Registered EV's in the State of Washington Using SAC

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Abstract: The purpose of our paper is to analyze the dataset from Better Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) that are currently registered through Washington State Department of Licensing (DOL). The data features historical data on multiple vehicles including data elements featuring models, range, location and clean alternative fuel incentive eligibility. The paper consists of a mapped and calculated statistical analysis of the data for vehicle model years from 2008 to 2022 as of February 17, 2023. Using the cloud visualization tool SAP Analytics Cloud (SAC) to import and clean the data, we will complete comprehensive investigations and employ class lecture information as needed. Then, we will present insights using analysis and visualization. Our research intends to reveal what electric vehicle (EV) models are more present in the state of Washington and which county has the most registered EVs. The research is relevant to the popularity trends for EV purchases made in the state of Washington which has become increasingly popular.

1. Introduction

This research employs SAP Analytics Cloud to analyze and present the historical data of Registered EV's in the state of Washington between 2008 and 2022. The main origin of this dataset is DATA.gov, [1] and it contains information on Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) that are currently registered with the Washington State Department of Licensing (DOL). The dataset does not include any timeseries features but rather specifics concerning EV ownership and make and model of the vehicles found in specific counties of Washington. Given the growing popularity of Electric Vehicles in the United States, our focus is on analyzing the data pertaining to electric vehicles in the State of Washington. We have chosen this dataset because as residents of the State of California, we can relate to the State of Washington's goal to transition into 100% new zero emission sales by 2035 for the environmental benefits and costs associated for ourselves and the future. Our data will uncover the driving sales in Washington and the cities where most EV purchases have been made to give us a good idea of the increase in EV ownership.

2. Related Work

In response to Washington state's goal of achieving 100% zero emission standards by 2030, there has been a need to identify areas with the highest concentration of electric vehicles to expand the EV charging infrastructure [2]. Therefore, the Washington Department of Licensing relies on the Electric Vehicle Population Dataset to track the most populated areas with electric vehicles. The information is in the State of Washington's data website.[3] Similarly, in this study, they manipulated the dataset to create a map that can be filtered by postal code. In contrast to our study, they had the ability to filter the data by legislative districts.
The second study from an online publication called Electrification Assessment of Public Vehicles in Washington, which discusses the significance of analyzing registered EV data in order to help reach the State of Washingtons goal of 100% public vehicles. [4] This study is similar to ours as they created bar charts to determine what counties contained the highest number of registered EVs to determine the number of charging stations. A way in which this study is dissimilar is that they primarily focused on the costs of transitioning all the state's public vehicles from combustion engines to 100% electric vehicles.
Another study completed by Puget Sound Clean Air Agency "the agency" demonstrated the drive that residents in the state of Washington have for purchasing an EV is largely based on their financial circumstances and the need to want to drive an eco-friendlier vehicle.[5] Unlike our study, we measured where the most populous EV ownership was in Washington rather than the reasons for the trends. Another highlight of the same study conducted by the agency illustrates how they contrasted data from other states such as California to show the growing car-sharing initiatives that are being broadcasted throughout the US. Our study, on the other hand, differs because we did not bring in data from other states. Although the study, Facilitating Low Income Utilization of Electric Vehicles, encompassed several data that we ran across on the web, the study was distinct because the report hoped to build future projects for low-income communities while our study demonstrated facts about EV ownership in the state of Washington.

3. Specifications

The dataset was retrieved from DATA.gov [1], a United States open data website that provides access to a wide range of datasets and resources on various topics including agriculture, education, finance, and public safety. This website also provides the public with additional resources to drive innovation and support research and development. This dataset was created on November 10, 2020. It was pulled by our team on February 28, 2023. The data was last updated on March 18, 2023 directly on the data source website, therefore, any new data past February 28, 2023, was not collected or included in our reports or analysis. As a result, the data is not up to date on the latest figures. However, since our focus is EVs up to 2022 models,

including any 2023 data would be irrelevant to this study, which would've been the new numbers on the recently updated dataset. Thus, the team is comfortable pursuing the information collected in February to create visualizations based on the dataset file referenced below.

Table 1. Data Specifications-

Dataset	Size (Total)
Electric_Vehicle_Population_Data.csv	29 MB

4. Implementation Flow Chart

The original dataset was obtained by downloading it from DATA.gov and was composed of VIN numbers, County, City, State, postal code Model Year, Make, Model, Type of Electric vehicle, Clean Alternative Eligibility, Vehicle Electric Range, and Electric utility provider. The flowchart presented below in figure 1, illustrates our data manipulation process. Additionally, the dataset employed was given in a solitary CSV file. Lastly, the models were then exported and presented in a PowerPoint file.

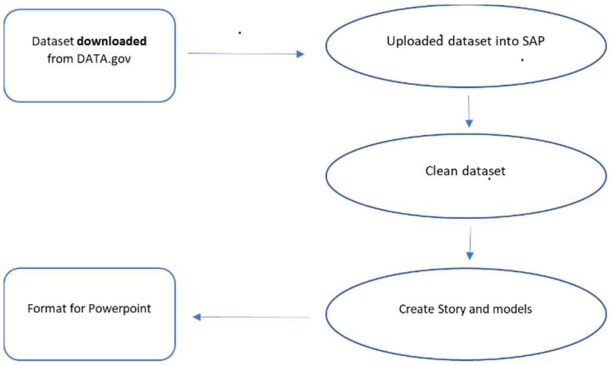

Figure 1. Implementation Flowchart

5. Data Cleaning

The group first separated Longitude and Latitude from the CSV file before uploading it onto SAP Analytics cloud as a datasheet for our story, as they were combined into one cell for each data row. We highlighted the column and selected "Text to Column" in the Data ribbon on excel to separate the data and remove commas and parentheses, which added an additional column to the data set while not hurting the integrity of the data, as the separated data from the original column was shifted to the right only. Once uploaded onto SAP Analytics cloud, we removed unnecessary columns for our story, like "2020 Census Track", "DOL Vehicle ID", "Legislative district", "Vase MSRP", "Electric range", "VIN".

6. Analysis and Visualization

Following data scrubbing to eliminate errors and inconsistencies, we identified the most relevant data for our analysis and proceeded to create several models using SAP Analytics Cloud. This resulted in a clear visual representation of Density of EV's in Washington, Electric Vehicle per postal code, Electric Vehicles by City/County, Electric Vehicles per Make/Model, and Tesla Models in Washington State.

6.1 Heat Map-Density of EV's in WA

A visual representation of the density of electric vehicles in the state of Washington was created using SAP Analytics Cloud Story Tab in the form of a Geo Map, which is shown as the first visualization (Figure 2). At this high-level, we can identify the regions of higher density of electric vehicle owners versus the areas with limited registered electric vehicles.

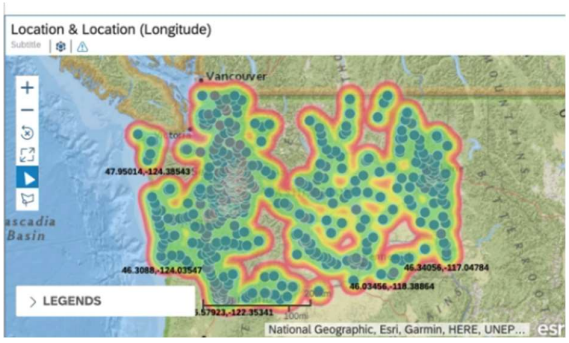

Figure 2. Heat Map-Density of EV's in WA

6.2 Electric Vehicles per Postal Code

The bar chart below (Figure 3) shows the total number of registered vehicles in the State of Washington by postal code. Listed are the top 15 and we can see the postal code 98004 contains the greatest number of electric vehicles with a total number of 17,948. The postal code with the least amount of registered electric vehicles was 98391 with a total of 11,137. Postal Code 98004 resides just outside of Seattle, which is a key focal point in upcoming visuals.

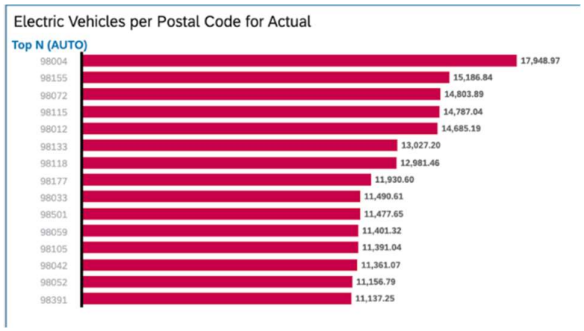

Figure 3. Electric Vehicles per Postal Code

6.3 Electric Vehicles by City/County

The below bar graphs show the Electric Vehicles by city and by county. Figure 4 shows that Seattle has the most amount of EVs than any other city in the state of Washington. In correlation, King County, which is where Seattle resides, has the most amount of EVs by county,

which is shown in Figure 5. This wide margin from the rest of the cities in the state of Washington shows that EVs are popular in urban centers, as Seattle is a metropolitan city.

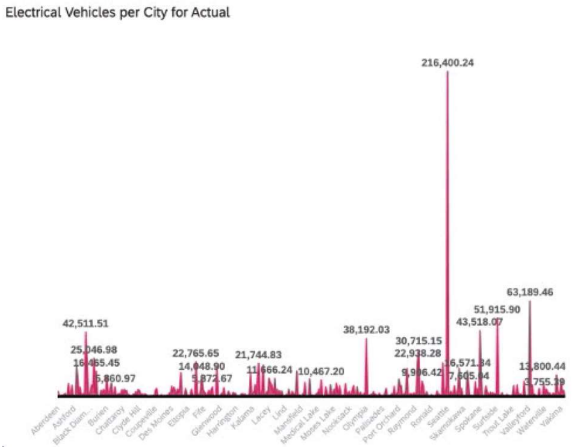

Figure 4. Electric Vehicles per City for Actual

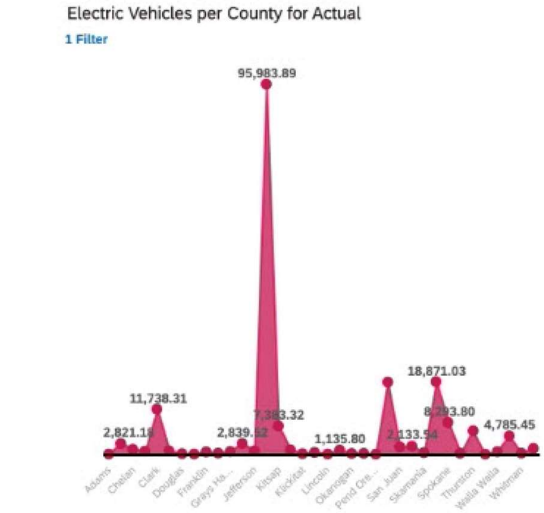

Figure 5. Electric Vehicles per County for Actual

6.4 Electric Vehicles per Make and Model

The figures below show the amount of by Make and Model for EVs, showing a side-by-side comparison from the manufacturer's Battery Electric Vehicle (BEV) highlighted in light blue, and the Plug-in Hybrid Electric Vehicle (PHEV) highlighted in dark blue. These bar charts can clearly show that Tesla, while only making Battery Electric Vehicles, clearly have a significant market share in the state of Washington.

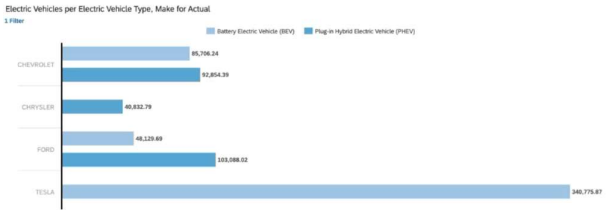

Figure 6A. Electric Vehicles per Electric Vehicle Type

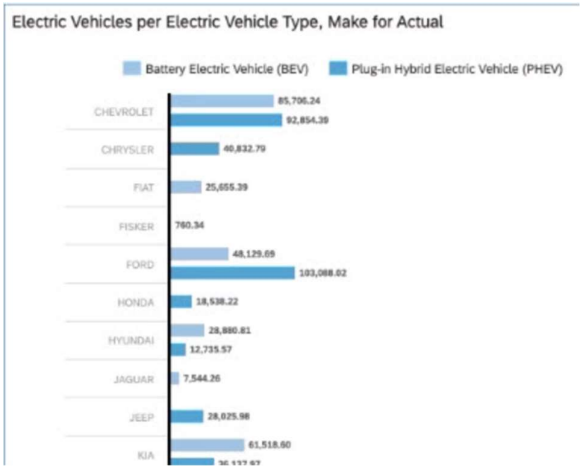

Figure 6B. Electric Vehicles per Electric Vehicle Type

6.5 EV Models Numbers in Washington State

The pie chart below shows the breakdown of EVs in the state of Washington by model year. Based on the data in Figure 8, model year 2022 had the most by plurality. You can visualize that EVs are becoming more popular in the state, going up in increments every year from 2013 to 2022. Note that this is by model year, not by how many were bought in the year. However, EVs purchased from the Maker usually are the current year.

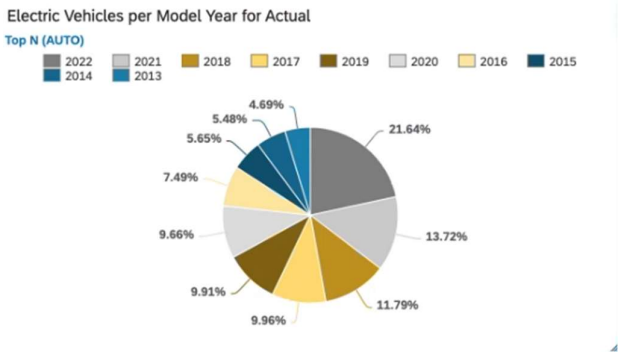

Figure 8. WA State EV Model Years

7. Conclusion

In conclusion, provided by the above analysis and visualization, we can conclude the following key points:

1) EVs have been purchased at a higher rate every year, from 2013 to 2022.
2) Seattle, a metropolitan city, has the most owned Electric Vehicles in the state of Washington.
    a. King County, where Seattle resides, has the most EVs, in direct correlation with the data
    b. Postal Code 98391 is also where Seattle resides, in direct correlation with the data
3) Telsa has the largest share of EVs in the state of Washington, by a wide margin.
4) EV sales in Washington are increasing on a year-to-year basis

8. Notes

Between seeking a dataset and deciding on a topic that we wanted to cover as a group, we gathered and collectively chose the dataset on EVs given the growing demand in the United States. We submitted the abstract and Dr. Jongwook Woo asked to know the size and whether we could deliver a tempo-spatial analysis with the selected data. To our findings, we were unable to conduct a tempo-spatial analysis because the data did not include the time of EV purchases but rather focused on the model types. Per discussion and confirmation with Dr. Jongwook Woo, we could not produce a regression analysis due to the limited scope of our data. These were acceptable conditions for our term analysis and Dr. Jongwook Woo authorized the okay to not include tempo-spatial analysis in our term paper. As such, our group dedicated our skills and interests by utilizing other tools learned through class lecture and readings.

References

[1] (2020, November 20). Electric Vehicle Population Data. DATA.GOV. Retrieved March 21, 2023, from https://catalog.data.gov/dataset/electric-vehicle-population-data

[2] (2022, March 10). Legislature approves historic Move Ahead Washington transportation package. Senatedemocrats.wa.gov. Retrieved March 21, 2023, from https://senatedemocrats.wa.gov/liias/2022/03/10/legislature-approves-historic-move-ahead-washington-transportation-package/.

[3] (2023, March 23). Electric Vehicle Population Data. Data.WA.gov. Retrieved March 23, 2023, from https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2

[4] (2020, November 12). Electrification Assessment of Public Vehicles in Washington. Department of Energy. Retrieved March 23, 2023, from https://afdc.energy.gov/files/u/publication/Electrification_draftfinalreport.pdf?664d99e453

[5] (n.d.). FACILITATING LOW INCOME UTILIZATION OF ELECTRIC VEHICLES. Washington State Department of Transportation. Retrieved March 23, 2023, from https://wsdot.wa.gov/publications/fulltext/LegReports/17-19/FacilitatingLowIncomeUtilizationOfElectricVehicles.pdf

[6] GitHub URL: https://github.com/kperello/bus5100-93