renton	28	Red
Yakima	189	Green
Federal Way	88	Green
Bellingham	40	Yellow
Kirkland	21	Red
Kennewick	124	Green
Auburn	56	Green
Redmond	16	Red
Pasco	192	Green
Marysville	83	Green
South Hill	152	Green
Sammamish	16	Red
Richland	87	Green
Lakewood	112	Green
Olympia	17	Red
Shoreline	38	Yellow
Lacey	79	Green
Burien	73	Green
Bothell	11	Red
Lynnwood	23	Red
Bremerton	47	Yellow
Edmonds	29	Red

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.

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 out 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

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

Figure 10: Population-to-# of Tesla Table

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>