

Washington State's Electric Vehicle Data Analysis

CIS 4200-02

Report By: Jesus Diaz, Jessie Estrada, Nitya Kondapalli,
Kevin Lew, Javier Machuca

Introduction

The main objective of this project is to analyze Electric Vehicle population data in order to determine the growth of electric vehicle population. This is important because utilizing electric vehicles will not only decrease the greenhouse gases and air pollutants in our environment, but it will be a great investment for many users who would like to save money and not pay for gas. As such, analyzing this data will show whether or not the population is increasing, and at what rate.

Data Set Background

In this project, we used an electric vehicle population dataset to figure out how many electric and hybrid vehicles originated in the state of Washington. The dataset contains information on the Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) currently registered through the Washington State Department of Licensing. We obtained this dataset from data.gov.

The dataset is organized in a tabular format, with each row representing a unique vehicle and each column representing a specific vehicle attribute. The attributes in this dataset include the Vehicle Identification Number (VIN), County, City, State, Postal Code, Model Year, Make, Model, Electric Vehicle Type, Clean Alternative Fuel Vehicle (CAFV) Eligibility, Electric Range, Base Manufacturer's Suggested Retail Price (MSRP), Legislative District, DOL Vehicle ID, Vehicle Location, Electric Utility, and 2020 Census Tract.

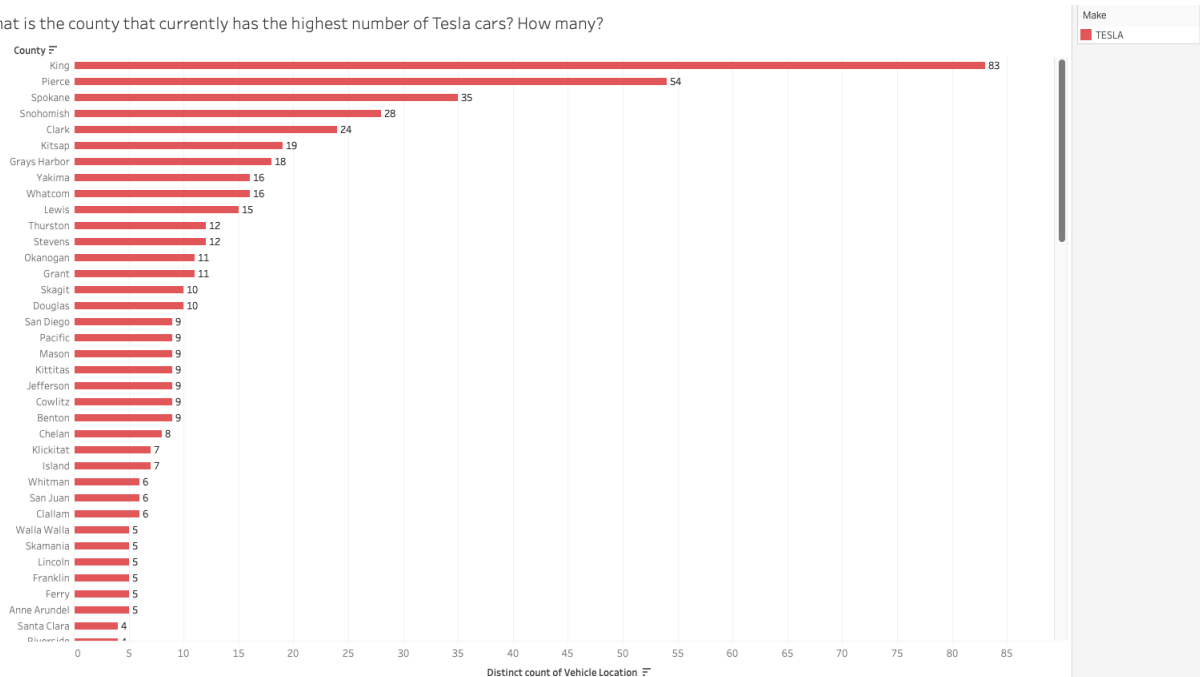
The dataset was obtained from Data.gov, a website maintained by the United States government that provides access to a wide range of datasets related to various topics such as climate, education, energy, finance, health, and many others. The website serves as a central repository of open data that can be freely accessed and used by the public, researchers, businesses, and government agencies for analysis, research, and development purposes.

Overall, with this dataset, we can analyze the characteristics of the vehicles themselves, such as their make, model, year, electric range, and base MSRP. This data can help us understand the trends and patterns in the adoption of EVs and PHEVs, the availability of different types of alternative fuel vehicles, and growth of EVs within the state of Washington.

Analysis & Discussion

What is the county that has the highest amount of Tesla vehicles?

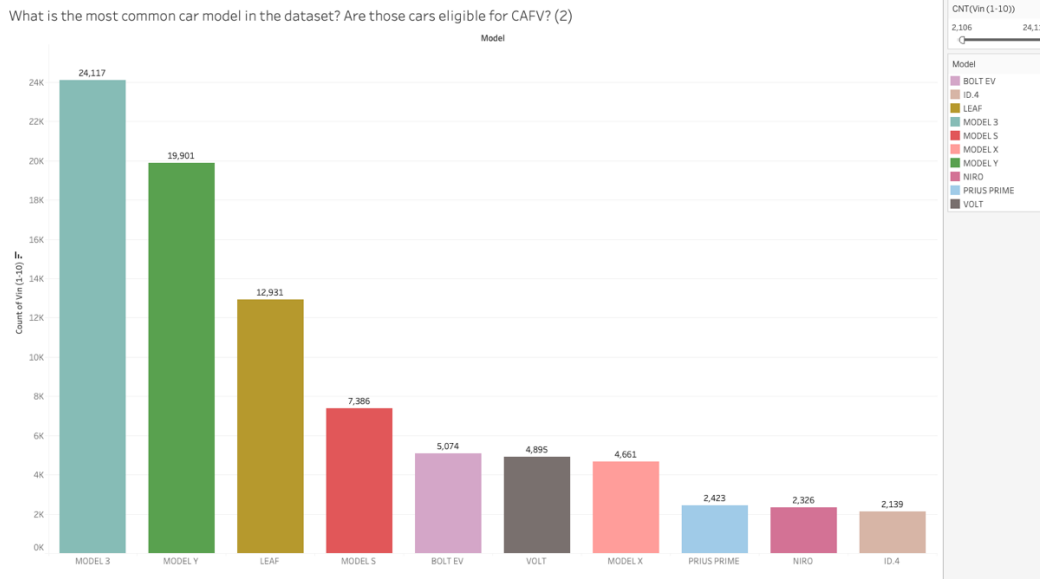
What is the county that currently has the highest number of Tesla cars? How many?



- Dimensions: County = All Counties; Make = Tesla
- Measures: Vehicle Location Count = Count [All different vehicle locations]

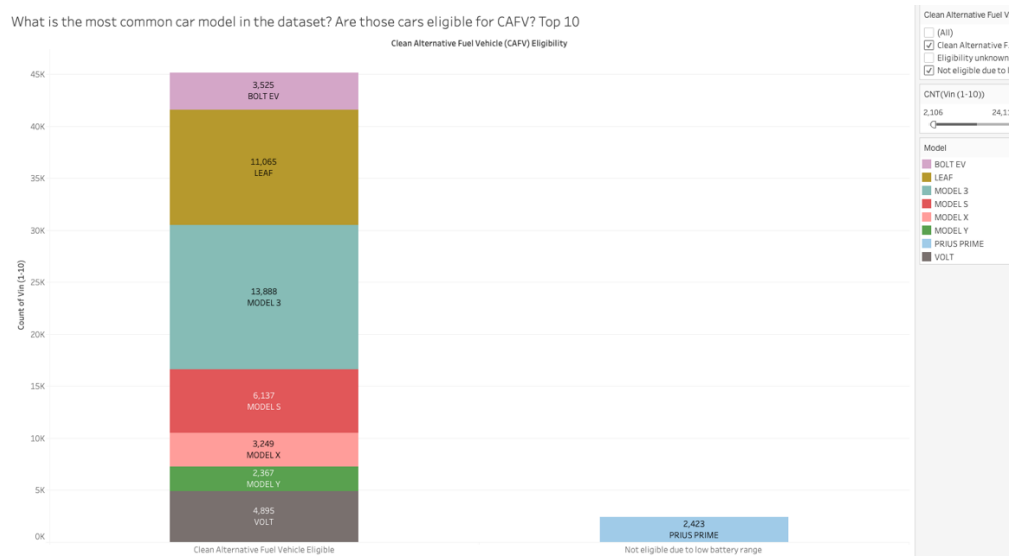
This Bar Chart showcases the current amount of Tesla vehicles in each County of State of Washington. The results show that King County has the current highest number of Tesla vehicles which is 83. As shown in the graph, this is a major difference in comparison to other counties. It is important to note that King County is the most populated county with around 2.0 million people in population. This can help support the idea that there are more electric vehicle chargers in this county and as such, an increase in Tesla vehicles.

What is the most common car model in the dataset? Are those cars eligible for CAFV?



- Dimensions: Car Model type; All Cars; Name = Most Common Car Model
- Measures: VIN Number Count = Top 10;

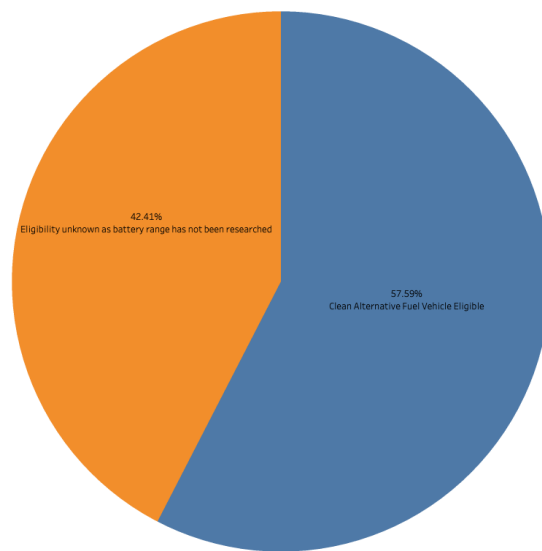
In this bar chart we see the top 10 car models in our dataset. The most common car model in this dataset would be Model 3 because it is the highest in the dataset at 24,117. The least popular one would be the ID.4 model that only has 2,139. As such we can conclude that the Model 3 from Tesla is the most popular electric vehicle in Washington State.



- Dimensions: Model type=All Models; Name=Clean Alternative Fuel Vehicle (CAFV)
- Measures: VIN Number Count = Top 10 & CAFV Eligibility is Known;

In this bar chart we also see the top 10 car models in our dataset. But, this time, we have filtered to only show these top 10 vehicles that have a known eligibility status for CAFV. CAFV vehicles are those that use an alternative fuel source that is not fossil fuels. It would also need to be approved for some categories such as have low or zero emission release, as well as sustainable manufacturing. As such, the vehicles on the left totaling 45,126 are all CAFV eligible. On the contrary the Prius Prime is the only vehicle not CAFV eligible due to its low battery range.

What is the most common car model in the dataset? Are those cars eligible for CAFV? TESLA

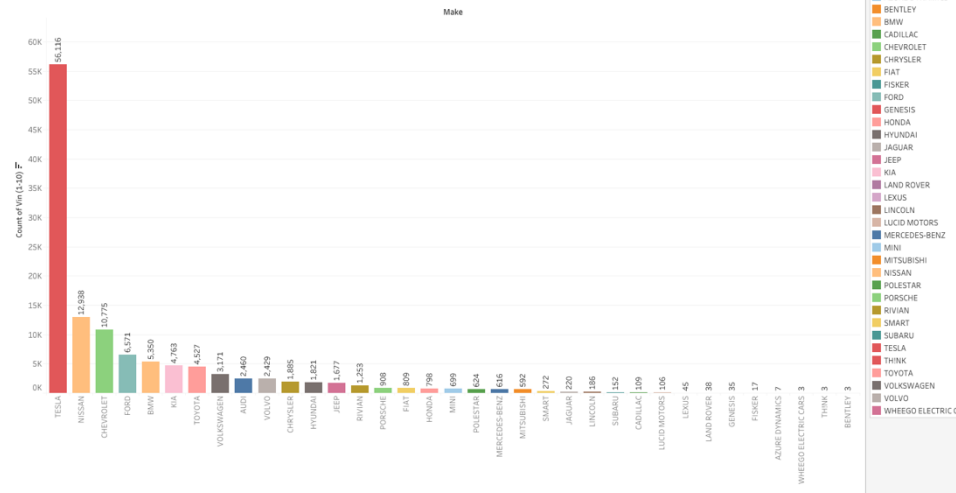


- Dimensions: Modes = Model 3
- Measures: VIN Number Count = Model 3s by Tesla

This Pie chart represents the Model 3 vehicles that are/aren't eligible for CAFV. As seen, it is surprising to see that not all Model 3 vehicles are eligible for CAFV. This is due to some not having their battery range researched. Although most of the Model 3 vehicles in our data set are eligible (more than 50%), we can make a very informed prediction that the other 42.41% of Model 3 vehicles are going to be eligible once the battery range is researched. This is due to model 3 vehicles having a very great battery range in comparison to other models from other manufacturers.

What are the most common manufacturers and their car models?

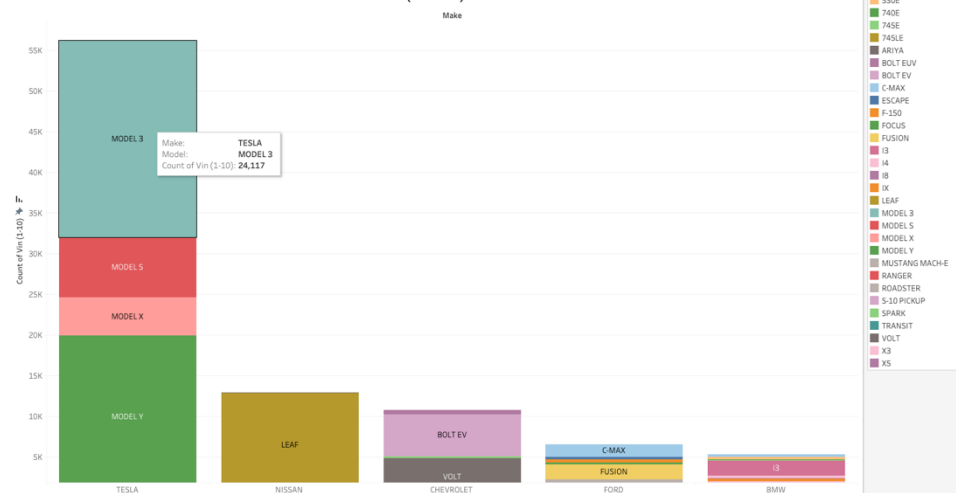
Most common manufacturer and their car models (Part 1)



- Dimensions: Makes = All Makes;
- Measures: VIN Number Count = All Vehicles

This bar chart shows every single different Vehicle Make and the total count of vehicles they have in our data set. As seen, Tesla is the most common vehicle Make because there is a noticeable difference in their total vehicles. We had a total of 56,116 Tesla vehicles in our data set with Nissan coming in second at 12,938. The Tesla Bar is significantly higher than the rest, thus supporting the idea that Tesla is the most common and popular vehicle Make in Washington State.

Most common manufacturer and their car models (Part 2)



- Dimensions: Makes = Top Five Makes;
- Measures: VIN Number Count = All Vehicles

This bar chart shows expands on the previous Bar chart, but this time, we are able to see the top five Makes, as well as the breakdown of the car models from each Make. We can still notice that Tesla is the most popular and that their popularity includes Model 3, Model S, Model X, and Model Y. Furthermore, we can confirm that the Model 3 is the most popular model from Tesla.

What are the cars purchased the most by year?

According to the pivot table we can see that Tesla sold more cars than other competitors in 2022. The tableau visualization shows us the different quantities of cars sold for each manufacturer compared to previous years.

Year of most purchased cars by manufacturer	
Row Labels	Count of Make
2022	27742
TESLA	14325
KIA	2127
FORD	1714
RIVIAN	1218
NISSAN	946
CHEVROLET	932
BMW	917
VOLVO	860
JEEP	671
VOLKSWAGEN	660
HYUNDAI	634
AUDI	612
TOYOTA	510
POLESTAR	374
CHRYSLER	329
PORSCHE	214
MINI	209
MERCEDES-BENZ	141
LINCOLN	107
LUCID MOTORS	95
MITSUBISHI	87
LEXUS	40

- Dimensions: Make & Model Year
- Measure: SUM (Model Year)

As you can see above, the pivot table shows all car brands and the count of Make. Here we can clearly see that in the year 2022, Tesla was the manufacturer with most purchases made for their vehicles.

What is the difference between BEV and PHEV?

Counts of BEV compared to PHEV		
Row Labels	Count of Make	
Battery Electric Vehicle (BEV)	94117	
TESLA	56115	
NISSAN	12938	
CHEVROLET	5880	
KIA	3479	
VOLKSWAGEN	3171	
FORD	2917	
HYUNDAI	1507	
AUDI	1254	
RIVIAN	1253	
BMW	1172	
FIAT	809	
VOLVO	802	
POLESTAR	624	
MINI	511	
PORSCHE	463	
MERCEDES-BENZ	348	
SMART	272	
JAGUAR	220	
LUCID MOTORS	106	
SUBARU	90	
TOYOTA	72	
MITSUBISHI	66	
Plug-in Hybrid Electric Vehicle (PHEV)	27860	
GENESIS	35	
AZURE DYNAMICS	7	
CADILLAC	3	
THINK	3	
CHEVROLET	4895	
TOYOTA	4455	
BMW	4178	
FORD	3654	
CHRYSLER	1885	
JEEP	1677	
VOLVO	1627	
KIA	1284	
AUDI	1206	
HONDA	798	
MITSUBISHI	526	
PORSCHE	445	
HYUNDAI	314	
MERCEDES-BENZ	268	
MINI	188	
LINCOLN	186	
CADILLAC	106	
SUBARU	62	
LEXUS	45	
LAND ROVER	38	
FISKER	17	
WHEEGO ELECTRIC CARS	3	
BENTLEY	3	
Grand Total	121977	

Dimension: Make

Measure: Count (Electric Vehicle Type)

The visualization shows the difference between BEV (Battery Electric Vehicle) and PHEV (Plug-in Hybrid Electric Vehicle). We can see Tesla's vehicles are completely electric. We can also see that compared to other Companies in Washington state, Tesla has the highest number of vehicles. From this visualization, we can argue that most people drive a BEV vehicle while a small group of people drives Hybrid vehicles.

Electric vehicles have gained significant popularity in recent years due to their environmental benefits and potential cost savings. As you explore the world of electric vehicles, it's essential to consider various factors to make an informed decision that aligns with your needs and preferences. One crucial aspect to assess is the electric range of different vehicle models. The electric range refers to the distance a vehicle can travel on a single charge. By understanding and analyzing the average electric range of different models, you can gain valuable insights into their performance and capabilities.

Which make and model has the highest electric range?

Which make and model has the highest electric range

Row Labels	Max of Electric Range
TESLA	337
MODEL S	337
MODEL 3	322
MODEL X	293
MODEL Y	291
ROADSTER	245
JAGUAR	234
I-PACE	234
POLESTAR	233
PS2	233
CHEVROLET	259
BOLT EV	259
SPARK	82
VOLT	53
S-10 PICKUP	39
HYUNDAI	258
KONA	258
IONIQ	170
TUCSON	33
SANTA FE	31
SONATA	28

From the given pivot table, we can gather the following information:

The pivot table shows the make and model combinations that have the highest electric range for each category.

As shown here:

- Tesla has the highest electric range among all other models and manufacturers thanks to their model S, with a range of 337.
- Notable manufacturers and models are Jaguar's I-Pace which had the 2nd highest electric range among all other models, with a range of 234 and Polestar's PS2 which has the 3rd highest, with a range of 233. They are noteworthy because in contrast to their multiple competitors, they were able to reach the top of the list with only one model of car.

The pivot table also provides the average electric range for each make and model alongside the maximum range. Briefly, we are able to observe the average ranges for each make and their respective models but more on that next.

- The average electric range for Tesla models listed is approximately 240.23.
- The average electric range for the Chevrolet models listed is approximately 126.95.
- The average electric range for the Hyundai models listed is approximately 117.60.

This pivot table provides an overview of the highest electric range and average electric range for each make and model combination. These values allow us to compare the electric range across different makes and models. With this, we are able to identify which make, and model combinations have the highest electric range within each category and observe the average electric range for each make.

What is the highest average range per model?

Row Labels	Average of Electric Range
MODEL Y	291
TESLA	291
KONA	258
HYUNDAI	258
BOLT EV	243.6953191
CHEVROLET	243.6953191
MODEL X	239.3327178
TESLA	239.3327178
MODEL 3	237.9313796
TESLA	237.9313796
ROADSTER	234.5
TESLA	234.5
I-PACE	234
JAGUAR	234
PS2	233
POLESTAR	233
MODEL S	226.3617403
TESLA	226.3617403
E-TRON SPORTBACK	218
AUDI	218

From the given pivot table, we can gather the following information:

This pivot table displays the models with the highest average electric range. Each model is listed along with its corresponding average range. Here are some observations:

- Tesla's Model Y has the highest average electric range among all models listed, with an average of 291. It's worth noting that the Model Y also had a maximum range of 291, shown in the previous pivot table.
- Hyundai's Kona has the 2nd highest average electric range, with an average of 258.
- Chevrolet's Bolt EV has the 3rd average electric range, with an average range of 243.7.
 - (And so on and so forth)

The pivot table allows for a comparison of the average electric ranges across different models, and we are able to see which models tend to have higher averages. It highlights the models that have the highest averages and this information can be valuable for comparing and selecting models based on their average ranges to help determine reliability and performance.

By using this information effectively, you can make informed decisions when it comes to selecting an electric vehicle that aligns with your range requirements, budget, sustainability goals, and overall lifestyle.

Vehicle Comparison: The information you have, such as average electric ranges and summary statistics, can be used to compare different electric vehicle models. By analyzing and comparing these metrics, you can identify models that align with your specific needs and preferences. For example, if range is a top priority for you, you can focus on models with higher average electric ranges.

Range Planning: Understanding the average electric range of different models allows you to plan your trips and manage your charging needs more effectively. If you have a good estimate of the average electric range, you can plan your journeys accordingly, ensuring that you have sufficient range to reach your destinations and access charging stations when needed.

Cost Considerations: The electric range of a vehicle can impact its overall cost of ownership. A vehicle with a higher electric range may require fewer charging sessions, potentially reducing your electricity costs. Additionally, it may enable you to take advantage of longer stretches of emission-free driving, which can be more cost-effective in the long run.

Sustainability and Environmental Impact: Electric vehicles offer the benefit of reducing greenhouse gas emissions compared to traditional internal combustion engine vehicles. By considering the average electric range, you can assess how well a particular model aligns with your sustainability goals. A higher electric range may allow for more electric-only driving, reducing your carbon footprint.

Practicality and Lifestyle Fit: The average electric range can also help you determine if an electric vehicle suits your lifestyle and driving patterns. If your daily driving needs fall within the average electric range of a specific model, it may be a practical choice for your everyday transportation needs. On the other hand, if your driving patterns frequently exceed the average electric range, you may need to consider alternative charging options or models with longer ranges.

Summary Statistics

<i>Range of top 10 models</i>	
Mean	241.5821157
Standard Error	6.414914105
Median	236.2156898
Mode	#N/A
Standard Deviation	20.28573957
Sample Variance	411.5112298
Kurtosis	3.923516079
Skewness	1.780174455
Range	73
Minimum	218
Maximum	291
Sum	2415.821157
Count	10

From the given summary statistics table, we can gather the following information:

- **Mean:** The average electric range of the top 10 models is approximately 241.58.
- **Median:** The median electric range of the top 10 models is approximately 236.22. This value represents the midpoint of the range values when arranged in ascending order.
- **Standard Deviation:** The standard deviation measures the dispersion or spread of the electric range values around the mean. It is approximately 20.29 in this case, suggesting that the electric range values vary by about 20.29 miles on average.
- **Sample Variance:** The sample variance quantifies the variability of the data. In this case, it is approximately 411.51, indicating a relatively high variance among the electric range values.
- **Skewness:** Skewness indicates the asymmetry of the distribution. A positive skewness value of 1.78 suggests that the distribution is right-skewed, meaning that the tail on the right side is longer or more spread out than the left side.
- **Range:** The range represents the difference between the maximum and minimum values in the dataset. In this case, the range is 73, indicating that the highest electric range value differs from the lowest value by 73 units.
- **Minimum and Maximum:** The minimum electric range among the top 10 models is 218, representing the lowest value in the dataset. The maximum electric range among the top 10 models is 291, representing the highest value in the dataset.

Summary of Key Findings

In our research we were able to find the key statistics such as average, median, the frequency, standard deviation, IQR, and variance for the range of all cars. The pivot tables listed out the five manufacture brands of cars who have the most electric cars for each model. We were able to find that the highest range per manufacture would be Tesla with their Model S vehicle at 337 miles per charge. However, in terms of average range Model Y has the highest at 291. After further analysis, it was determined that King County, Washington had the highest population of electric vehicles. In 2022, the total number of electric vehicles (27,742) purchased was the highest compared to 2021 (18,494).

We were able to find that the car with the most efficient range would be Tesla's Model Y, which has the highest average electric range among all models listed, with an average of 291. It's worth noting that the Model Y also had a maximum range of 291 shown in the previous pivot table.

We were able to determine that Tesla's Model 3, Model Y, and Nissan's Leaf were the three most common cars that were provided from the dataset. The Tesla cars are eligible for CAFV. The most common car model in this dataset would be Model 3 because it is the highest in the dataset at 24,117. The least popular one would be the ID.4 model that only has 2,139. As seen, it is surprising to see that not all Model 3 vehicles are eligible for CAFV. This is due to some not having their battery range researched.

To find our results, we had the dimensions County and the measure count for the vehicle. We also used a filter for Tesla. In our Tableau findings, we were able to determine the country to have the most Tesla cars would be in the United States. We were able to narrow our findings to the state of Washington and the city and King County had the greatest number of Tesla with 83. It led to our conclusion that there is a correlation on the number of purchased electric cars would influence the number of charging stations in the county as well. From this analysis, we can conclude that since King County is the most populated County in Washington, this is where the highest number of Tesla are at. This demonstrates that areas that are more populated most likely lead to more electric vehicle purchases. This County is very populated, which also supports the idea that there are more chargers here. Countys that are away from the city and are not as populated could have less chargers, therefore less people are likely to purchase them.

In 2022 we found that the three manufacturers that most purchased vehicles were from Tesla. It had the largest leading difference at 14,325. Next, we had Kia with 2,127 and Ford with 1,714. Tesla is the most popular car in terms of sales in the year 2022.

Another one of our Tableau graphs illustrates the count of BEV (Battery Electric Vehicle) compared to PHEV (Plug-in Hybrid Electric vehicle. The top 3 brands Tesla, Nissan, and Chevrolet are the 3 brands that make the most EVs. Both Tesla and Nissan make BEVs. Chevy has 4895 that are PHEV and 5880 that are BEVs. Tesla had the most BEVS while Chevrolet had

the most PHEV. From the visualization we can see that BEVs are more popular than PHEV as of 2023. The quantity of total BEV is 94,117 compared to 27,860. Based on the numbers, we can conclude that battery electric vehicles would be the direction manufacturers would trend to when making vehicles.

Limitations: One limitation in the data would be the missing values of our data set as it prevented us from finding the actual range of every vehicle. However, after taking time to fill in the missing values, we were able to resolve this issue.

Conclusion: From the data, we can determine that electric vehicles are trending towards being more popular. The most popular electric vehicle would be the Tesla as it has the highest population of vehicles in the state of Washington. Their different models of vehicles show that they are the leading manufacturer in terms of electric range efficiency. Whether it is in terms of sales, BEV manufactured or electric range it has the best overall numbers. Comparing the different electric vehicles, the data will help determine how efficient the car is overall and if it meets the needs that the buyers are looking for. By producing more electric vehicles it reduces the long-term cost by minimizing the number of charges. In addition, the increase of electric vehicles benefits the environment by limiting the amount of CO₂ produced from fossil fuels.