Sri Lanka Institute of Information Technology

Electric Vehicle Population

IE3041

Data Management and Business Intelligence

Project ID: 02

Registration	Student Name
IT 22264152	Sachintha H D D

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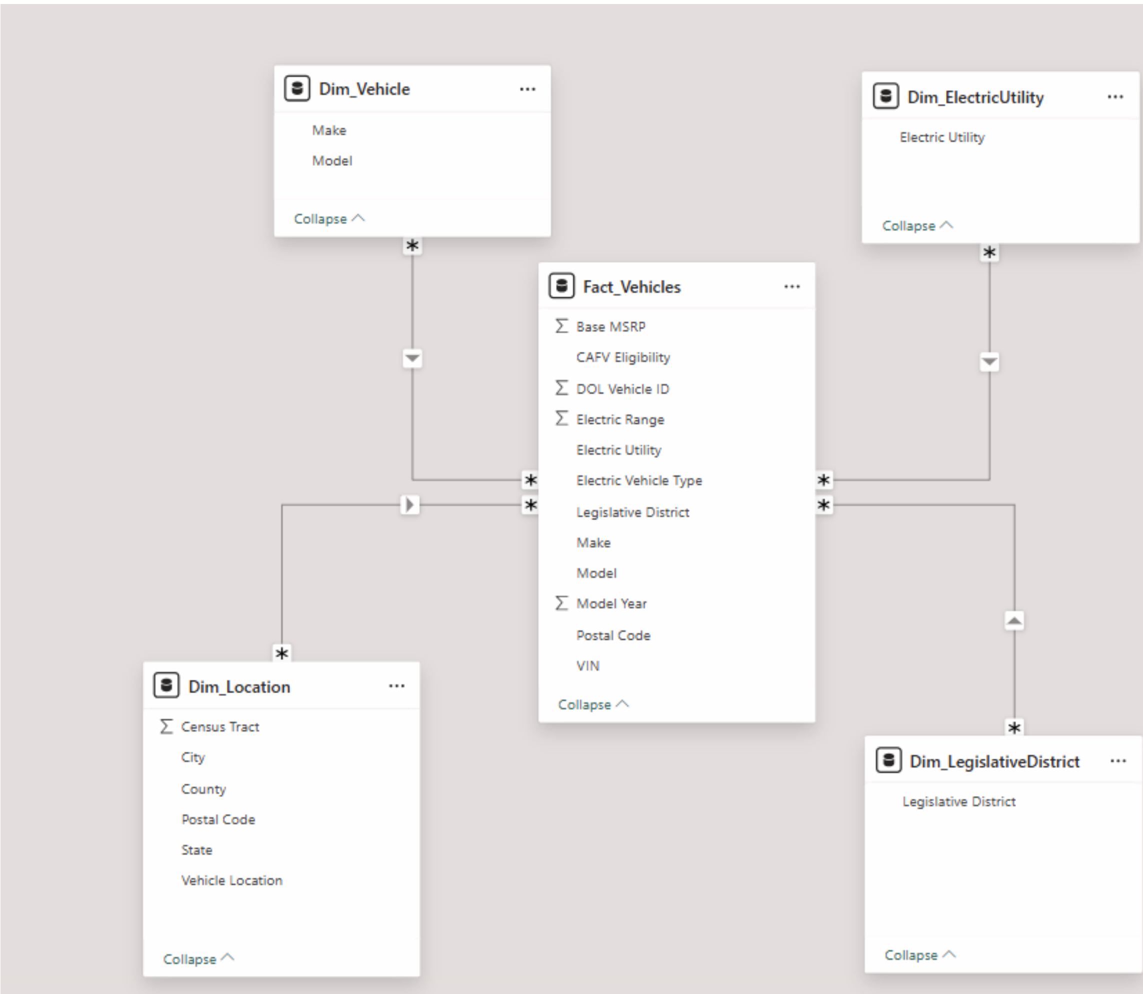
1. Introduction

The Electric Vehicle Population Data dataset on the USA Open Data Portal (https://data.gov) has detailed data on electric vehicles owned and registered in Washington State. Released and updated by the Washington State Department of Licensing (DOL), the dataset has BEV and PHEV information. Covering registrations from 2002 through 2025 in 481 cities, the dataset includes 45 different vehicle models. It is an important dataset for tracking electric vehicle uptake trends, offering rich descriptions of vehicle type, geographic reach, and registration patterns. Policymakers, analysts, and infrastructure planners can leverage the dataset to analyze growing shifts to electric mobility, calculate market penetration, and prepare supporting services like charging facilities and emissions cuts. The data set showcases Washington's commitment to sustainability and facilitates stakeholders in making decisions based on facts for a cleaner transportation future.

The data set has various columns such as VIN (Vehicle Identification Number), County, City, State, Postal Code, Model Year, Make, Model, Electric Vehicle Type, Clean Alternative Fuel Vehicle (CAFV) Eligibility, Electric Range, Base MSRP, Legislative District, etc. The data underwent initial cleaning steps before any analysis was performed. This entailed removing rows with missing or null values in important fields like City, Model Year, Make, and Electric Vehicle Type. Additionally, records with zero Electric Range or Base MSRP were invalid or incomplete and were removed. Also, duplicate records, especially with the same VIN, were removed to maintain data integrity. These cleaning processes ensure that the analysis reflects genuine and meaningful trends in electric vehicle adoption.

2. Schema and Relationships

In this data warehouse schema, the **Fact_Vehicles** table acts as the central fact table containing key metrics such as VIN, Model Year, Electric Vehicle Type, Electric Range, and MSRP. It is connected to four-dimensional tables: **Dim_Vehicle** (Make, Model), **Dim_Location** (Postal Code, City, State), **Dim_ElectricUtility** (Electric Utility), and **Dim_LegislativeDistrict** (Legislative District). Each relationship is many-to-many, meaning each vehicle in the fact table links to one entry in each dimension. This star scheme enables efficient Power BI data analysis, filtering, and reporting. A visual model was created and captured as a screenshot to validate this relational structure.

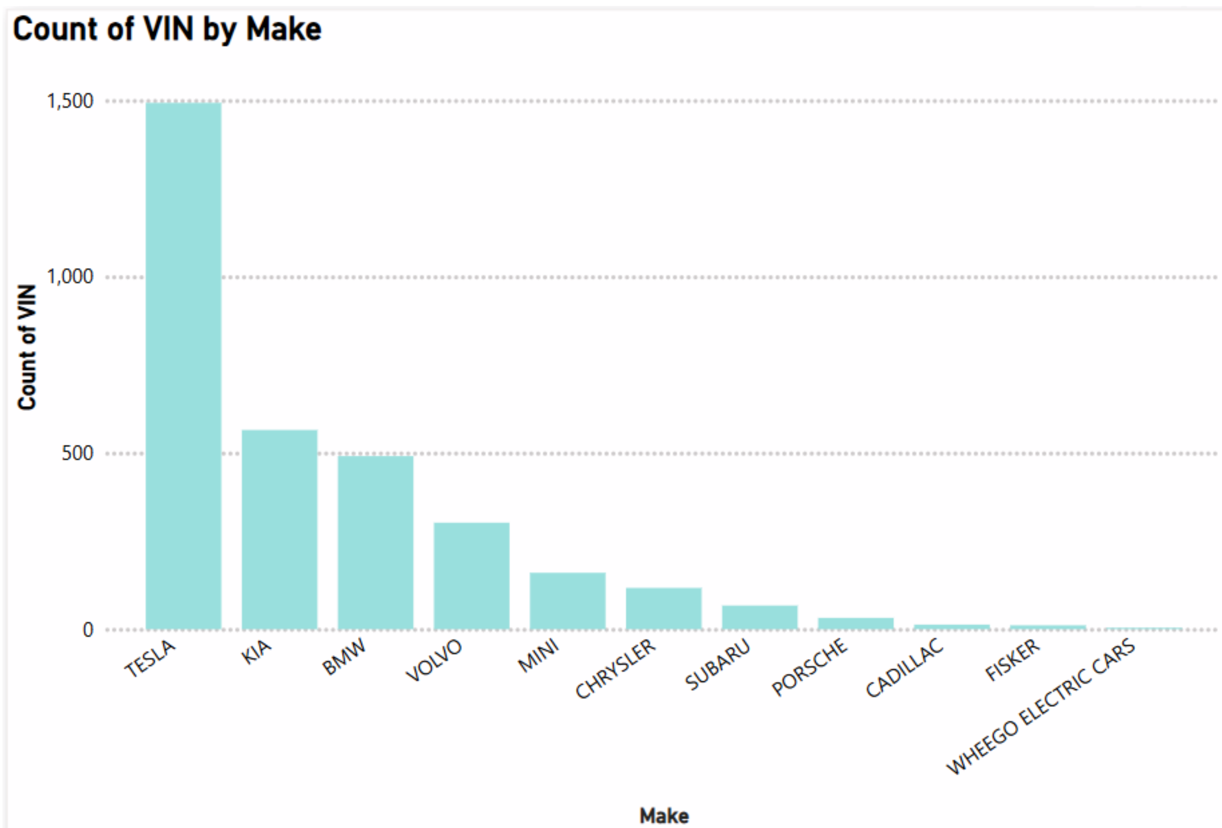


3. Visualizations and Interpretations

Stacked column chart

This visualization displays the total number of electric vehicles for each manufacturer, based on their VIN (Vehicle Identification Number) count. It highlights that TESLA dominates the EV market, followed by other brands like Nissan, BMW, and Ford. This helps identify the market leaders in EV adoption within the dataset.

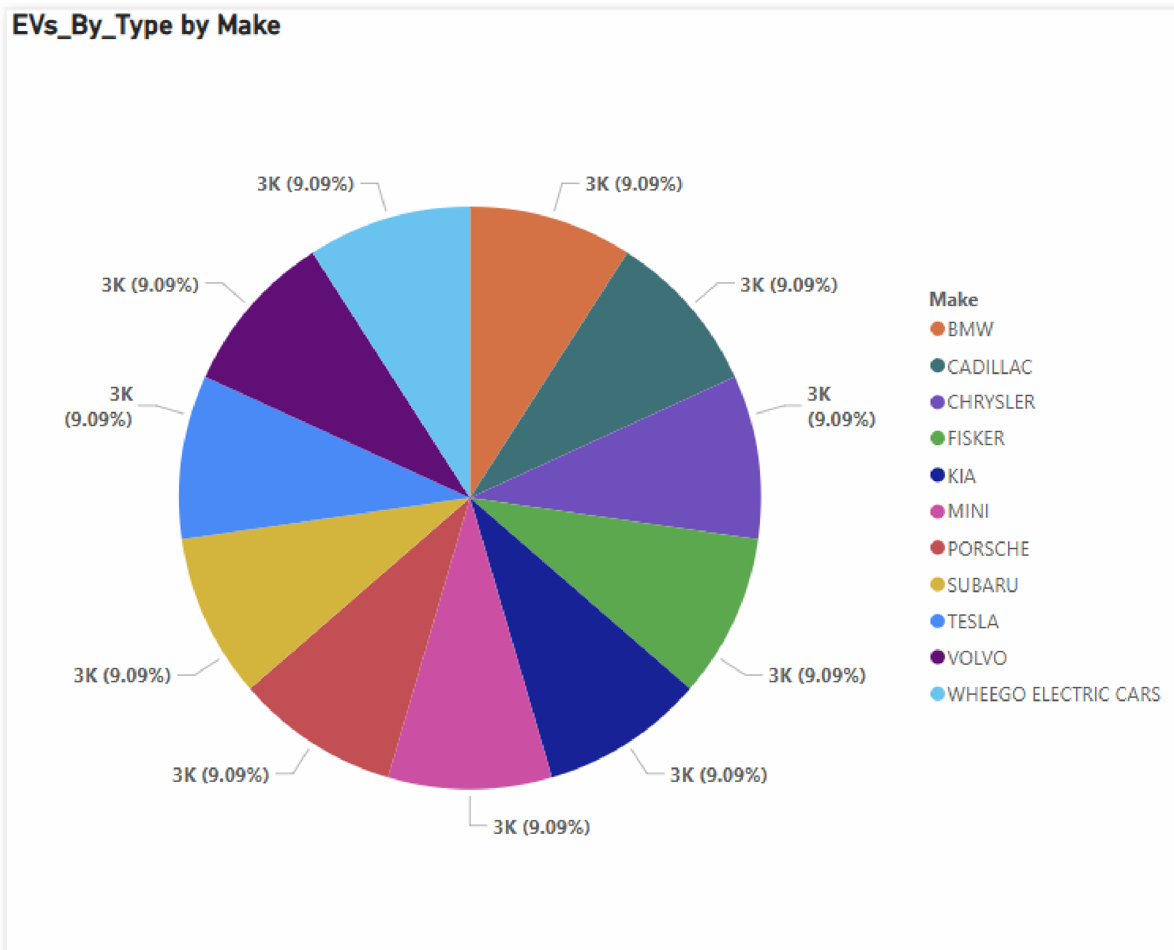
Insight: Useful for understanding which manufacturers have the largest presence in the EV space.



Pie Chart

This chart shows the distribution of EV types (BEV vs. PHEV) across different vehicle makers. Each slice represents a make and its share of either Plug-in Hybrid or Battery Electric Vehicles. Visualization makes it easy to see which brands focus more on fully electric vs. hybrid technology.

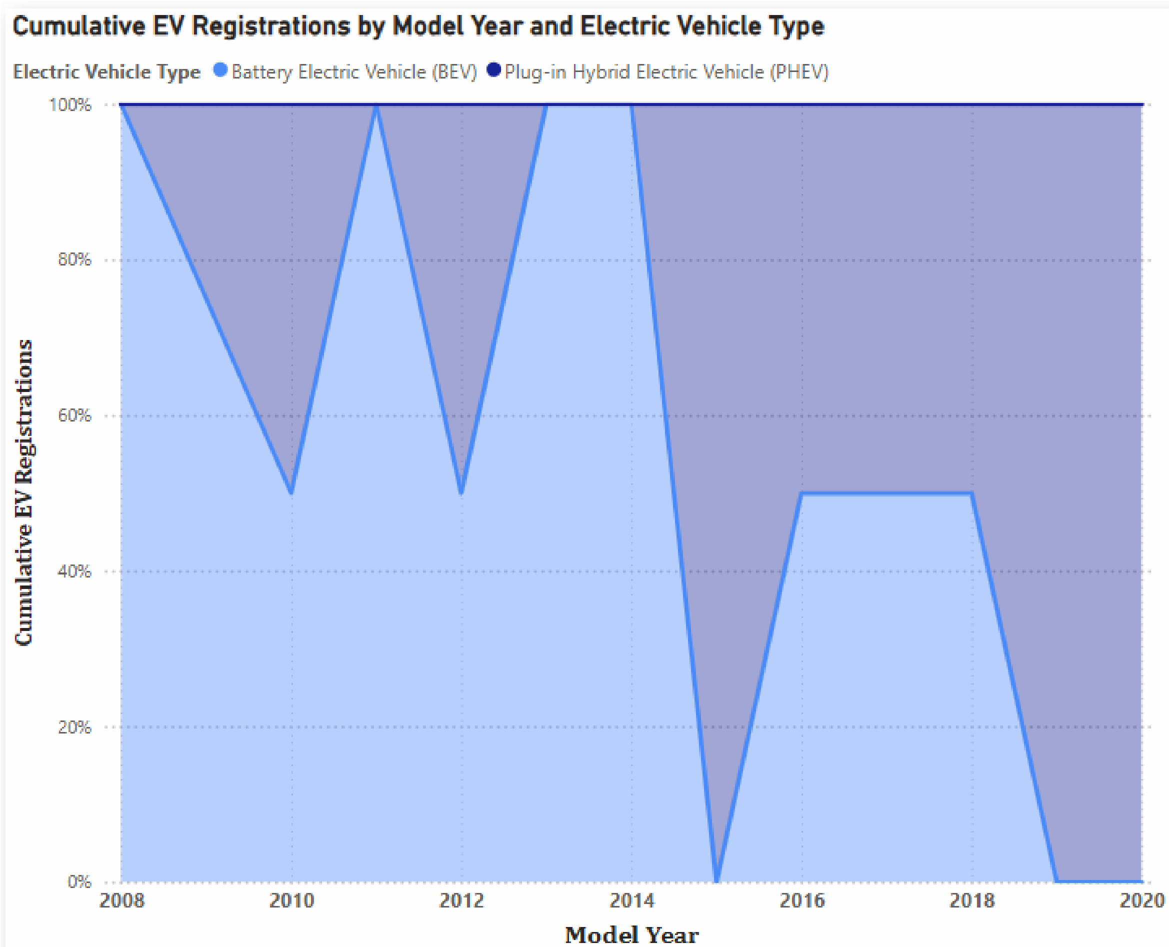
Insight: Helps evaluate manufacturer strategies toward electrification, e.g., TESLA focuses entirely on BEVs.



Stacked area chart

This area chart displays the cumulative growth of electric vehicle registrations over time, broken down by EV type. It visually communicates the increasing trend in EV adoption and shows when certain types (BEV or PHEV) gained popularity.

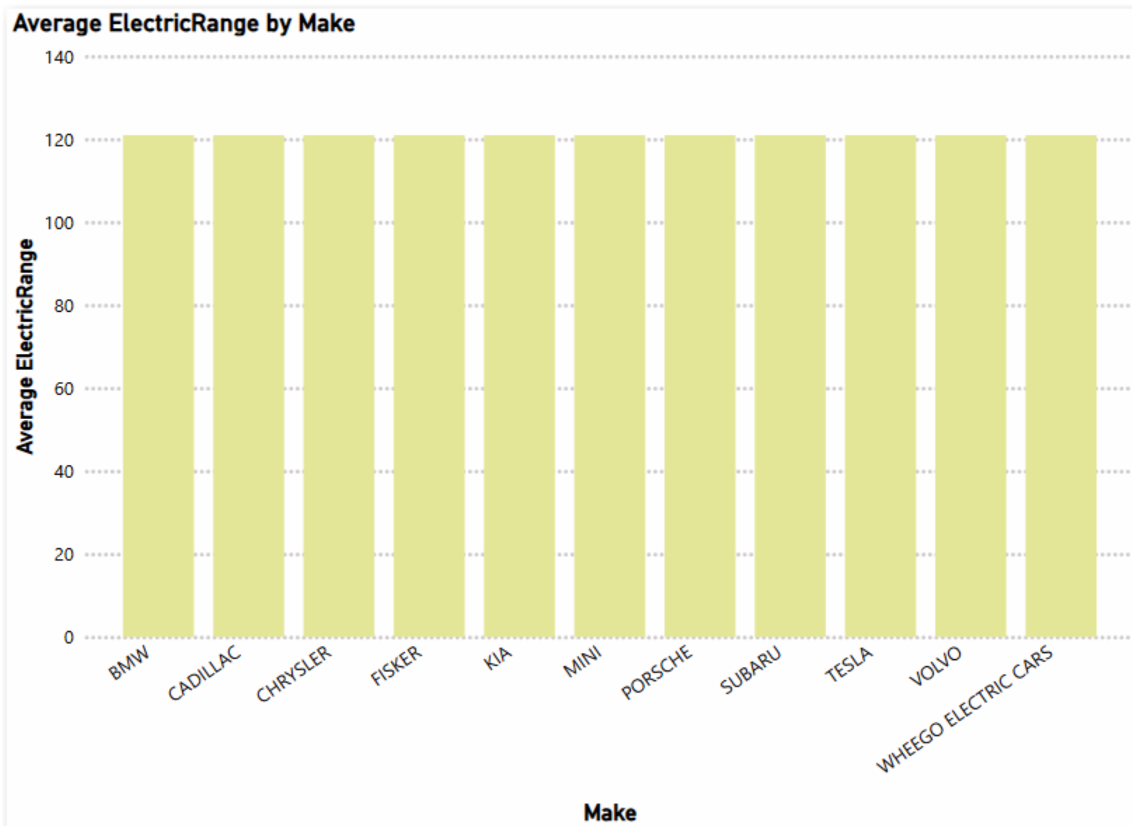
Insight: Reveals how electric vehicle adoption has accelerated or declined in specific years and allows for trend forecasting.



Clustered bar chart

This chart presents the average electric driving range offered by each EV make. It highlights the brands that offer higher efficiency or capacity. Makers like TESLA and BMW show consistently high average ranges, showcasing their technological edge in battery performance.

Insight: Useful for comparing real-world usability and innovation across manufacturers.

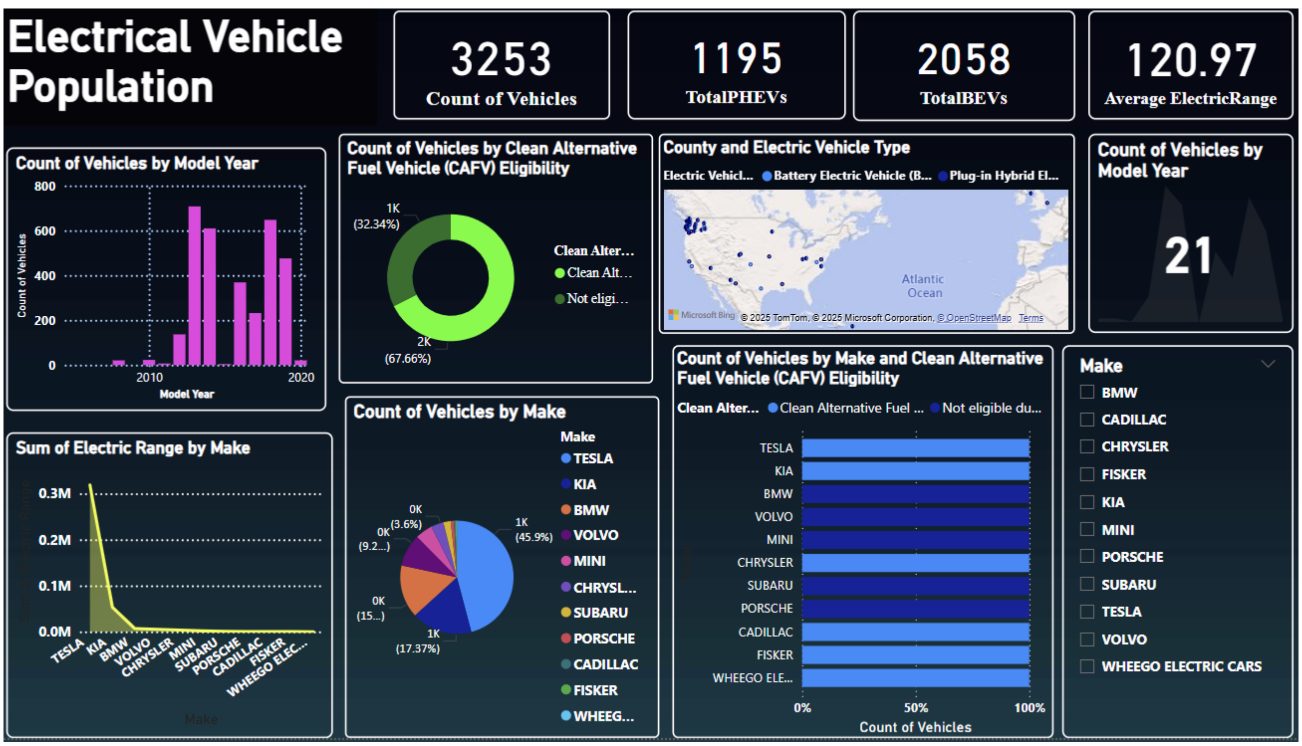


Electric Vehicle Population Dashboard

The Power BI Electric Vehicle Population Dashboard offers a centralized, interactive display of the key insights of the EV dataset to enable strategic decision-making. It has four core KPI cards: Total EVs, which displays the overall number of electric vehicles; Total BEVs, which displays the percentage of purely electric models; Average Model Year, which indicates the newer fleet age; and Maximum Electric Range, which indicates technological advancements in battery technology.

In addition to the KPIs, several insightful charts are included. A Stacked Column Chart illustrates EV distribution among top manufacturers such as Tesla and Nissan. A Pie Chart breaks down EV types (BEVs vs. PHEVs) by manufacturer to identify brand focus. The Area Chart illustrates cumulative registration growth of EVs over time to enable visualization of adoption behavior. A Clustered Bar Chart also contrasts average electric range by manufacturer useful in analyzing performance and consumer demand.

Together, these charts present an overall, fact-based portrait of electric vehicle trends, adoption rates, and company performance that enables stakeholders to monitor progress and plan.



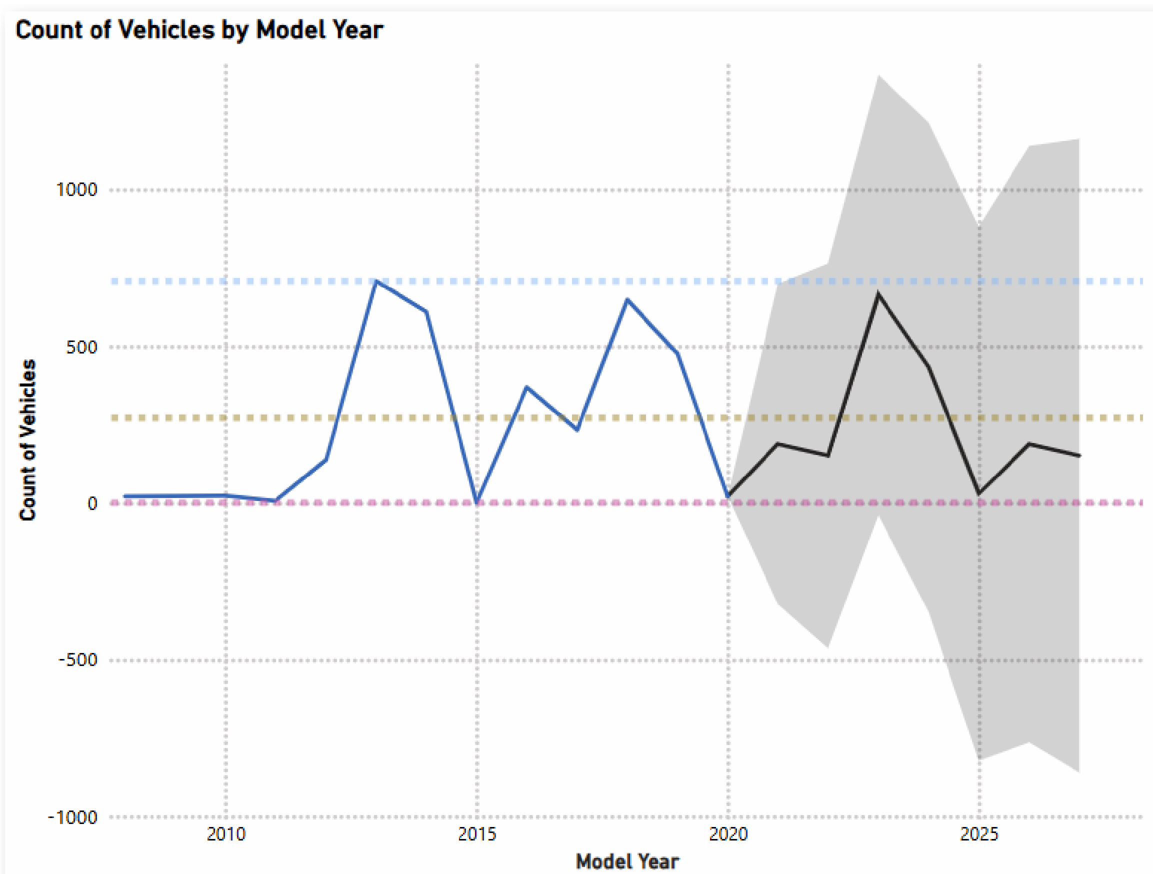
4. Finding and Forecasting

Forecast: Count of Vehicles by Model Year

This line chart shows the historical and predicted number of electric vehicle registrations per model year. The blue line represents actual vehicle counts, while the black line and shaded gray area illustrate the forecast and confidence interval for upcoming years.

- The data shows a steady growth in registrations from around 2012, peaking between 2015–2018.
- The forecast anticipates a moderate increase in the number of vehicles after 2023, though with high uncertainty, as shown by the wide confidence band.

Insight: There is potential for continued growth in EV registrations, but external factors (policy, supply chains, consumer demand) will significantly influence outcomes.

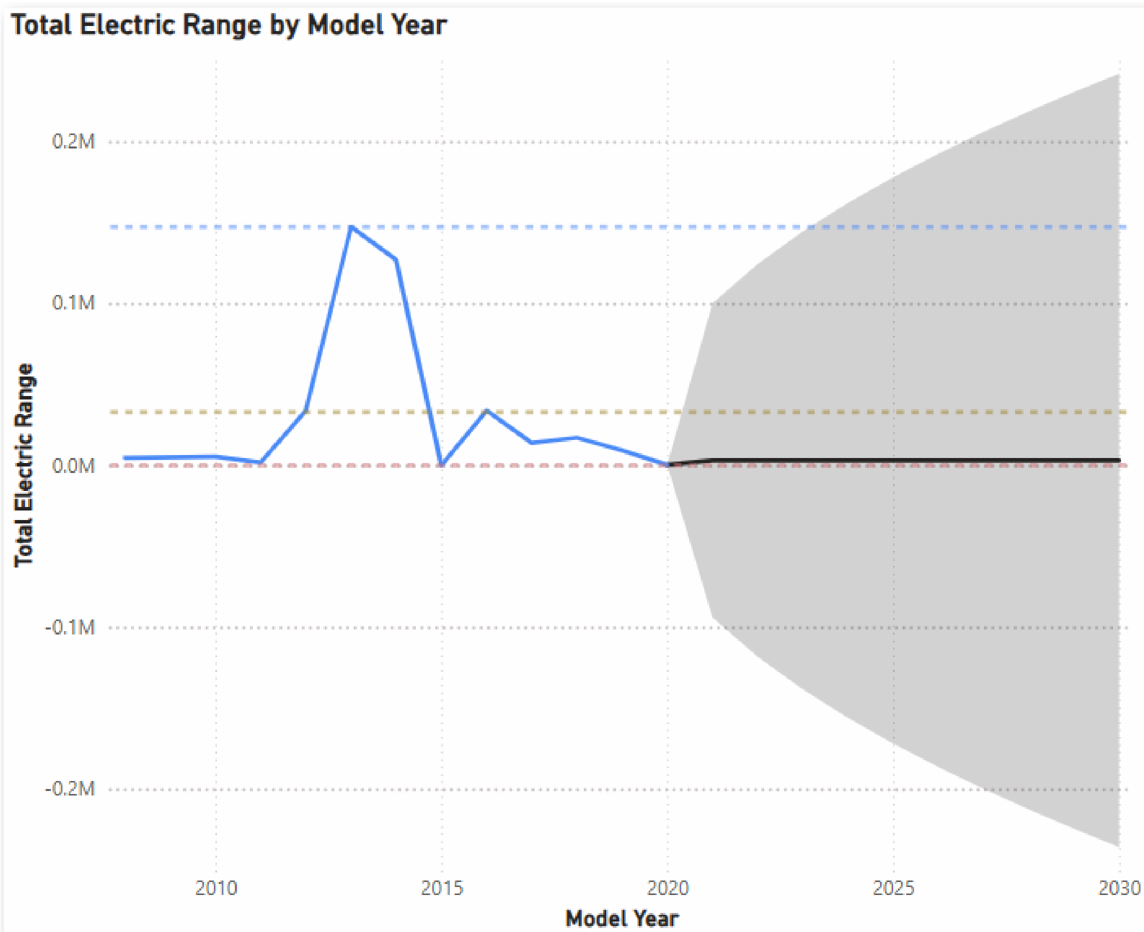


Forecast: Total Electric Range by Model Year

This visualization predicts the total electric range capacity of vehicles by model year. The blue line shows historical totals, and the black line with a gray forecast area shows projected values.

- A sharp increase in total electric range occurred around 2014, aligning with broader EV adoption.
- Forecasts for post-2023 suggest a possible increase in total range, likely due to advancements in battery technology and an increasing number of vehicles.

Insight: As EV technology advances, higher electric ranges are expected in future models, which could further enhance EV adoption.



5. Recommendations

After analyzing and projecting the electric vehicle (EV) population dataset, various strategic suggestions are put forth to aid in decision-making and policy development.

Firstly, visual trends recognize specific countries that have consistent growth in EV registrations. Policymakers and EV producers should target these high-growth counties for concentrated marketing campaigns, dealership establishment, and supply chain improvement. Local governments are encouraged to offer tailored incentives in these counties to further catalyze EV adoption where momentum is already building.

Second, data visualization shows that SUVs and Plug-in Hybrid Electric Vehicles (PHEVs) are increasingly popular. The advice to manufacturers is to synchronize production plans with this trend by making more of these popular models. Addressing consumer demand for larger and more functional EVs can enhance market competitiveness and enlarge customer bases.

Thirdly, low EV uptake areas suffer from a lack of charging infrastructure. There needs to be targeted investment in public charging points in these underrepresented areas. Not only will this cater to current EV owners, but also give confidence to potential buyers, in the knowledge that their travel needs can be fulfilled with reliability.

Lastly, forecasts indicate continued growth in EV adoption in the coming years. To stay ahead of this growth, the private and public sectors must aggressively scale up battery supply chains, manufacturing capacity, and service and maintenance services. In so doing, they will have sufficient resources to meet growing demand and avoid supply chain bottlenecks in the future.

Briefly, these data-driven recommendations are designed to facilitate further EV market growth through regional promotional targeting, consumer-driven production, infrastructure, and future readiness planning.

6. Conclusion

The analysis of the Electric Vehicle Population dataset provided us with valuable information regarding the distribution, trends, and technological advancement of electric vehicles in Washington State. By utilizing a data warehouse with a star schema model and Power BI for visualizations, we were able to display raw vehicle registration data as meaningful intelligence that can support strategic decision-making.

The visualizations pointed to TESLA being the top manufacturer, Battery Electric Vehicles (BEVs) being at the front on adoption, and certain counties trending as hotspots for EV adoption. The models also confirmed the analysis by modeling a steady increase in the number of electric vehicles and total electric range provided across future model years, suggesting sustained advancements in battery technology and industry growth.

Such inferences have already been used for generating pragmatic and visionary recommendations, such as giving high priority to emerging regions, accelerating public charging infrastructure, and preparing to gear up the supply chain to meet growing demand. In addition, the integration of data cleaning, modeling, and advanced visualization has highlighted the strength of business intelligence tools concerning making information-based policy and business decisions.

Overall, the project illustrates quite well how properly planned data and diligent forecasting can make transportation planning sustainable and contribute to the growth of electric vehicle markets. The project highlights the potential of EV analytics in deciding future infrastructure, environmental policies, and manufacturing strategies.