DATA ANALYTICS ASSIGNMENT

ELECTRIC VEHICLE POPULATION TRENDS: COUNTYWISE ANALYTICS REPORT FOR WASHINGTON STATE DEPARTMENT OF LICENSING.

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INTRODUCTION

The Washington State Department of Licensing (WSDOL) is doing a significant investigation into the core of electric mobility trends, in light of the changing landscape of sustainable transportation. This initiative is more than a reactionary measure to evolving circumstances; rather, it embodies a proactive endeavor aimed at comprehending and leveraging the profound impact of electric vehicles (EVs) within our localities.

In light of global environmental concerns, there has been a significant increase in the need for transportation solutions that prioritize ecological considerations. Within this particular context, it is acknowledged by the Washington State Department of Labour (WSDOL) that it holds a significant position in providing guidance throughout this transition. In pursuit of this objective, we have commenced the "Electric Vehicle Population Trends: Countywise Analytics Report," a substantial undertaking designed to thoroughly analyze and document the extent of electric vehicle (EV) adoption and its consequences in the various counties of Washington State.

BACKGROUND

In recent times, there has been a notable transformation in the automotive sector, wherein electric vehicles (EVs) have emerged as the leading contenders in the realm of environmentally friendly transportation. Nevertheless, this transition presents distinct problems and prospects. The presence of fierce competition, the volatility of market demands, and the continuous evolution of consumer behaviors underscore the need for a strategic approach in comprehending and adjusting to these dynamics.

PROJECT OBJECTIVES

The main aim of this thorough research is to provide a detailed analysis of the trends in electric vehicle (EV) adoption across the counties of Washington State. The report aims to accomplish multiple significant objectives by means of comprehensive investigation and strong analytical framework:

a) **Informed Decision Making**: The objective of this initiative is to provide decision-makers with the essential knowledge and understanding required to develop effective strategies and policies that will facilitate the widespread adoption of electric vehicles. Gaining insight into the patterns and trends associated with the registration and utilization of electric vehicles (EVs) is of paramount importance in fostering an ecosystem that supports sustainable transportation(Singh et al., 2023).

b) **Promoting Sustainability**: This initiative aims to support Washington State's sustainability objectives by facilitating the adoption of electric mobility. This paper aims to promote environmentally conscious decision-making and serve as a source of inspiration for ongoing endeavors in carbon emissions reduction.

c) Holistic Visibility: The primary objective of holistic visibility is to offer a comprehensive perspective of the electric vehicle (EV) industry in Washington State to various stakeholders, legislators, and the general public. Our objective is to provide a comprehensive analysis of the adoption of electric vehicle (EV) technology across various regions by presenting data at the county level. This approach allows for a more nuanced understanding of the extent to which different areas are embracing EV technology.

d) Enhancing Infrastructure: The objective is to identify certain regions or sectors that require infrastructure development in order to facilitate the widespread adoption of electric vehicles. By identifying areas of deficiency and potential areas for improvement, we can strive towards the strategic placement of charging stations and support systems(Illgen & Höck, 2019).

e) Public Engagement: The objective of this initiative is to foster a meaningful and inclusive conversation with the general public regarding the advantages of electric vehicles and the significant influence that each county holds in influencing the trajectory of transportation in the next years.

INTRODUCTION TO THE DATASET

The dataset titled "Electric Vehicle Population Size History By County" comprises 18,769 instances and 10 features (*Electric Vehicle Population Size History By County*, 2020). It provides valuable information regarding the adoption of electric vehicles in different counties. The dataset description is presented in Table 1 (*Electric Vehicle Population Size History By County*, 2020). The report provides comprehensive information on various aspects of electric vehicles, including the types of vehicles available, their primary purposes, and the overall adoption rate of electric vehicles in relation to the total number of vehicles in use. The dataset was examined using the Google Colab platform, which is widely recognized for its capabilities in data analysis and machine learning tasks. Within the dataset, it is observed that both the variables 'County' and 'State' exhibit a total of 80 missing values each. Although there are certain limitations in the dataset, it still offers significant insights into the trends and patterns related to the adoption of electric vehicles. Policymakers and researchers have the opportunity to utilize this data in order to gain insights into the patterns of adoption, monitor the progress of sustainable transportation, and develop effective strategies to promote the continued usage of electric vehicles. The meticulous process of data cleaning and utilization of sophisticated analytical techniques are crucial in order to derive accurate and reliable conclusions from this dataset(Alnaqbi et al., 2023). These practices are necessary to obtain precise insights that can be effectively applied in the realm of sustainable transportation planning. Figure 1 illustrates the historical data depicting the population size of electric vehicles by county.

	Date	County	State	Vehicle Primary Use	Battery Electric Vehicles (BEVs)	Plug-In Hybrid Electric Vehicles (PHEVs)	Electric Vehicle (EV) Total	Non-Electric Vehicle Total	Total Vehicles	Percent Electric Vehicles
0	January 31 2017	Saratoga	NY	Passenger	1	1	2	79	81	2.47
1	December 31 2022	Middlesex	MA	Passenger	2	1	3	63	66	4.55
2	June 30 2017	Fulton	GA	Passenger	1	0	1	115	116	0.86
3	November 30 2021	Arlington	VA	Passenger	1	1	2	130	132	1.52
4	November 30 2019	Ferry	WA	Passenger	5	2	7	4415	4422	0.16

Figure 1: Heading of Electric Vehicle Population Size History by County.

Feature	Data Type	Description
DATE	CALENDAR DATE	On this day (the end of this month), counts of registered automobiles are made.
COUNTY	TEXT	The owner of a vehicle is registered to live in this particular area of the state. It is possible for vehicles that are registered in Washington state to be found in other states.
STATE	TEXT	The geographic region being referred to in relation to the record is the specific area within the country.
VEHICLE PRIMARY USE	TEXT	This explains the vehicle's principal intended use.
BATTERY ELECTRIC VEHICLES (BEVS)	NUMBER	The tally of automobiles that are recognized to be propelled exclusively by an energy sourced from an onboard electric battery.
PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVS)	NUMBER	The number of vehicles that are recognized to be powered by a combination of energy derived from an onboard electric battery and an external source that allows for recharging.
ELECTRIC VEHICLE (EV) TOTAL	NUMBER	The total number of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) combined.
NON-ELECTRIC VEHICLE TOTAL	NUMBER	The number of non-electric vehicles.

Total Vehicles	number	Every powered vehicle has a county registration. Electric vehicles are encompassed within this category.
Percent Electric Vehicles	number	Comparison between non-electric and electric automobiles.

Table 1: Description of the dataset

DATASET BACKGROUND

The dataset presented here represents a comprehensive compilation of meticulously collected and analyzed data spanning several years. The dataset in question originates from the Washington State Department of Licensing (DOL) and encompasses the registration records of electric vehicles(*Electric Vehicle Population Size History By County*, 2020). This dataset offers a comprehensive and informative perspective on the current state of green transportation within the region. In an era characterized by growing global awareness of the need to minimize carbon footprints and foster environmentally sustainable alternatives(Schanes, Giljum, & Hertwich, 2016), this dataset assumes a pivotal role in informing policy decisions, conducting market analyses, and evaluating environmental impacts.

DATA QUALITY

Ensuring the reliability and accuracy of the data is crucial in this context. The Washington State Department of Licensing (DOL), an authoritative institution, diligently collects and verifies every record. To ensure the reliability and comprehensiveness of the dataset, rigorous quality checks and validation processes are implemented. These measures are put in place to guarantee that the dataset can be trusted and relied upon for accurate information. The careful focus on maintaining data quality ensures that any analysis performed on this dataset is based on precise and reliable information, thereby promoting confidence in the derived insights.

DATA TRANSFORMATION BEFORE ANALYTICS

Prior to conducting analytics, the raw dataset is subjected to a sequence of transformations. The aforementioned transformations are not simply procedural actions; rather, they play a crucial role in molding the dataset into a structure that is suitable for thorough analysis. The execution of tasks such as date standardization, handling missing values, and converting data types is carried out with great attention to detail. Following the data transformation process, the dataset has been enhanced to include 18,689 instances. This indicates that the dataset has undergone refinement and restructuring, resulting in a more organized and structured dataset suitable for analysis. The primary goal is to establish a standard and cohesive approach, facilitating smooth data analysis.

In addition, columns such as "Percent Electric Vehicles" undergo a conversion from string formats to numeric values, enabling accurate numerical calculations. The process of managing missing values and addressing inconsistencies in the dataset is crucial for ensuring reliable and accurate analytics(Twala, 2009). The execution of these transformation processes with meticulousness

establishes the framework for perceptive and dependable analyses, serving as the bedrock on which strategic decisions can be formulated.

SOLUTION OVERVIEW

This report serves as a comprehensive guide, providing strategic direction to our senior executives as they navigate the complex terrain of electric mobility. It goes beyond mere numerical data, offering valuable insights and recommendations. Our Business Intelligence (BI) reporting solution is designed to enhance user experience and provide valuable insights based on data analysis. By incorporating a user-centric approach and leveraging data-driven methodologies, our solution aims to transform the way leaders interpret information, develop strategies, and bring about significant changes.

UNDERSTANDING DIVERSE STAKEHOLDER NEEDS

The comprehension of diverse stakeholder needs is a crucial aspect in various domains. It is essential to acknowledge and address the varying requirements and perspectives of stakeholders involved in a particular project, organization, or decision-making process(Kiker et al., 2005). In the complex network of stakeholders within an ecosystem, it is crucial to prioritize the comprehension of distinct requirements.

a) LEGISLATORS: Legislators are currently seeking valuable insights to aid in the development of effective policies that will promote sustainable transportation.
b) INFRASTRUCTURE DEVELOPERS: The focus of infrastructure developers lies in the identification of specific regions that are suitable for targeted infrastructure development, with a particular emphasis on the establishment of charging stations.
c) ENVIRONMENTAL ORGANIZATIONS: Examining patterns to bolster sustainable initiatives and promote environmentally conscious modes of transportation.
d) BUSINESS ENTREPRENEURS: Business entrepreneurs must possess a comprehensive understanding of market trends in order to identify potential investment opportunities and develop effective market penetration strategies. By staying abreast of the latest market developments, entrepreneurs can make informed decisions about where to allocate their resources and how to position their products or services within the market.
e) GENERAL PUBLIC: Facilitating the availability of transparent and easily accessible data to foster an informed public discourse regarding the adoption of electric vehicles (EVs).

KEY ELEMENTS OF OUR BI SOLUTION

Solution Element	Purpose	Key Audience
United States EV Analytical Dashboard	Provide in-depth analysis and insights on the electric vehicle (EV) market in the United States.	Senior executives, policymakers, legislators, business entrepreneurs.
Categorization of Registered Vehicles in USA Dashboard	Classify and analyze registered vehicles in the USA based on various criteria.	Legislators, policymakers, environmental organizations, general public.
Vehicles Registration by DOL Dashboard	Track and visualize vehicle registrations data processed by the Department of Licensing (DOL).	Legislators, infrastructure developers, policymakers, general public.
Forecast Dashboard	Use data-driven methods to predict future trends and developments in the EV market, aiding decision-making.	Business entrepreneurs, policymakers, legislators, infrastructure developers.

Table 2: Key Audience for our Dashboards

TECHOLOGY SELECTED

After conducting a thorough evaluation of essential assessment criteria, we have made a deliberate selection of these particular tools for our Business Intelligence (BI) solution. The business intelligence (BI) solution has been carefully crafted by utilizing a combination of Tableau, Power BI, Google Colab, and Microsoft Excel. These tools have been selected based on their strong alignment with our specific requirements. These tools demonstrate remarkable capabilities, allowing us to effectively address the diverse requirements of our business intelligence solution. The strong features and functionalities of these solutions make them an excellent choice, as they ensure that our business intelligence solution is well-equipped to deliver thorough and insightful analyses tailored to our organization's specific needs.

Criteria	Reasons for Selection
Ease of Implementation	Selected tools offer straightforward implementation processes, ensuring a hassle-free setup for our BI solution.
Low Cost	Tableau, Power BI, Google Colab, and Microsoft Excel are cost-effective options, providing excellent value for our organization's budget.
Mobile Capability	These tools provide seamless access to data and analyses on various devices, eliminating the need for additional mobile development efforts.

Ease of Use	Intuitive interfaces of Tableau, Power BI, Google Colab, and Microsoft Excel allow users, even those without a data background, to utilize the tools effectively.
Scalability	Chosen tools are scalable, accommodating the growth of our organization and ensuring continued support for increasing data volumes and user requirements.
Speed to Insight	The tools offer fast data processing and analysis, enabling quick insights, essential for making swift and informed decisions in dynamic business environments.
Future Proof	Continuous enhancements and updates from these tools' developers guarantee long-term viability, making our BI solution adaptable to future organizational needs.

Table 3: The criteria used for the selection of BI tools.

QR CODE FOR INSIGHTS

Please find the QR codes for each dashboard in our solution below for your convenience. To gain access to the corresponding dashboard, you can conveniently scan the provided code. Furthermore, we provide web links for these dashboards as an alternative means of accessing them.

Figure 2: QR code for United States EV Analytical Dashboard

Figure 3: QR code for Categorization of Registered Vehicles in USA Dashboard

Figure 4: QR code for Vehicles Registration by DOL Dashboard

Figure 5: QR code for Forecast Dashboard

1. https://public.tableau.com/app/profile/yash.satishbhai.raja/viz/DashboardUSEvs/Dashboard1
2. https://teams.microsoft.com/l/message/19:023de728-6a64-4357-9d38-5be286d353b8_b245fcf7-ef82-4bad-9ac1-1cfc538d847b@unq.gbl.spaces/1696551632797?context=%7B%22contextType%22%3A%22chat%22%7D
3. https://app.powerbi.com/view?r=eyJrIjoiZTJhMzMyMmQtYzYyMS00ZmVkLThkMTEtOWYwMjI4YjhhMGJhIiwidCI6ImNiODUwZjNhLTU3YWYtNDk1Yi1iNThlLTY3ZTI4NjU5ZGU2YyIsImMiOjEwfQ%3D%3D
4. https://app.powerbi.com/view?r=eyJrIjoiNjQ2YTgwNWItYWU3Mi00NTA4LWIxOTYtNDQ4YTU3ZjRjY2NiIiwidCI6ImNiODUwZjNhLTU3YWYtNDk1Yi1iNThlLTY3ZTI4NjU5ZGU2YyIsImMiOjEwfQ%3D%3D

NOTE: Weblinks of these QR code provided as well.

SOLUTION DETAILS

In our effort to cater to the diverse needs of senior executives, policymakers, legislators, and business entrepreneurs, we've meticulously developed a series of interactive dashboards integral to our comprehensive Business Intelligence (BI) solution. The first among these is the **United States EV Analytical Dashboard**.

UNITED STATES EV ANALYTICAL DASHBOARD

Within this dashboard, a wealth of essential information is unveiled. In a nation where the total vehicle count stands at a staggering **491,962,196**, it's noteworthy that **5,205,311** of these vehicles are electric. These electric vehicles, dispersed across **298** distinct counties of the USA, represent a significant stride towards sustainable transportation practices.

Figure 6, displayed within our United States EV Analytical Dashboard, serves as a visual gateway into a world of profound analysis and insights regarding the electric vehicle (EV) market in the United States. Here, trends, patterns, and crucial key performance indicators (KPIs) are laid bare, providing an invaluable resource for understanding the dynamics of the electric vehicle market landscape in the country.

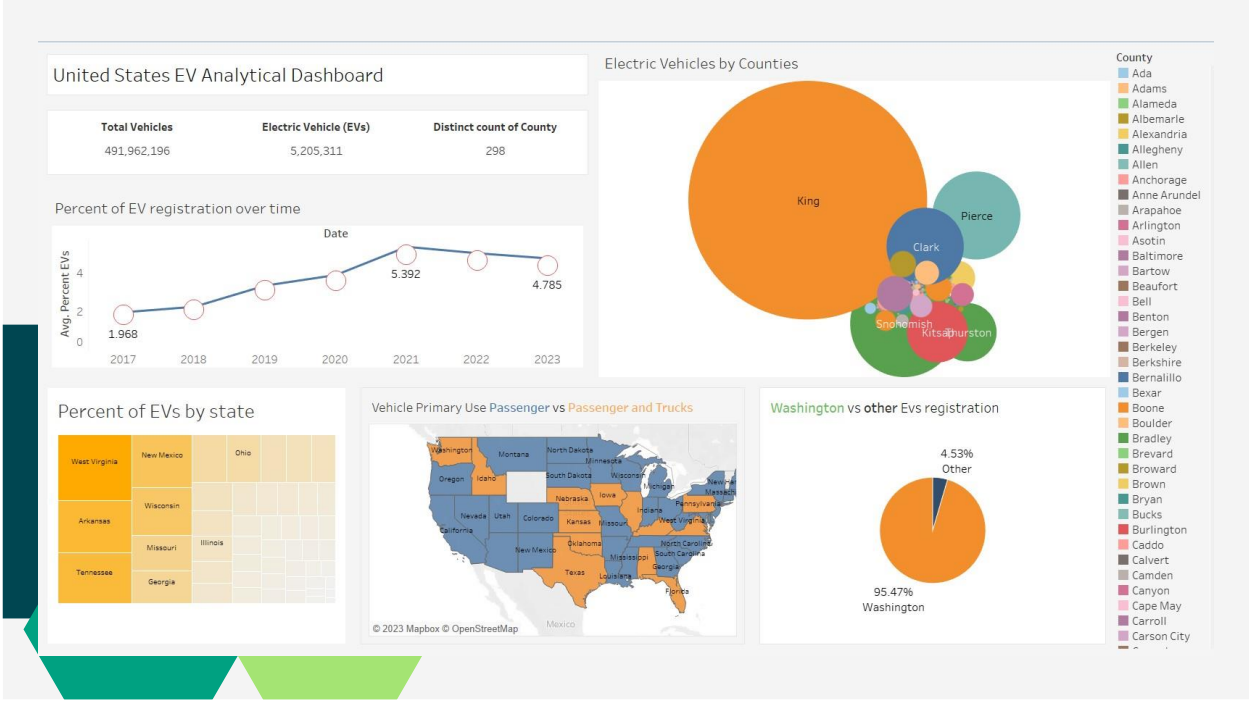


Figure 6: United States EV Analytical Dashboard

Figure 7 displays a comprehensive representation of the principal utilization of vehicles throughout the United States. The blue region depicted on the map denotes areas where automobiles are solely utilized for the transportation of passengers. On the other hand, the orange region denotes areas where vehicles fulfill a dual function, serving as means of transportation for both passengers

and products, which includes the usage of trucks. It is vital to acknowledge that these differentiations are applicable just to officially registered electric vehicles within the nation. This visual representation provides a clear understanding of how different areas incorporate electric vehicles into both passenger and commercial transportation.

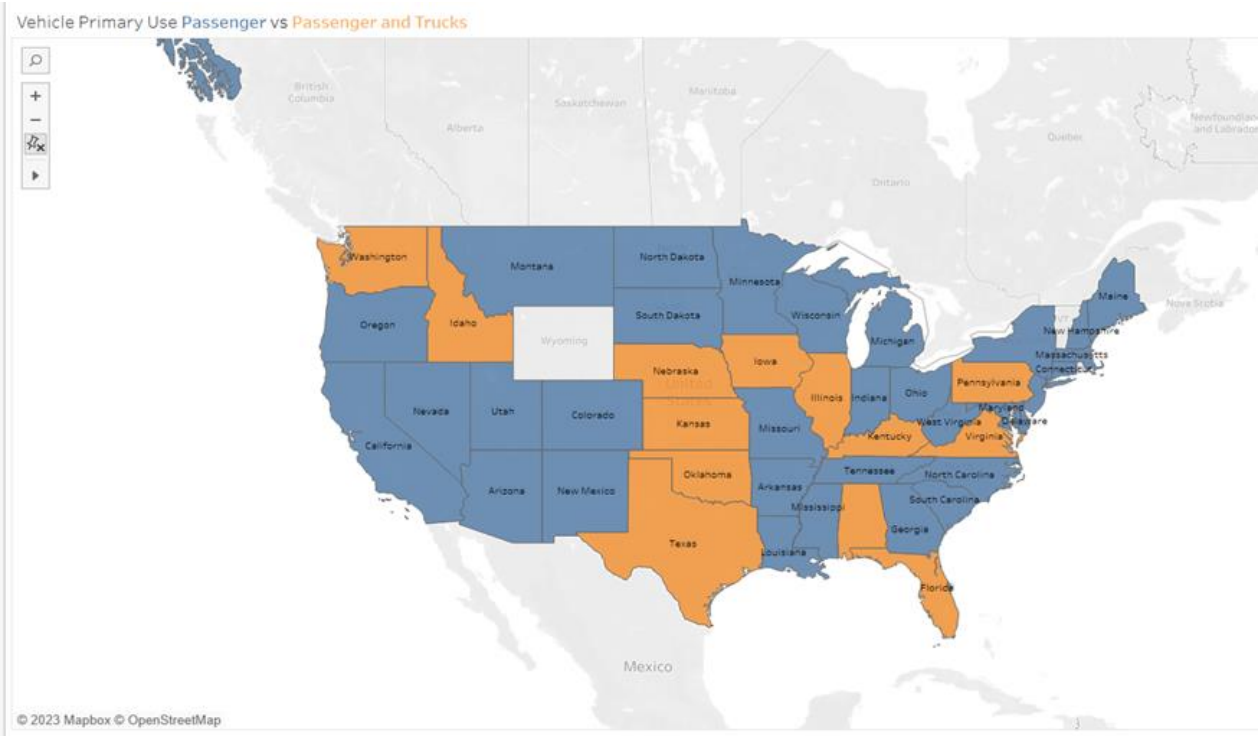


Figure 7: United States Vehicle Primary Use (Passenger vs Passenger and Trucks)

In Figure 8, we present the percentage of electric vehicles (EVs) by state in the United States. For instance, West Virginia stands out with the highest percentage, boasting 33.69% of electric vehicles among all states. This is represented by the blue region on the map. However, it's crucial to note that this high percentage doesn't necessarily mean West Virginia has the largest number of electric vehicles in the USA. In fact, Washington holds that title, boasting the highest actual number of EVs. This insight provides a balanced perspective, emphasizing both the prevalence and the sheer quantity of electric vehicles in different states.

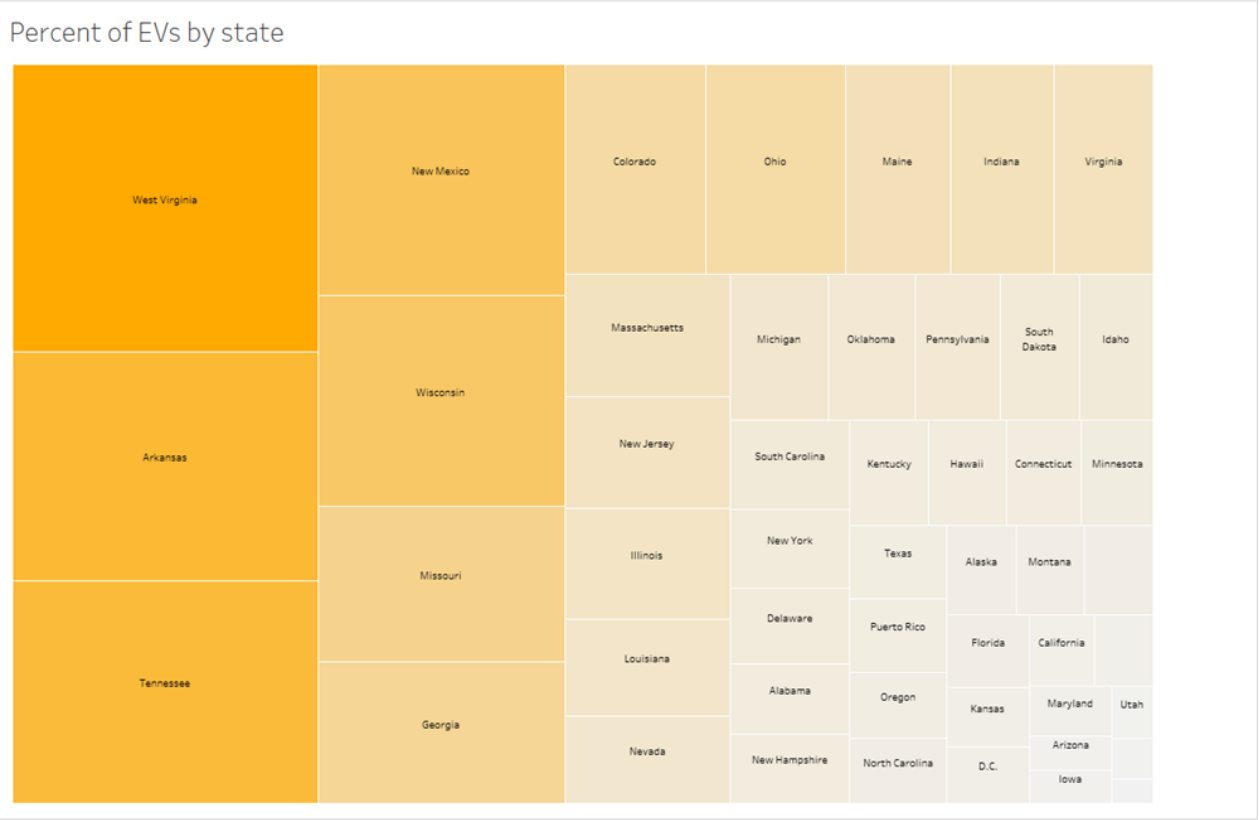


Figure 8: Percent of EVs by state

Figure 9 presents an analysis of the temporal evolution of electric vehicle (EV) registrations, expressed as a percentage, spanning the years **2017** to **2023**. In 2017, electric cars (EVs) accounted for approximately **2%** of the total vehicle population in the United States, representing the nadir of their market share during this timeframe. Nevertheless, there is a discernible rising trajectory observed across the years. The year 2021 exhibited the greatest level of saturation, with an approximate value of **5.4%**. After reaching its highest point, there is a gradual decrease observed, resulting in a reduction in the percentage to approximately **4.8%** by the year 2023. The presented data provides a depiction of the dynamic progression of electric vehicle adoption, demonstrating a progressive upward trend with intermittent variations observed throughout the years.

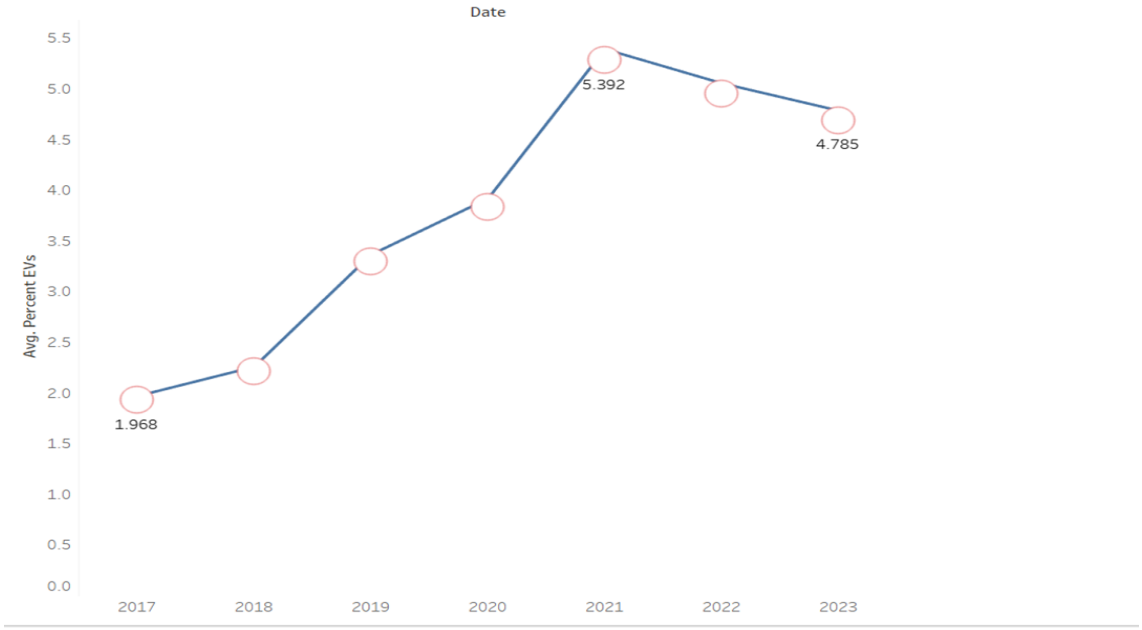
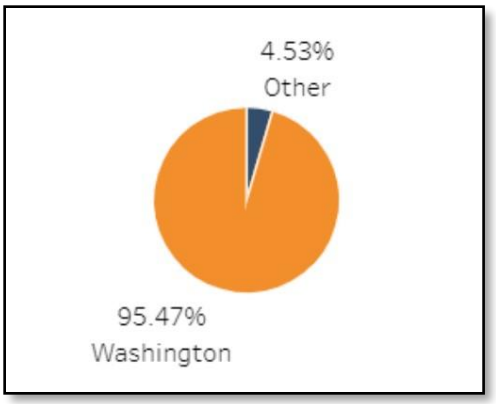


Figure 9: Percent of EV Registration Over Time



In Figure 10, we compare electric vehicle (EV) registrations in Washington with other states. The data clearly demonstrates that Washington leads the pack with an impressive **95.47%** of all electric vehicles registered in the state. This significant majority highlights Washington's notable contribution to the overall adoption of electric vehicles in the country.

Figure 10: Washington vs other EVs registration

In Figure 11, the visualization focuses on electric vehicles (EVs) across counties. A prominent orange circle signifies that **King** County boasts the highest number of EVs, totaling an impressive **2,792,933**. In contrast, non-electric vehicles in the county amount to **123,932,841**. When considering the total number of vehicles in King, both electric and non-electric, the figure stands at **126,725,774**. This data paints a clear picture of the substantial presence of electric vehicles in King amid the overall vehicle landscape.

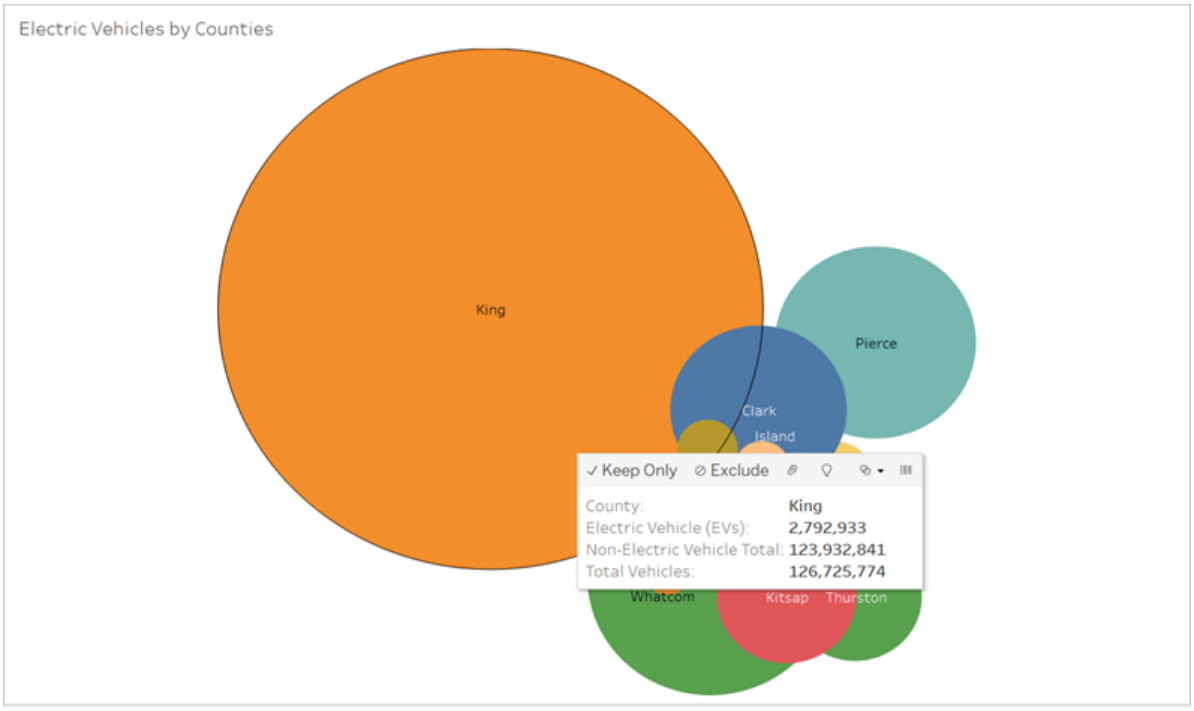


Figure 11: Electric Vehicles by Counties

CATEGORIZATION DASHBOARD

The Categorization of Registered Vehicles in USA Dashboard serves as a tool to classify and analyze registered vehicles in the United States based on various criteria. The dashboard has been purposefully developed to address the requirements of legislators, politicians, environmental organizations, and the wider public. This dashboard facilitates informed decision-making, policy formulation, and the promotion of public knowledge of vehicle classifications in the United States by offering comprehensive insights into the many categories of registered cars. In Figure 12, we introduce the "Categorization of Registered Vehicles in USA Dashboard.

The data in Figure 13 shows how electric vehicles are distributed among Californian counties. For example, Alameda County stands out as having 288 registered electric vehicles, or 1.48 percent of all automobiles in the county on average. This data helps us analyze the adoption trends across the state by giving us a thorough grasp of the ubiquity of electric vehicles in particular areas.

In Figure 14, we present a Bar Chart detailing the registration of vehicles in the top 5 states. Washington stands out as the leader, registering an impressive total of over 100 million vehicles. Among these, more than 5 million are battery electric vehicles, contributing to a grand total of nearly 10 million electric vehicles in the state.

Taking the second spot is Iowa, with a total registration of 10 million vehicles. However, in comparison to Washington, Iowa has registered fewer battery electric vehicles. Notably, the total number of electric vehicles registered in the remaining four states is relatively similar, showcasing a balanced distribution when compared to Washington's significant lead.

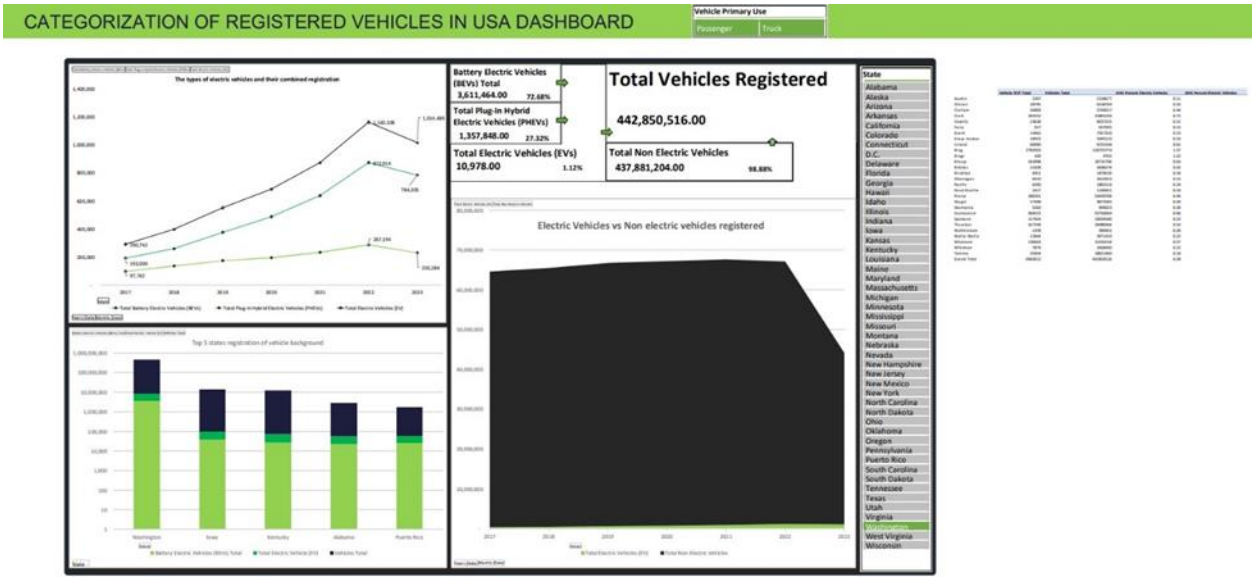


Figure 12: Categorization of Registered Vehicles in USA Dashboard

	Vehicle (EV) Total	Vehicles Total	AVG Percent Electric Vehicles	AVG Percent Electric Vehicles
Alameda	288	22170	1.48	
Berkeley	15	1645	0.92	
Contra Costa	278	24728	1.29	
El Dorado	11	379	2.91	
Fresno	47	8619	0.55	
Kern	68	11767	0.60	
Los Angeles	991	80426	1.31	
Marin	41	1820	2.46	
Monterey	111	9934	1.24	
Napa	12	122	9.90	
Placer	88	4317	2.10	
Riverside	373	48356	0.86	
Sacramento	113	13242	1.02	
San Bernardino	50	6722	0.78	
San Diego	1377	205114	0.70	
San Francisco	104	4880	2.12	
San Joaquin	67	5672	1.27	
San Luis Obispo	11	676	1.63	
San Mateo	120	8301	1.52	
Santa Barbara	11	796	1.45	
Santa Clara	733	25207	3.33	
Santa Cruz	59	1822	3.57	
Shasta	23	948	2.44	
Solano	80	8420	1.08	
Sonoma	37	1939	2.04	
Tulare	11	2164	0.51	
Tuolumne	35	468	7.57	
Ventura	209	22017	1.03	
Grand Total	5363	522671	1.76	

Figure 13: Electric Vehicle in California by County

This chart provides a logarithmic view, offering a clear perspective on the varying registrations across states and highlighting Washington's remarkable dominance in the electric vehicle market.

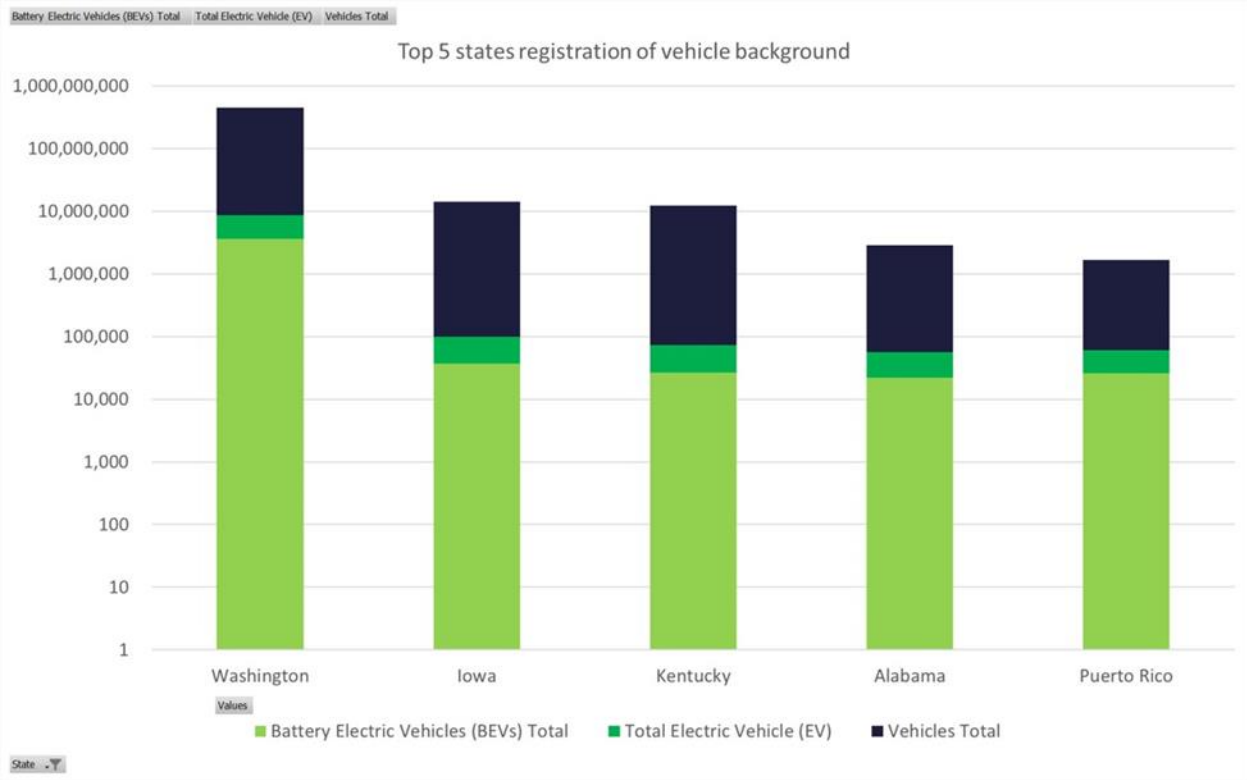


Figure 14: Top 5 states registration of vehicle background

Figure 15 presents a compelling comparison between electric vehicles and their traditional non-electric counterparts in Washington. As we're aware, electric vehicles are relatively new to the market, and the automobile industry has long been dominated by non-electric vehicles. Unsurprisingly, considering factors such as cost and market penetration, the total number of non-electric vehicles far surpasses that of electric vehicles. Even in direct comparison, electric vehicles make up a significantly smaller portion of the total vehicles registered in the state, highlighting the substantial presence of traditional vehicles in Washington's automotive landscape.

Figure 16 provides an analysis of electric vehicles in the state of Washington, with a particular emphasis on the different types of vehicles and their cumulative registration numbers throughout the years. This Line chart tracks the growth patterns from 2017 to 2023. During this period, we witnessed a significant surge in the total number of electric vehicles, escalating from 3,591 to 14,964. Notably, battery electric vehicles demonstrated remarkable growth, soaring from 1,700 to 9,360 at its peak. Meanwhile, plug-in hybrid electric vehicles maintained a consistent rise, averaging around 5,000 registrations at their peak. This data underscores the evolving landscape of electric vehicles, depicting a substantial increase in their adoption, especially in the battery electric category.

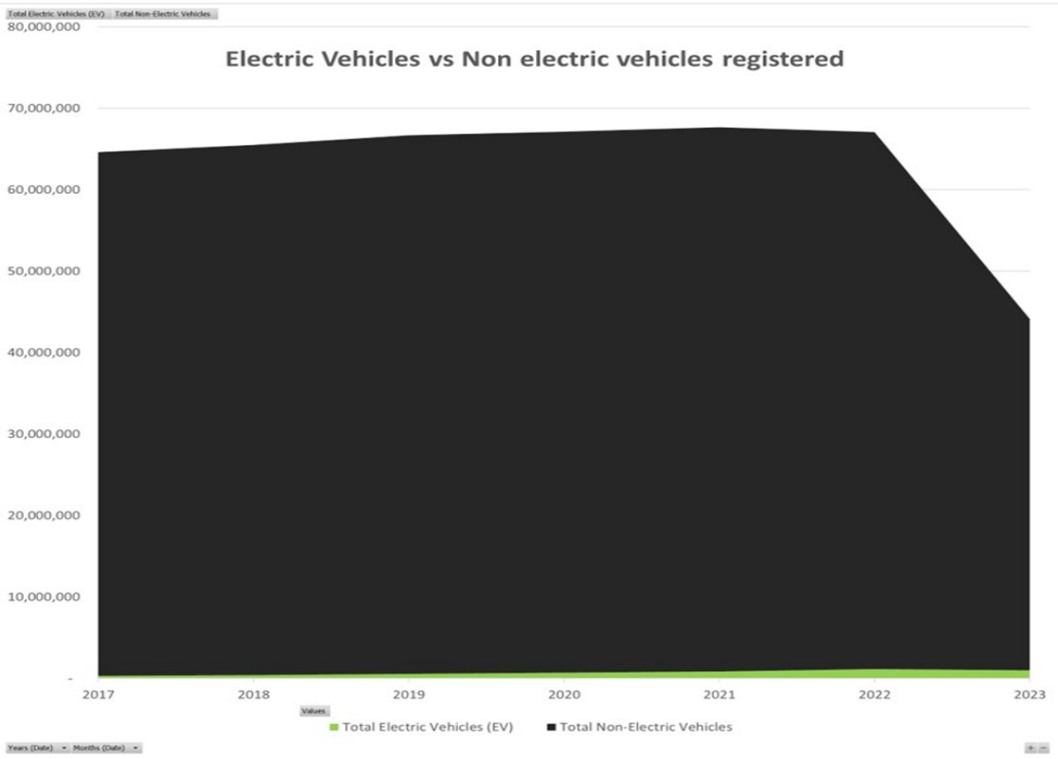


Figure 15: Electric Vehicles vs Non electric vehicles registered for Washington

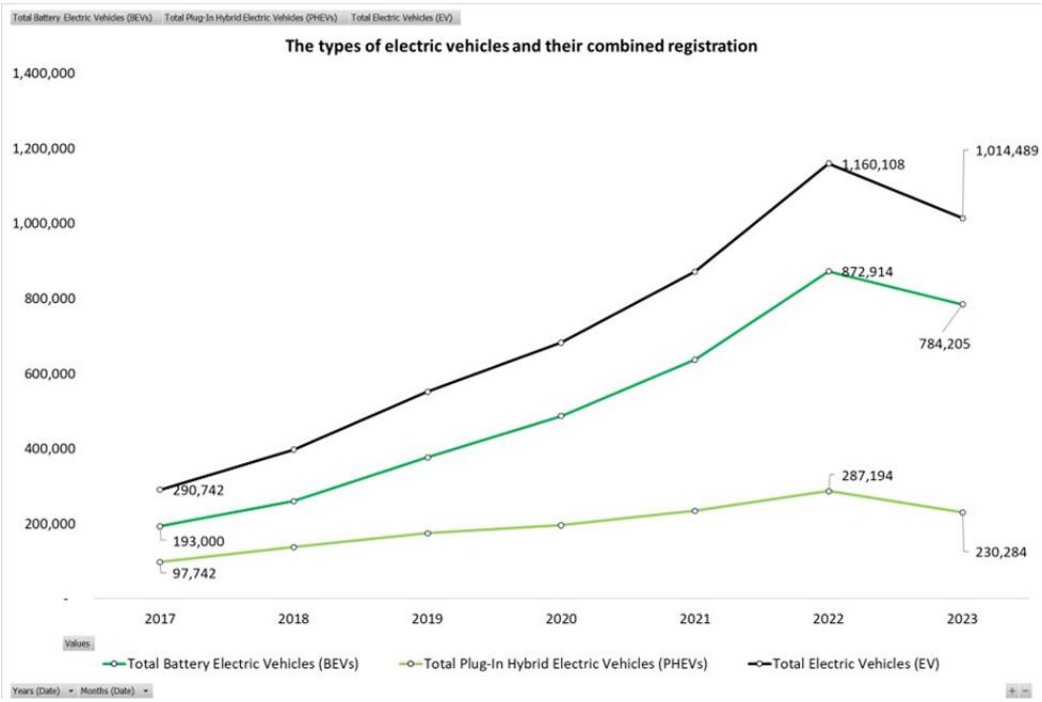


Figure 16: The types of electric vehicles and their combined registration for Washington

Figure 17 and Figure 18 depict the Categorization of Registered Vehicles Dashboard for Alaska and Puerto Rico, respectively. The aforementioned data plays a crucial role in providing policymakers, legislators, and the general public with valuable insights on the automotive landscape. It enables them to make well-informed decisions that are specifically adapted to the distinct circumstances of Alaska and Puerto Rico.

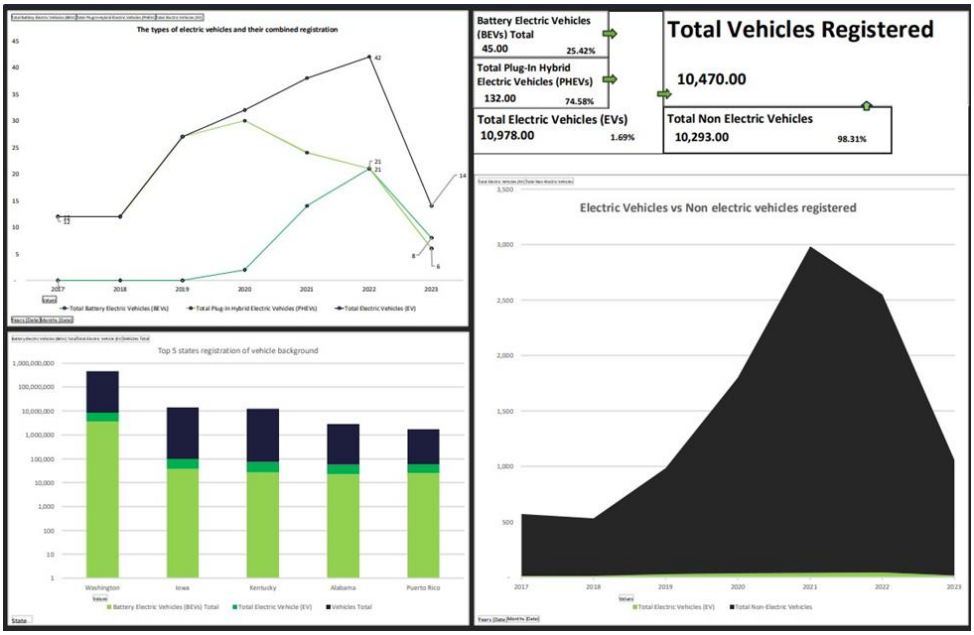


Figure 17: Categorization of Registered Vehicles Dashboard for ALASKA

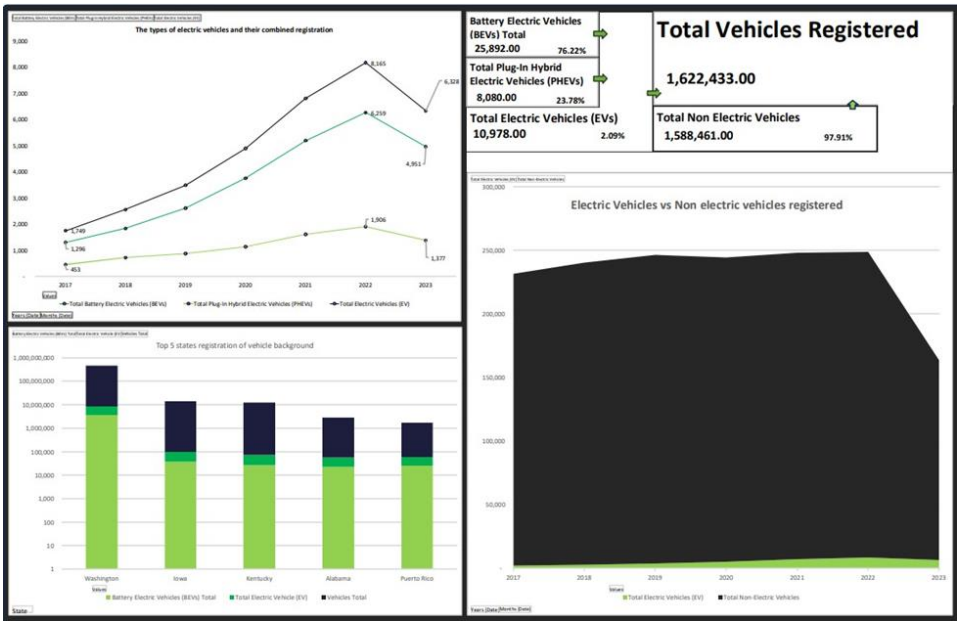


Figure 18: Categorization of Registered Vehicles Dashboard for PUERTO RICO

VEHICLES REGISTRATION BY DOL DASHBOARD

The Vehicles Registration by DOL Dashboard plays a vital role in monitoring and presenting vehicle registration data that is overseen by the Department of Licensing (DOL). This dashboard has been specifically developed to address the requirements of lawmakers, infrastructure developers, politicians, and the wider public, providing a comprehensive perspective on vehicle registrations. By offering easily understandable and valuable information, it facilitates the process of making well-informed decisions and developing strategic plans for a wide range of individuals and groups involved.

In the following sections, we'll delve into the insights this dashboard provides, shedding light on vehicle trends, patterns, and crucial data points essential for policymakers, infrastructure developers, and the general public. Let's explore the wealth of knowledge Figure 19 has to offer.

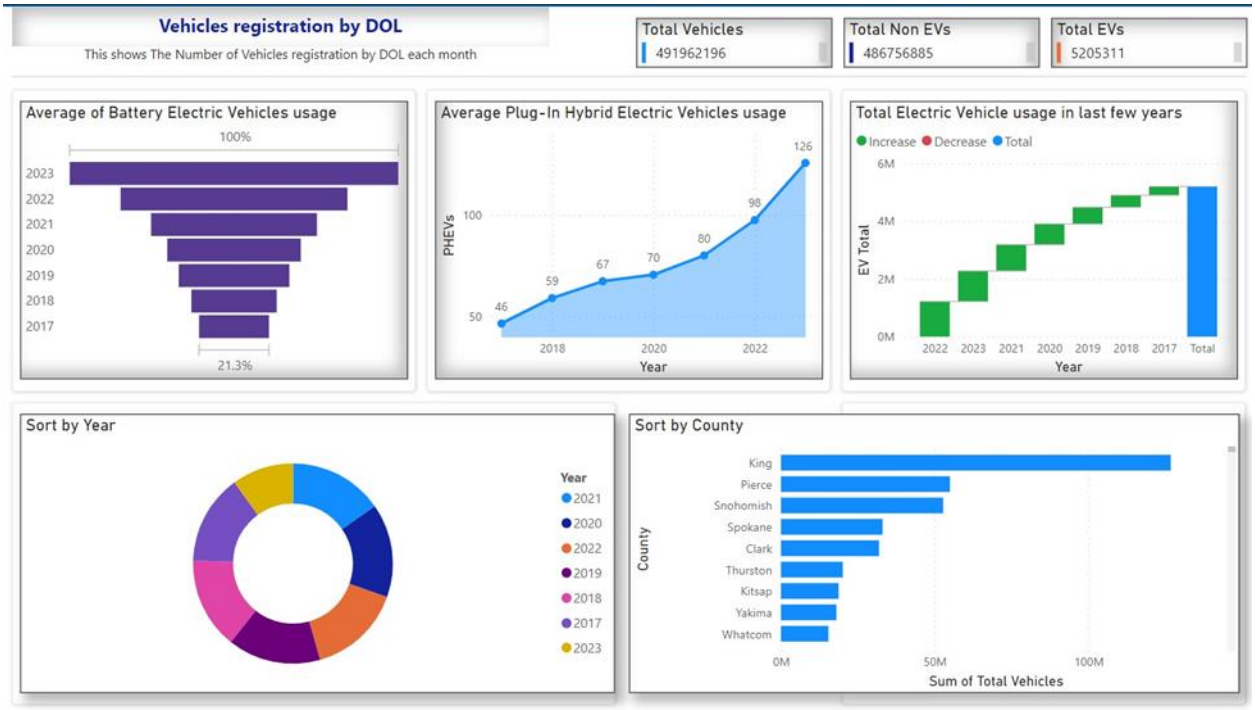


Figure 19: Vehicles Registration by DOL Dashboard

Figure 20 pertains to the mean values of consumption for Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). The above data depicts a consistent upward trend in the utilization of batteries in automobiles from the year 2017 to 2023. Between the years 2017 and 2022, Plug-in Hybrid (PHEV) vehicles exhibited a sustained level of usage, with a notable high of 0.3 million PHEVs observed throughout this timeframe. Nevertheless, a notable transformation took place in the year 2022, resulting in alterations in the trajectory depicted by the graph as we progressed towards the year 2023. The observed shift in usage patterns of PHEVs is of significant importance, warranting a comprehensive analysis to ascertain the underlying factors that have led to this transformation.

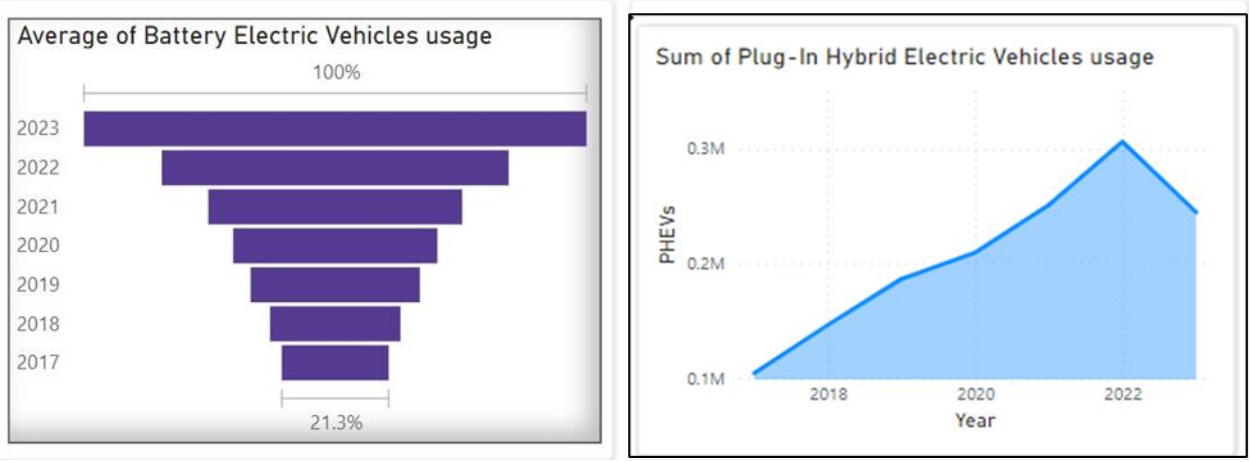


Figure 20: Average of Battery Electric Vehicles usage and Average Plug-In Hybrid Electric Vehicles usage

Figure 21 sheds light on the total electric vehicle usage in the USA from 2017 to 2022. Historically, electric vehicle adoption has shown consistent and positive trends, with a uniform increase noted from 2017 to 2022. This steady growth pattern has been a promising sign for sustainable transportation. However, a noteworthy change occurred in 2023, where the rate of increase decreased. This shift is a significant development and warrants closer analysis to understand the factors contributing to this change in the trajectory of electric vehicle usage in the country.

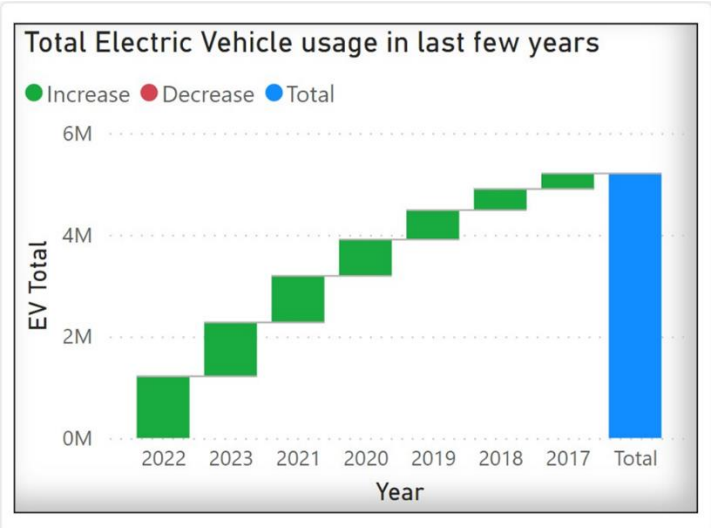
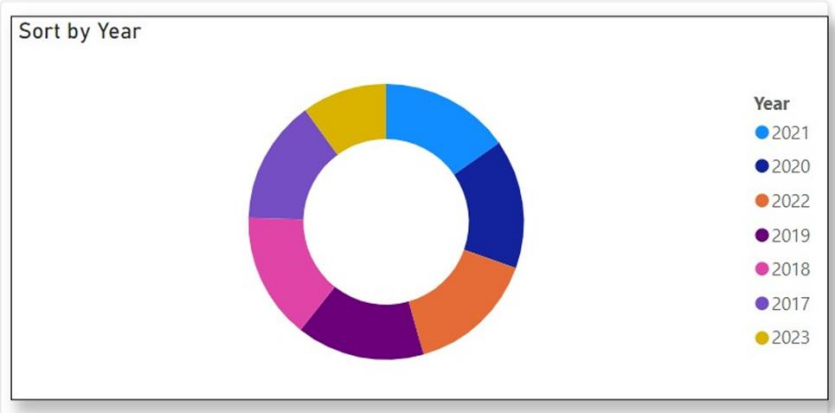


Figure 21: Total Electric Vehicle usage 2017 to 2022 in USA

Figure 22 illustrates a graphical depiction of the proliferation of electric vehicles during successive years. Upon careful examination of the graph, it becomes apparent that the proliferation of electric vehicles has exhibited a stable and uniform pattern, with little fluctuations observed across the years. The observed stability of this characteristic was noteworthy, with a marginal decrease observed in the year 2023. Nevertheless, it is crucial to note that in the preceding years, the disparities in dissemination were quite minimal. The presented data highlights the persistent



pattern of electric vehicle distribution, except for the year 2023 which stands out as an exceptional divergence from the generally constant trend.

Figure 22: Spread of electric vehicles by year

Figure 23 presents an analysis of the overall vehicle population across different counties. The graph presents a clear depiction of the fact that King County exhibits the greatest count of registered automobiles, therefore occupying the foremost position. Pierce and Snohomish Counties are situated in close proximity. It is noteworthy that the car populations in the remaining counties exhibit a high degree of similarity, suggesting a rather even distribution. The data presented offers significant insights into the geographical distribution of automobiles, highlighting the notable concentration of vehicles within some counties.

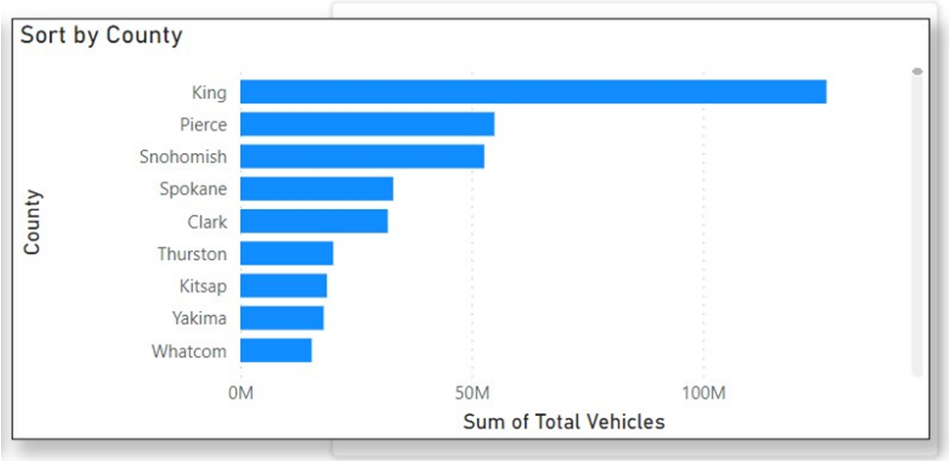


Figure 23: Sum of Total Vehicles by County

FORECAST DASHBOARD

The Forecast Dashboard is designed to utilize data-driven methodologies in order to anticipate future trends and advancements in the Electric Vehicle (EV) market. The fundamental objective of this tool is to provide support to business entrepreneurs, policymakers, legislators, and infrastructure developers in making educated and well-considered decisions. Through the utilization of precise data analysis, this dashboard provides significant insights, enabling stakeholders to effectively manage the dynamic EV market with assurance and strategic expertise.

Figure 24 presents the Forecast of Annual Vehicles Count by County. Historically, the purchase of electric vehicles has followed an upward trend. However, a shift occurred from 2022 to 2023. Looking ahead, it is anticipated that this pattern will change once more. The graph foresees a notable increase in the adoption of electric vehicles, surpassing previous records. This projection suggests a promising future for electric vehicle purchases, indicating a surge in popularity and adoption rates beyond anything seen before.

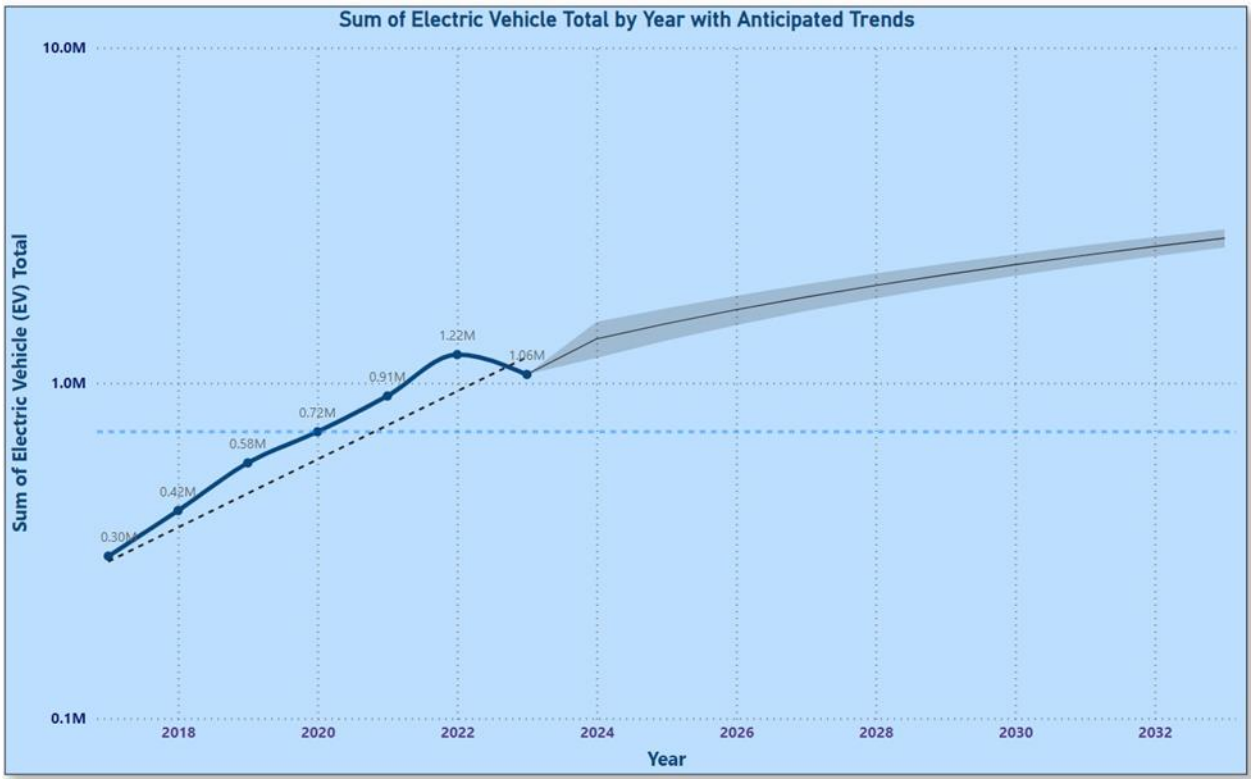


Figure 24: Forecast of Annual Vehicles Count by County

In Figure 25, we examine the Trend of Non-Electric Vehicle Usage. Historically, the usage of non-electric vehicles has remained relatively stable. However, a notable deviation occurred from 2022 to 2023. Looking ahead, projections indicate that this pattern is set to transform further. By 2024, the graph is anticipated to dip slightly from its initial peak and maintain this lower level for an extended period. This shift suggests a shift in transportation dynamics, potentially indicating an increased reliance on public transit, such as buses, over individual modes of transportation.

Figure 26 provides an in-depth analysis of the annual count of Battery Electric Vehicles (BEVs) and offers future projections. Throughout history, there has been a discernible upward trend in the usage of battery electric vehicles. According to projections, it is anticipated that this positive trend will continue, stretching beyond the year 2024. Nevertheless, a conspicuous disruption transpired over the period spanning from 2022 to 2024, exerting a substantial influence on the acquisition of

vehicles. This phenomenon necessitates a more thorough analysis in order to comprehend the variables that are contributing to this deviation from the otherwise stable pattern.

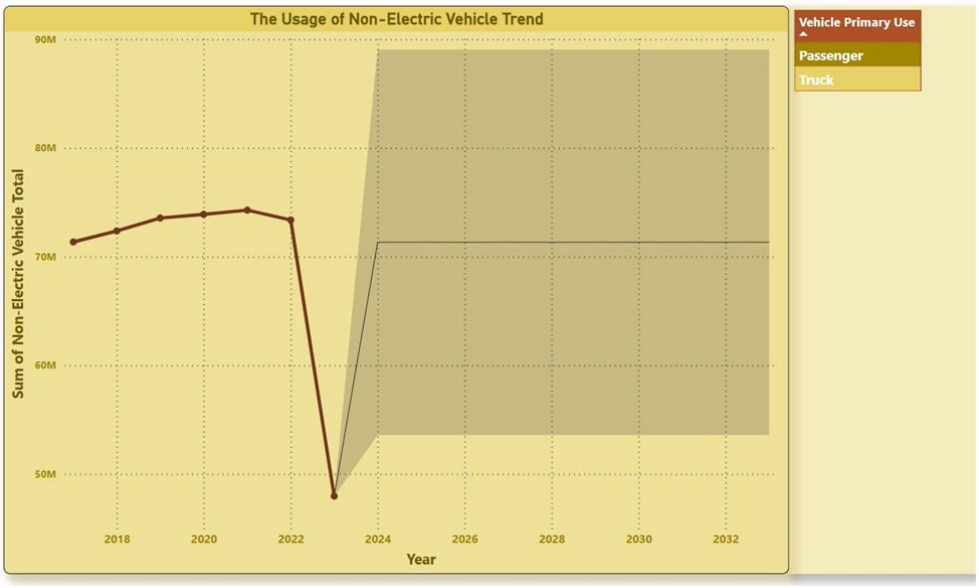


Figure 25: The Usage of Non-Electric Vehicle Trend

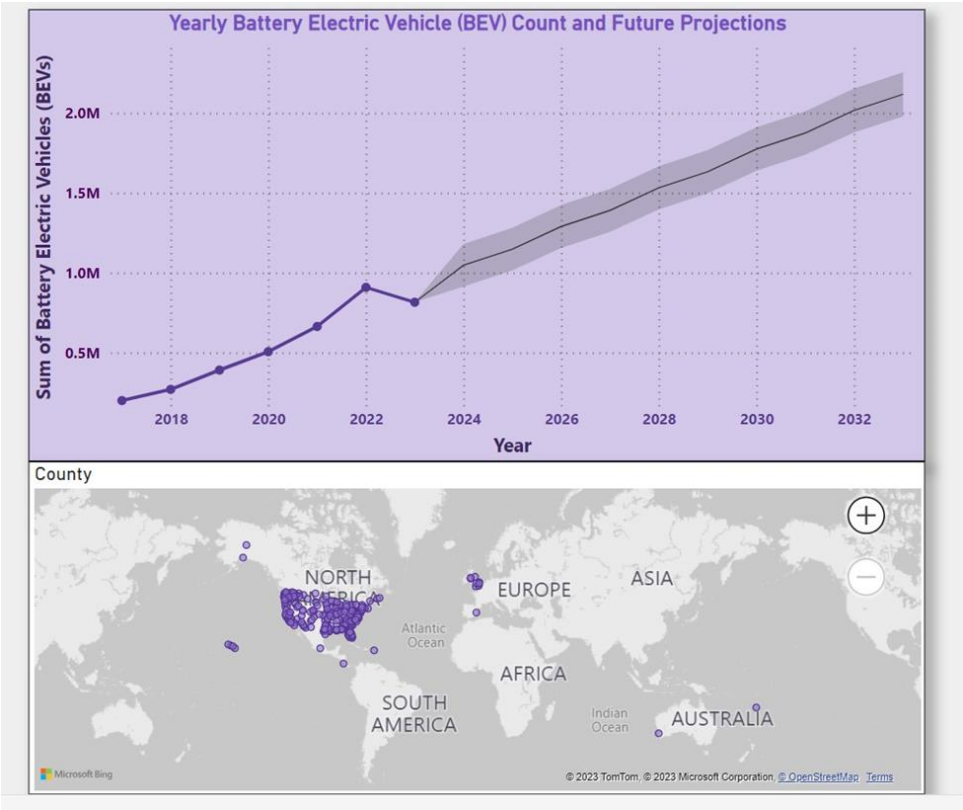


Figure 26: Yearly Battery Electric Vehicle (BEV) Count and Future Projections

Figure 27 provides insights into the historical and projected trends pertaining to Plug-in Hybrid Electric Vehicles (PHEV) across time. Throughout history, there has been a persistent and prolonged stagnation in the adoption of plug-in hybrid electric vehicles, with usage rates remaining consistently low and exhibiting a flat trajectory. Nevertheless, a notable transition transpired in the year 2022 wherein there was an upturn in purchasing. However, this surge was of little duration as it was promptly succeeded by a steep decrease in the subsequent year, 2023. According to projections, it is anticipated that the graph will experience a subsequent increase in the future. The variability observed in this pattern gives rise to thought-provoking inquiries on the determinants that impact these fluctuations, hence necessitating additional investigation in order to attain a thorough comprehension of this dynamic phenomenon.

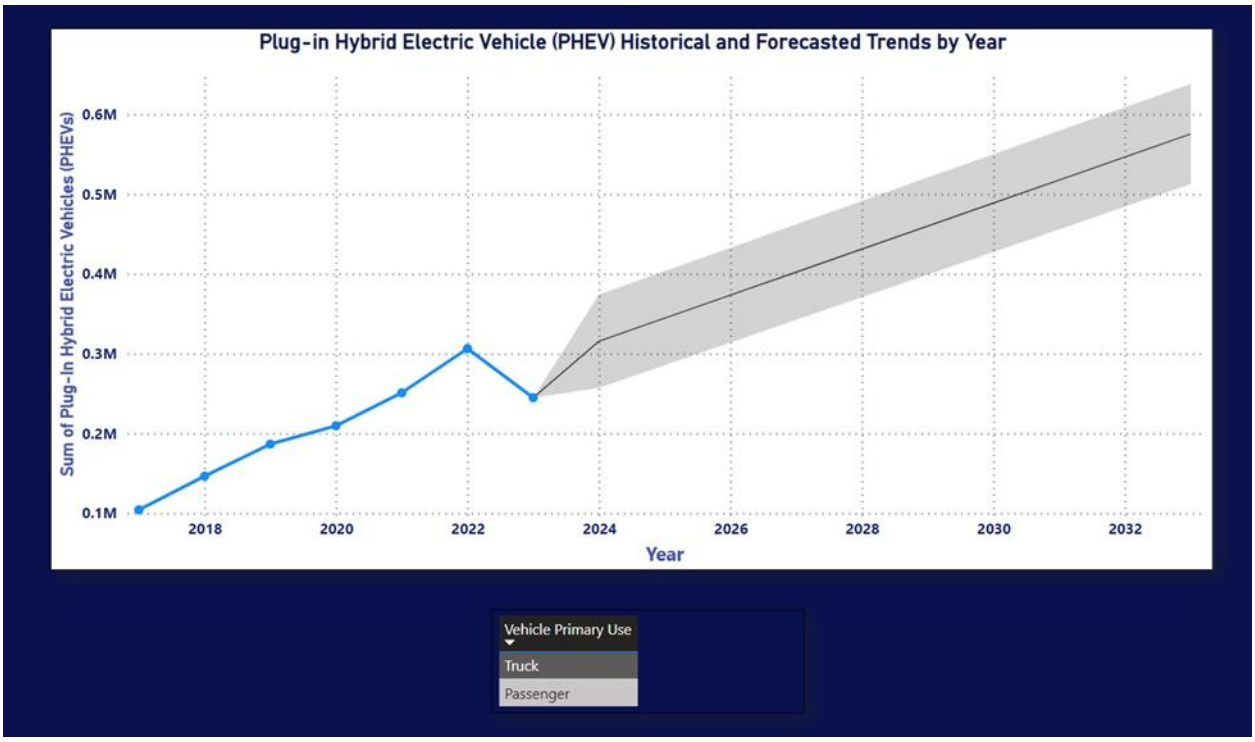


Figure 27: Plug-in Hybrid Electric Vehicle (PHEV) Historical and Forecasted Trends by Year

JUSTIFICATION FOR CHOSEN BI REPORTING SOLUTIONS AND DASHBOARD ATTRIBUTES:

UNITED STATES EV ANALYTICAL DASHBOARD

DATA DEPTH AND VISUALIZATION (CHOSEN BI REPORTING SOLUTION):

The selection of the United States EV Analytical Dashboard was based on its capacity to offer comprehensive insights into the patterns of electric car uptake. Power BI, as the chosen solution, has exceptional proficiency in managing extensive datasets and producing aesthetically captivating and interactive reports. The scholarly literature, exemplified by Khan underscores the importance of data depth and visualization methods in the field of

business intelligence, as they facilitate thorough analysis and informed decision-making(Khan et al., 2020).

INTERACTIVE VISUALIZATIONS (DASHBOARD ATTRIBUTES):
The incorporation of interactive elements, such as drill-down capabilities and filtering mechanisms, serves to augment user involvement and comprehension. The significance of interactivity in data visualization is emphasized in a study conducted by (Tešendić & Krstićev, 2019). The findings of their research suggest that interactive dashboards have a positive impact on user satisfaction and enhance the sharing of insights.

CATEGORIZATION DASHBOARD

CLASSIFICATION AND POLICY FORMULATION (CHOSEN BI REPORTING SOLUTION): The primary objective of the Categorization Dashboard is to categories and conduct an analysis of registered vehicles using diverse criteria. This platform specifically caters to the needs of legislators, politicians, and environmental organizations. The selection of Power BI was based on its proficiency in data categorization and its ability to conduct analysis with a focus on policy. The importance of data classification in business intelligence systems for the purpose of successful policy formation is emphasized in academic research, as demonstrated by (Garani et al., 2019).

BAR CHARTS AND LOGARITHMIC VIEWS (DASHBOARD ATTRIBUTES): Bar charts provide a concise means of comparing data, hence facilitating the decision-making process(Khan et al., 2020). Moreover, the utilization of logarithmic perspectives, as observed in the dashboard, proves to be advantageous in the presentation of data encompassing extensive ranges, hence guaranteeing a well-balanced and precise depiction (Al-Okaily et al., 2022).

VEHICLES REGISTRATION BY DOL DASHBOARD

DATA MONITORING AND PRESENTATION (CHOSEN BI REPORTING SOLUTION): The Vehicles Registration by DOL Dashboard is designed to monitor and present vehicle registration data. Power BI's real-time data monitoring capabilities make it suitable for this purpose. Academic research by Al-Okaily et al highlights the importance of real-time data monitoring in data warehouse systems for timely decision-making(Al-Okaily et al., 2022).

MEAN CONSUMPTION TRENDS (DASHBOARD ATTRIBUTES): Presenting mean consumption trends, as seen in Figure 20, provides valuable insights into the usage patterns of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). Analyzing such trends supports strategic planning and business development (Khan et al., 2020).

FORECAST DASHBOARD

DATA-DRIVEN FUTURE PREDICTIONS (CHOSEN BI REPORTING SOLUTION): The Forecast Dashboard utilizes data-driven methodologies to anticipate future trends in the electric vehicle market. Power BI's predictive analytics capabilities enable accurate forecasting, supporting business entrepreneurs and policymakers. Academic research by Khan et al.

emphasizes the importance of data-driven predictive analysis in business intelligence for informed decision-making(Khan et al., 2020).

HISTORICAL AND PREDICTIVE ANALYSIS (DASHBOARD ATTRIBUTES): Combining historical trends with predictive analysis offers a holistic view, aiding in proactive decision-making (Khan et al., 2020). Integrating past data with predictive modeling techniques aligns with best practices in business intelligence.

ASSUMPTIONS

In order to streamline the analysis process and derive relevant conclusions from the available data, a number of assumptions were made during the preparation of the analysis report for the senior executive team.

a) It is presumed that the dataset under consideration does not contain any notable outliers that may potentially distort the study. The presence of outliers has the potential to significantly influence the outcomes and understandings derived from the data.
b) Consistency was assumed in the formatting, units, and measurement of the data for all variables. The presence of consistent data is crucial in ensuring that comparisons and analyses yield results that are both useful and reliable.
c) The Washington State Department of Licensing (WSDOL) can finance the recommendations that are listed in this report.
d) The Washington State Department of Licensing (WSDOL) can help various companies to pitch new markets successfully.

FINDINGS

DESCRIPTIVE

MARKET GROWTH TREND: The analysis of the graph reveals a consistent increasing acceleration, indicating a yearly rise in the number of vehicles. This upward trajectory highlights a growing market for vehicles, suggesting a positive trend in the automotive industry.

DOMINANCE OF THE WASHINGTON IN STATE AND KING IN COUNTY IN USA: The graph clearly identifies the Washington in state and King in county as the major players in the USA vehicle market. These two countries occupy the majority share, signifying their dominance in the industry. This insight is crucial for businesses looking to expand internationally and target key markets.

ANOMALY IN 2023: A notable deviation from the established trend occurred in 2023, marked by a significant break in the graph. This deviation from the norm suggests a shift in market dynamics or external factors influencing vehicle sales patterns. Identifying the cause of this anomaly is essential for adapting strategies to changing market conditions.

PREDICTIVE:

RISE OF TRUCK USAGE: Predictive analysis indicates a forthcoming shift in consumer preferences, with truck usage expected to surpass passenger vehicles. This prediction suggests a growing demand for trucks, possibly due to changing industry needs or consumer preferences. Businesses in the automotive sector should prepare for this shift by adjusting their product offerings and marketing strategies accordingly.

RELIABILITY OF PREDICTIVE MODEL: The predictive model's reliability was established by feeding it with historical data and accurately predicting past trends. This validation process ensures the model's accuracy and reliability for future predictions. Reliable predictive models are invaluable for businesses, guiding them in making informed decisions and investments based on data-driven forecasts.

a) The total number of vehicles in the past five years has been on an increasing trend. This is evident from the graph. The prediction says the figures may be at 71,633,374 in the future. This may however not be a significant increase from the previous figures. The figure may also be constant for several years.
b) The number of electric vehicles being sold has been on the higher side in the last five years. From the prediction, the trend is expected to go higher and record 2,704,035 in the futures
c) The number of non-electric vehicles has been higher and the trend has been smoothly increasing. However, the trend is expected to break and the purchase to reduce. The expected figures are 71,322,539 in the future.
d) The purchase of battery electric vehicles has been consistent in the past. Consequently, this is expected to increase further and reach 2,117,129 in the future
e) The purchase of plug-in Hybrid electric vehicles has been in high demand previously. In the future, this is expected to go higher to reach 575,265.

STRATEGIC RECOMMENDATIONS FOR ENHANCING WSDOL OPERATIONS BASED ON BI ANALYSIS

1. ENHANCE DIGITAL SERVICES:

With the increasing trend in vehicle registrations and the growing population of electric vehicles (EVs), WSDOL should prioritize the expansion of digital services. Investing in user-friendly online platforms for car registrations, renewals, and license applications can drastically accelerate operations and improve customer satisfaction(Cohen & Eimicke, 2000). By creating a smooth online experience, WSDOL can adapt to the modern expectations of its clients and reduce operational workload in physical offices.

2. DATA-DRIVEN RESOURCE ALLOCATION:

Leveraging the power of data analytics, WSDOL should execute data-driven resource allocation. By regularly monitoring regional vehicle registration trends and patterns, WSDOL can distribute resources more efficiently to manage demand surges or drops. This guarantees that employees, infrastructure, and services are optimally allocated, decreasing operational bottlenecks and expenses.

Allocating resources based on data is consistent with the strategy objective of increasing operational effectiveness(Sahoo, Kumar, & Upadhyay, 2023). This suggestion can be supported by academic research on resource distribution in government organizations.

3. STREAMLINE REPORTING AND COMPLIANCE:

The Washington State Department of Licensing (WSDOL) should give careful consideration to the use of advanced business intelligence (BI) reporting solutions in order to enhance the efficiency of reporting and compliance procedures. This involves the implementation of automated reporting processes and the provision of interactive dashboards to facilitate regulatory and compliance monitoring. The implementation of such a strategy has the potential to streamline the decision-making process, minimize the need for manual data processing, and improve the precision of reporting(Bharadiya, 2022).

This proposal is in accordance with the Washington State Department of Labor's dedication to promoting transparency and accountability. The inclusion of references to Business Intelligence (BI) implementations in other government institutions can provide valuable support for this approach.

4. EVOLVE BI CAPABILITIES FOR INFORMED DECISIONS AND SUSTAINABLE BUSINESS OUTCOMES EV INDUSTRY

To optimize decision-making and business outcomes, it is imperative to evolve our Business Intelligence (BI) capabilities continuously. By doing so, we ensure that our key audiences have access to valuable and actionable insights.

Key Audience	**Data Element Benefits**
Senior Executives	Continuous BI evolution ensures access to real-time, relevant data, aiding strategic decisions. Interactive dashboards offer visual insights, enabling swift analysis and fostering proactive leadership(Sharda et al., 2014).
Policymakers and Legislators	Detailed EV market trends facilitate informed policy formulation. Categorized vehicle data aids in crafting legislation tailored to regional needs.

Business Entrepreneurs	Market-specific data enhances market penetration strategies(Diestre, Rajagopalan, & Dutta, 2015). Historical and predictive analysis aids business planning. Access to trends supports product/service alignment with market demands.
Environmental Organizations, General Public	Insights into EV adoption trends promote awareness campaigns(Singh et al., 2023). Data on vehicle categorization aids environmental impact assessments. Accessible information fosters public education on sustainable transportation.

Table 4: BI-Driven Data Benefits for Key Audiences in the Electric Vehicle Industry

COMPARE THE TECHNIQUES USED BY DIFFERENT MEMBERS

When evaluating the methodologies employed by our team, it is evident that each approach has distinct advantages and drawbacks. The utilization of descriptive analysis proved to be of great value in the process of exposing prevailing trends, including the identification of countries with the highest vehicle ownership rates and major manufacturers in the industry. The primary advantage of this approach is its ability to provide a comprehensive understanding of the present situation.

On the other hand, predictive analysis shown its capability in anticipating future advancements. By employing predictive models, it is possible to make precise estimations regarding the projected numbers of forthcoming vehicle acquisitions. This approach presented a prospective viewpoint, providing valuable insights into future expectations.

CONCLUSION

In this in-depth study, we delved into the world of electric vehicles (EVs) in the United States. Using advanced tools like Power BI, Google Colab, and Tableau, we analyzed vast amounts of data to uncover important trends. What we found was a thriving market with a consistent increase in car registrations, creating a favorable environment for businesses and policymakers. Washington state, especially King County, stood out as key areas for market growth. However, 2023 brought an unexpected change, reminding us of how quickly the market can shift. This emphasized the need for adaptability among stakeholders, urging them to respond swiftly to changing consumer preferences.

Our analysis has led to significant insights, especially for policy and strategy decisions. We've crafted recommendations based on a deep understanding of past trends and future predictions, focusing specifically on the ever-changing EV industry. These recommendations offer practical strategies for businesses and policymakers, including improving online services, smart resource allocation based on data, and simplifying reporting processes. By following these steps, organizations can effectively tackle challenges and enhance their overall performance. Our report combines precise data analysis with strategic thinking, providing stakeholders with a clear guide to

navigate the dynamic electric vehicle market in the United States, ensuring flexibility and success in this ever-evolving industry landscape.

SELF-REFLECTION

HASAN, TAMIM | 30432576

Reflecting on this transforming journey, I am struck by the enormous changes I've experienced. Not only have my abilities improved, but my entire outlook on data analysis and teamwork has transformed in ways I never expected.

KEY LEARNINGS AND PERSONAL GROWTH:

Tools like Tableau and Google Colab were just tools in my toolbox at first. However, as the course went, they evolved into extensions of my analytical thinking, assisting me in dissecting intricate patterns inside large datasets. Working with SAP in the labs turned out to be a valuable and positive experience. Making a presentation, which was formerly a scary chore, became an opportunity to weave fascinating narratives from raw data. These challenges put my adaptability and problem-solving skills to the test, which I had polished through real-world problem-solving experiences such as handling complex case studies and cleaning untidy datasets. We encountered difficulties with predictive analysis, dealing with overfitting and precision-recall concerns. However, as a team, we overcame these challenges by utilizing Power BI and coming up with creative solutions.

RECOGNIZING MY GROWTH AND LEARNING:

This course demonstrated to me that my abilities extend beyond technical proficiency. Collaborating with Yash, in particular, demonstrated the importance of teamwork and synergy in learning. His knowledge of Microsoft Excel matched mine, emphasizing the power of collective intelligence. This collaborative spirit did more than just improve my talents; it demonstrated the enormous results that can be achieved via teamwork.

IMPACT ON CURRENT LEARNING AND FUTURE CAREER:

The praise we received for our presentation was more than just confirmation; it demonstrated the power of straightforward data transmission. This wonderful experience has fueled my motivation for future endeavors, propelling me confidently into unexplored territory. My approach to learning has changed dramatically. With renewed confidence and a larger perspective, I now have the fortitude to face both academic and professional problems head on.

Standing here, I realize how much this course has influenced my identity as a data professional and collaborator. The hurdles I've overcome, the skills I've gained, and the recognition I've gotten have propelled me towards a future in which I'm not just prepared, but eager to make substantial contributions in the dynamic field of data analysis. I'm prepared to negotiate the intricacies of the working world, making data-driven decisions and supporting innovation, because I've improved my analytical skills and developed effective communication tactics.

In essence, this course has been more than an academic experience; it's been a transformative journey that has sculpted my identity and equipped me for the exciting challenges ahead.

RAJA, YASH SATISHKUMAR | 30416705

Upon the successful completion of this course, I have gained a comprehensive insight into the world of Business Intelligence. I now understand that Business Intelligence is an indispensable process that involves the use of data analytics to gain a deeper understanding of an entity's current standing, potential, and future prospects. This process enables us to identify areas of improvement and make informed decisions that ultimately lead to the smooth and efficient functioning of data systems. Furthermore, I have learned about the fascinating history of Business Intelligence, including the evolution of EIS from being exclusively for executives to becoming an essential tool for everyone. The course has also helped me understand the five stages of Business Intelligence, which are crucial for any organization aiming to make data-driven decisions. I understood the differences between BPM and BI, I understood the stages of optimizing a business process, where we need to know where we want to go, how we get there, how we are doing, and what we need to do differently.

As I worked on the assignment, I discovered how to utilize Tableau, Excel, and Power BI more effectively. I gained expertise in creating a variety of charts, including area charts, bubble charts, and maps, using Tableau and presenting them in a visually appealing manner. Excel taught me how to tailor slicers and craft dashboards that convey a professional look. Furthermore, I learned to efficiently clean data, which is a crucial aspect of data analysis. Overall, the assignment helped me to enhance my skills and become proficient in data visualization and analysis.

The course has taught me these three crucial skills:

1. Creating interactive dashboards: This skill will enable me to communicate my analysis effectively to stakeholders using visually appealing graphics.
2. Presentation skills: The course has taught me how to create and deliver an engaging presentation that effectively conveys my message to the audience.
3. Analyzing case studies: The course has improved my ability to understand and analyze case studies, which will be beneficial in solving case study interviews.

Speaking personally and honestly, I have experienced errors while using SAP, and I believe there are other software options that may be more effective than SAP. However, I am willing to give SAP the benefit of the doubt, as it is possible that my limited access to the software due to using an educational version may be contributing to the issues. I faced issues while installing all the SAP software on my PC for assignments, and the limited access and authorizations of the software that I was able to install forced me to use alternative software for completing my assignments.

MANAWADU, RASHMIKA| 30426083

In this course, I've embarked on a transformative journey, delving deep into the realms of Business Intelligence and Data Warehousing. My personal understanding of the course content has illuminated the pivotal role of these technologies in today's data-driven landscape.

PERSONAL UNDERSTANDING OF COURSE CONTENT:

The course unveiled the significance of BI and Data Warehousing in unlocking actionable insights from data. These technologies act as the linchpin of data-driven decision-making, empowering businesses to thrive in an increasingly competitive environment.

Three Most Valuable Learnings:

1. Predictive Analytics: The ability to harness historical data for predictive modeling has been a revelation. This skill equips me to forecast future trends and optimize decision-making, enhancing my contributions to my current learning and future professional endeavors. For example, during our group project, I attempted to develop a predictive model using Python within Jupyter notebook. While we faced convergence challenges, the experience underscored the power of predictive analytics in uncovering hidden patterns.
2. Data Cleaning, Conversion, and Formatting: The practical knowledge of data wrangling is indispensable. I've grasped the importance of cleaning, converting, and formatting data correctly to ensure its reliability and suitability for analysis. During our project, I led the data preprocessing phase in Jupyter notebook, which resulted in cleaner, more usable data.
3. BI Dashboard Deployment: Crafting and deploying BI dashboards has been an enlightening experience. The ability to visualize insights in a digestible manner enhances communication and decision-making. For instance, I successfully created and shared a BI dashboard using Power BI, which greatly benefited our project team's understanding of our dataset.

PERSONAL FEELINGS ON SAP PRODUCTS:

The use of SAP products in lab exercises and assignments was a mixed experience. On one hand, SAP provided a comprehensive platform for learning and applying BI concepts. However, it also presented challenges in terms of complexity and learning curve. With time and practice, I started to appreciate the power and flexibility of SAP tools, and I believe they will be advantageous in my future career as they are widely used in industry settings. And also, these experiences have helped me a lot to handle Microsoft Power BI.

PROJECT CONTRIBUTIONS:

In our group project, my contributions were multifaceted. I have completed the data cleaning, conversion, and formatting process through Jupyter notebook. This meticulous data preparation laid the foundation for our subsequent analyses. Additionally, I endeavored to develop a predictive module, applying machine learning techniques in Python through Jupyter notebook. While we encountered challenges with model convergence, this endeavor expanded my technical skills and

provided valuable insights into the complexities of predictive analytics. Ultimately, I successfully leveraged Power BI Desktop version to generate predictions from our dataset, further enhancing our project's value.

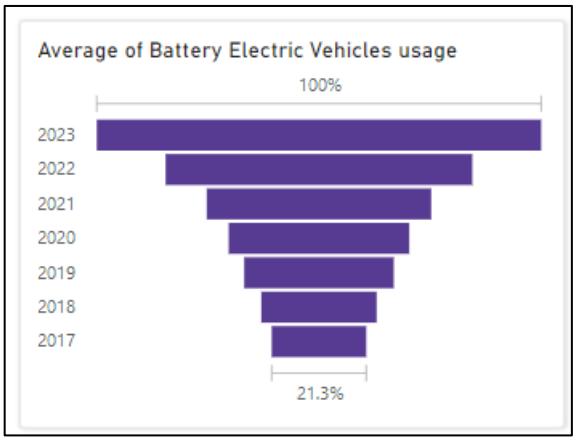
In conclusion, this course has deepened my understanding of BI and Data Warehousing, equipping me with crucial skills and experiences. My involvement in the group project allowed me to apply these newfound capabilities in a real-world context. As I continue my learning journey, I am enthusiastic about leveraging these skills to drive data-driven decisions and contribute meaningfully to future professional endeavors.

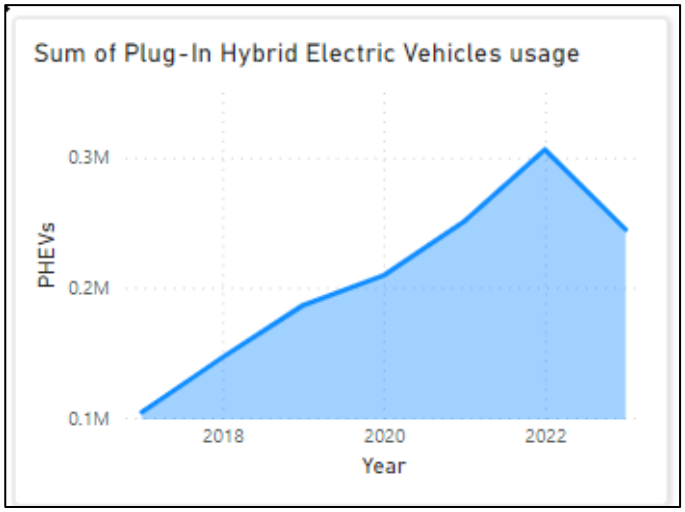
HANNADIGE, SAJITH NIPUNA KARUNARATHNA SELLA | 30418781

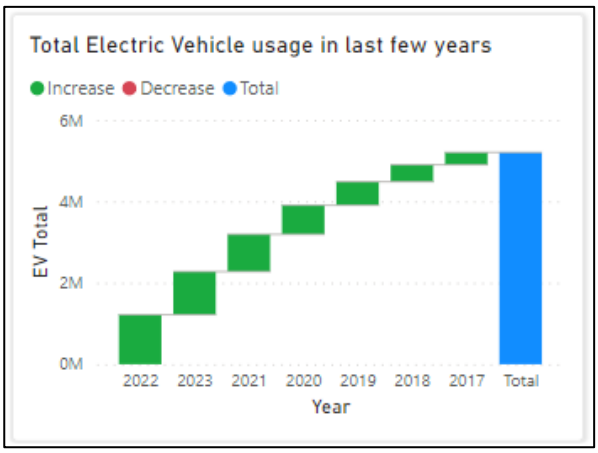
We have started this Assignment with 4 people in our group and our task is to make a report by using given data set and graphically represent it to the audience by analysing the data, in order to do that we have been asked to select 4 tools (Graphical representation dash boards to analyse the given data) and at least 2 techniques to elaborate the answers out of descriptive, predictive and prescriptive techniques.

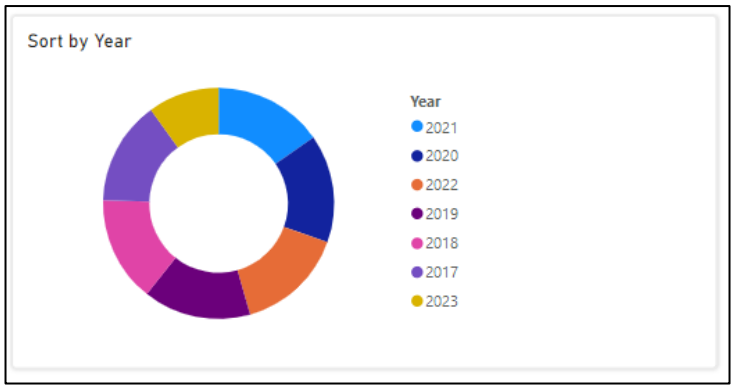
So firstly we have to select a favourable data set to back our assignment and after spending so many hours on finding a good data set finally we found a good data set regarding registered electric and non-electric vehicle population in US we have use different tools to analyse the clean data like Tableau, Google Collab, Microsoft excel, Jupyter, Power BI online and desktop version out of these scenarios my part is to create a dashboard using the given data set and analyse the answers using Power BI online version which is most user friendly graphical representation tool that I have ever used.

Power BI reporting solution – This tool has been selected for the analysis based on its good capability when it comes to matters of versatility, user-friendliness and ease of customization. This tool serves as an empowerment to senior executives as it encourages us to use data-driven insights in decision-making processes. The dashboard on the other hand helps keep track and identify weak points that need reinforcement therefore acting as the central tool.









These Are some Charts I could able to create from Power BI online version

There are so many things I have learned from this assignment

How to choose a good data set and cleaned them for analysation and how to use complex multi dimension data bases

How to enter data in to different charts and graphs to obtain graphical representation and how to design BI dashboards according to the requirement based on BPM

Analysing and forecasting the given data set to make a report based on the given data set to gain insights, generate values from data and to track predict behaviours.

Personal feeling of SAP product used in the lab exercise and assignments.

We have done Considerable amount of SAP exercises in the Lab and we got a thorough basic knowledge about how to make a sap data base and align data so many new features. With some hand on experience during the lab session it seems that Learning SAP is bit difficult but more effective and easier to use when its properly learned.

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