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ELECTRIC VEHICLE ANALYSIS

A Mini-Project Report

For

DATA ANALYSIS - 23CAH-725

Submitted By

ANSHUMAN PAL (23MCI10043)

MD MASOOD AHMED (23MCI10049)

From

23MAM-2 (A)

Submitted to

KRISHAN TULI (E8786)

Signature

Abstract

This project analyzes the electric vehicle (EV) market in the United States, utilizing Power BI to derive insights into trends, market share, and consumer preferences. The analysis is based on a comprehensive dataset containing key information on Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). The dataset includes attributes such as city, state, make, model, electric range, and pricing, allowing for a detailed examination of the EV landscape.

Key performance indicators (KPIs) were identified, including the total number of vehicles, average electric range, and market shares of BEVs and PHEVs. Through various visualizations—such as line charts to illustrate growth over time, map charts to depict regional adoption rates, and bar charts to highlight the dominance of specific brands—significant trends and patterns were identified.

The findings indicate substantial growth in the EV market, with BEVs increasingly preferred by consumers. This project underscores the potential for further adoption of electric vehicles and provides valuable insights that can inform policymakers, manufacturers, and consumers in understanding the dynamics of the electric vehicle sector.

1. Introduction

The electric vehicle (EV) market in the United States has witnessed remarkable growth over the past decade, fueled by advancements in technology, increasing environmental awareness, and supportive government policies. With a shift towards sustainable and eco-friendly transportation, the adoption of electric vehicles, including Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs), has surged. This project aims to analyze the current landscape of the U.S. electric vehicle market using data visualization techniques in Power BI.

The analysis covers various aspects, including the total number of vehicles, average electric range, growth patterns by model year, geographical distribution, and market share of leading manufacturers and models. By understanding these trends, the project seeks to offer valuable insights into the factors driving electric vehicle adoption, the technological progress in the industry, and the role of incentives in promoting clean transportation. The findings provide a comprehensive overview of the electric vehicle market, helping stakeholders make informed decisions to accelerate the transition towards a sustainable future.

2. Methodology

The analysis was conducted using Power BI, with data sourced from a CSV file downloaded from Google. The steps involved in the methodology are as follows:

2.1. Data Collection:

- The data for the project was obtained from a CSV file downloaded from an online source via Google. The dataset includes information on electric vehicles in the U.S., covering details such as vehicle type, model year, electric range, state distribution, manufacturer, and eligibility for Clean Alternative Fuel Vehicle (CAFV) incentives.

2.2. Data Preparation:

- **Data Import:** The CSV file was imported into Power BI for analysis.
- **Data Cleaning:** Basic cleaning steps were performed to ensure data quality, including handling missing values, correcting data types, and removing any duplicates.
- **Data Transformation:** Data transformations were carried out using Power Query, including renaming columns, filtering relevant data (e.g., vehicles from 2010 onwards), and creating calculated columns where necessary to enhance the dataset.

2.3. Data Modeling:

- Relationships between different data fields were established to support dynamic visualizations and analysis.
- Measures and calculated fields were created using DAX (Data Analysis Expressions) to derive insights such as total electric vehicles, percentage calculations, and average electric range.

2.4. Data Visualization:

- Power BI's visualization features were used to create interactive dashboards and reports. Key visualizations included:
  - **Line/Area Charts:** To illustrate trends over time for electric vehicle adoption by model year.
  - **Map Charts:** To visualize the geographical distribution of EVs across states.
  - **Bar Charts:** For identifying the top 10 manufacturers based on the total number of vehicles.
  - **Pie/Donut Charts:** To show the proportion of vehicles eligible for CAFV incentives.
  - **Tree Maps:** To highlight the top 10 electric vehicle models.
  - Interactive elements such as slicers and filters were added to allow for detailed exploration of the data.

2.5. Insights and Analysis:

- The visualizations were used to derive insights, such as the growth of the EV market, regional adoption trends, and the impact of incentives on market growth.

3. Problem Statement and Key Performance Indicators (KPIs)

State the main purpose of the analysis, which is to understand the electric vehicle (EV) landscape in the U.S., including market growth, technological advancements, and adoption trends of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).

KPIs Requirements:

- **Total Vehicles:**
  - Explain the goal of understanding the total number of electric vehicles (both BEVs and PHEVs) to assess market size and growth.
- **Average Electric Range:**
  - State the purpose of analyzing the average electric range to gauge the efficiency and technological progress of electric vehicles.

- **Total BEV Vehicles and Percentage:**
  - Describe the need to identify the total number of BEVs and calculate their percentage to understand the prominence of fully electric vehicles.
- **Total PHEV Vehicles and Percentage:**
  - Outline the goal of determining the total number of PHEVs and calculating their share to gain insights into the plug-in hybrid vehicle market.

Chart Requirements:

- **Total Vehicles by Model Year (From 2010 Onwards):**
  - Visualization: Line/Area Chart
  - Description: Describe how the chart illustrates the growth of electric vehicles over time, providing insights into adoption trends from 2010 onwards.
- **Total Vehicles by State:**
  - Visualization: Map Chart
  - Description: Explain how the map visualization reveals the geographical distribution of EVs across states, helping identify regions with higher adoption rates.
- **Top 10 Total Vehicles by Make:**
  - Visualization: Bar Chart
  - Description: Highlight how this chart identifies the leading manufacturers based on the total number of vehicles, offering insights into brand dominance.
- **Total Vehicles by CAFV Eligibility:**
  - Visualization: Pie/Donut Chart
  - Description: Detail how this chart illustrates the proportion of vehicles eligible for CAFV incentives, providing insights into the impact of incentives on adoption.
- **Top 10 Total Vehicles by Model:**
  - Visualization: Tree Map
  - Description: Describe how the tree map highlights the most popular electric vehicle models, offering insights into consumer preferences.

4. Dataset Used

4.1. Description:

- This dataset encompasses records of electric vehicles (EVs) across various states in the U.S., providing insights into both Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). It allows for a comprehensive analysis of electric vehicle trends, market growth, and consumer preferences.

4.2. Attributes/Columns:

The dataset includes the following key attributes:

- City: The city where the vehicle is registered.
- State: The state of registration.
- Postal Code: The postal code for the vehicle's registered location.
- Model Year: The year the vehicle model was produced.
- Make: The manufacturer of the vehicle (e.g., Tesla, Nissan).
- Model: The specific model of the vehicle (e.g., Model S, Leaf).
- Electric Vehicle Type: The classification of the vehicle, either Battery Electric Vehicle (BEV) or Plug-in Hybrid Electric Vehicle (PHEV).
- Clean Alternative Fuel Vehicle (CAFV) Eligibility: Indicates if the vehicle qualifies for Clean Alternative Fuel Vehicle incentives (Yes/No).
- Electric Range: The maximum distance the vehicle can travel on electric power alone, measured in miles.
- Base MSRP: The manufacturer's suggested retail price for the vehicle.
- Legislative District: The legislative district associated with the vehicle's registration.
- DOL Vehicle ID: The Department of Licensing vehicle identification number.
- Vehicle Location: Details regarding the physical location of the vehicle.
- Electric Utility: The electric utility company associated with vehicle registration.

5. Solution Description

5.1. Total Vehicles:

- Solution: Calculated the total number of electric vehicles (including both BEVs and PHEVs) in the dataset. Created a new measure named "Total Vehicle" and "DistinctCount" formula is used by the Vehicle ID to count total number of Vehicle.

  Total Vehicles = DISTINCTCOUNT(Electric_Vehicle_Population_Data[DOL Vehicle ID])

- Used a card visualization in Power BI to display the total count.

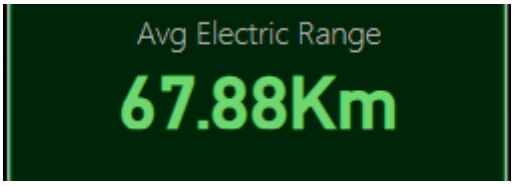
- Insights: The result showed the overall growth of electric vehicle adoption in the U.S., indicating a steady increase in recent years.

5.2. Average Electric Range:

- Solution: Calculated the average electric range of the vehicles in the dataset by aggregating the electric range values.

  Average Range = CONCATENATE(FORMAT(AVERAGE(Electric_Vehicle_Population_Data[Electric Range]),"0.00"),"Km")

- Used a card or line chart to display the average range and its change over time.



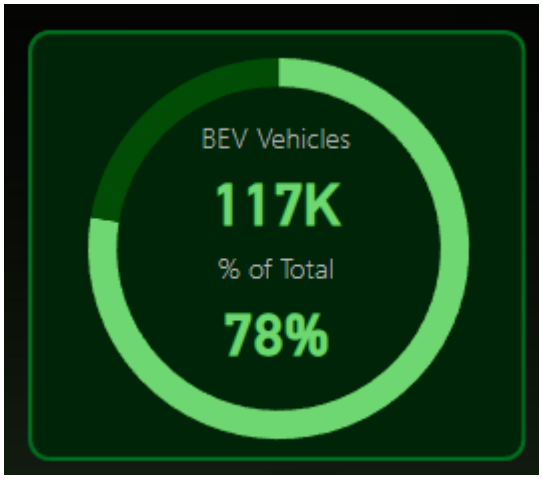
- Insights: The analysis revealed improvements in the average electric range over the years, indicating technological advancements in EV battery efficiency.

5.3. Total BEV Vehicles and Percentage:

- Solution: Filtered the dataset to identify Battery Electric Vehicles and calculated the total number of BEVs. Also, calculated the percentage of BEVs relative to the total electric vehicle count using DAX expressions.

  BEV Vehicles = CALCULATE([Total Vehicles], Electric_Vehicle_Population_Data[Electric Vehicle Type]="Battery Electric Vehicle (BEV)")

Percent of BEV = [BEV Vehicles]/[Total Vehicles]



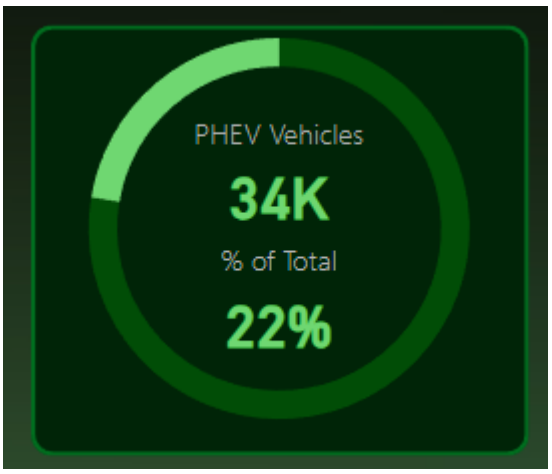
- Insights: The analysis showed that BEVs had a significant share of the market, suggesting a trend toward fully electric vehicles over plug-in hybrids.

5.4. Total PHEV Vehicles and Percentage:

- Solution: Similarly, filtered the dataset to identify Plug-in Hybrid Electric Vehicles and calculated their total number and percentage relative to all electric vehicles.

  PHEV Vehicles = CALCULATE([Total Vehicles], Electric_Vehicle_Population_Data[Electric Vehicle Type]="Plug-in Hybrid Electric Vehicle (PHEV)")

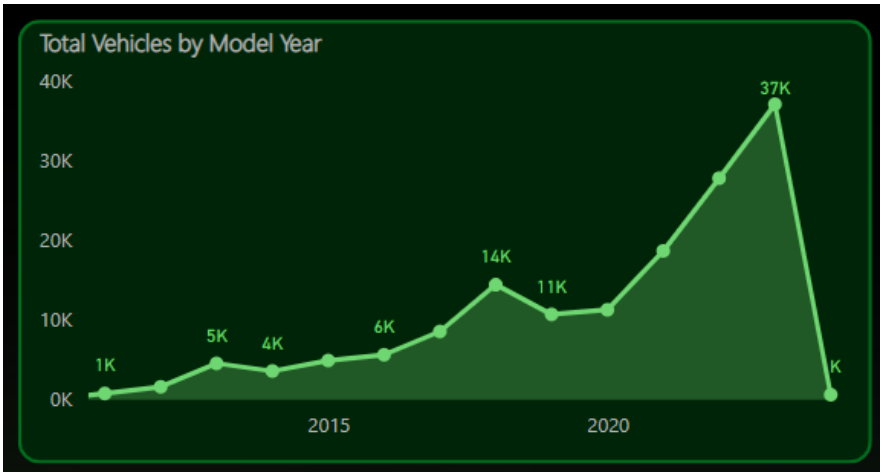
  % of PHEV = [PHEV Vehicles]/[Total Vehicles]



- Insights: The analysis provided insights into the market share of PHEVs, which, while substantial, was smaller than that of BEVs, indicating a preference for fully electric options.

5.5. Total Vehicles by Model Year (From 2010 Onwards):

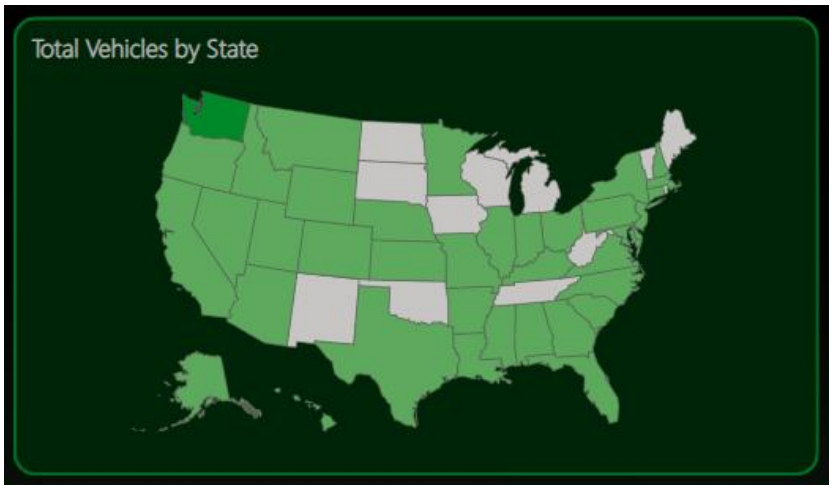
- Solution: Created a line or area chart showing the number of electric vehicles by model year from 2010 onwards. This involved filtering the dataset by year and aggregating the vehicle counts for each year.



- Insights: The chart illustrated the rapid growth in electric vehicle adoption in recent years, with a noticeable increase after 2015, reflecting rising consumer interest and policy support for EVs.

5.6. Total Vehicles by State:

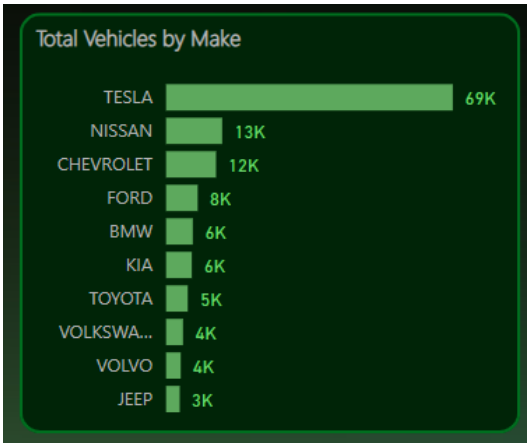
- Solution: Used a map visualization to show the distribution of electric vehicles across different U.S. states. The dataset was grouped by state to aggregate the total number of vehicles for each location.



- Insights: The map identified regions with higher adoption rates, such as California, indicating that state-specific policies and incentives might play a significant role in driving EV adoption.

5.7. Top 10 Total Vehicles by Make:

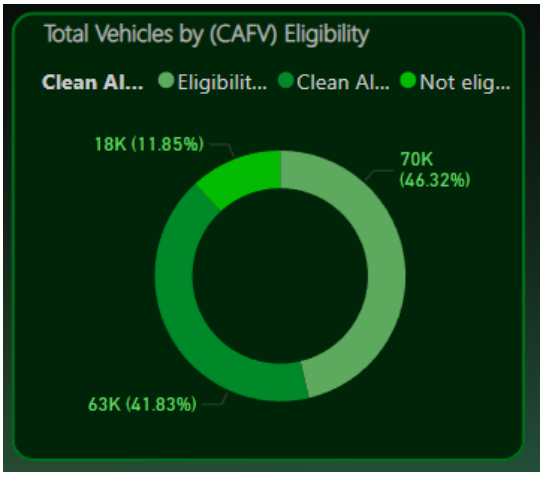
- Solution: Created a bar chart to display the top 10 manufacturers based on the total number of electric vehicles. The data was sorted and filtered to show the leading brands.



- Insights: The analysis highlighted the dominance of certain manufacturers in the market, with brands like Tesla leading the way in terms of the number of electric vehicles.

5.8. Total Vehicles by CAFV Eligibility:

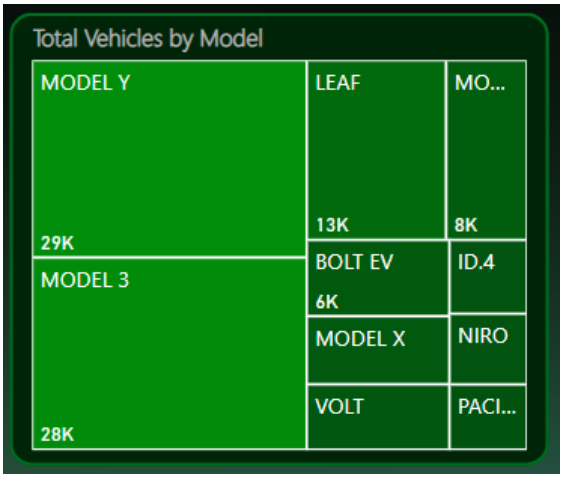
- Solution: Used a pie or donut chart to show the proportion of vehicles eligible for Clean Alternative Fuel Vehicle (CAFV) incentives. Calculated the percentage of vehicles that qualify for these incentives.



- Insights: The chart helped understand the impact of CAFV incentives on vehicle adoption, indicating that a significant portion of electric vehicles qualified for these benefits.

5.9. Top 10 Total Vehicles by Model:

- Solution: Created a tree map visualization to highlight the top 10 electric vehicle models based on the total number of vehicles in the dataset. This involved filtering and sorting the data by vehicle model.



- Insights: The tree map provided insights into consumer preferences, showing the popularity of specific models such as the Tesla Model 3 and Chevrolet Bolt.

6. Conclusion

The Electric Vehicle Analysis project provided a comprehensive overview of the current landscape of electric vehicles (EVs) in the United States. By utilizing Power BI to analyze the dataset, we gained valuable insights into the growth trends, market dynamics, and consumer preferences associated with both Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).

The analysis revealed key performance indicators, such as the total number of vehicles, average electric range, and the market share of BEVs and PHEVs. Through visualizations, we were able to identify patterns in vehicle adoption over the years and across different states, highlighting regions with significant growth and areas that may benefit from increased incentives and infrastructure development.

Overall, this project emphasizes the importance of data-driven decision-making in understanding the electric vehicle market. The insights gained can inform policymakers, manufacturers, and consumers alike, contributing to the ongoing transition toward sustainable transportation solutions. Continued analysis and monitoring of this dataset will be essential as the market evolves, helping stakeholders adapt to changing trends and consumer needs in the electric vehicle sector.