

# **“ Project Title : Driving the Future: Analyzing Electric Vehicle Adoption ”**

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# Project Title: "Driving the Future: Analyzing Electric Vehicle Adoption "

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## Introduction:

This project involves analyzing electric vehicle (EV) data, focusing on various attributes like vehicle make, model, type, range, eligibility for alternative fuel programs, and geographic distribution. This data could help in understanding the adoption of electric vehicles across different regions in Washington, analyzing eligibility for alternative fuel programs, and assessing patterns in EV model popularity, range, and usage across counties

## Project Description:

The dataset contains detailed records of registered electric vehicles across Washington State, including information on vehicle make, model, year, type, electric range, CAFV (Clean Alternative Fuel Vehicle) program eligibility, and geographic registration details. This data provides a unique opportunity to:

- Assess the distribution of EVs by geographic location.
- Identify which vehicle types are most prevalent and analyze range capabilities.
- Examine eligibility for alternative fuel programs.
- Understand the relationship between EV distribution and local electric utility providers.

## Data Source:

The data was obtained from an official registry, including key details about EVs in United States. Each entry represents an EV registered in Washington, capturing essential details such as model year, make, type, and eligibility for fuel programs.

## Dataset Attributes:

1. **Vehicle Identification (VIN):** A unique identifier for each vehicle, truncated to the first 10 characters for privacy.
2. **Geographic Information:**
  - **County:** The county where the vehicle is registered.
  - **City:** The city of registration.
  - **State:** Always Washington (WA) in this dataset.
  - **Postal Code:** ZIP code associated with the registration.
3. **Vehicle Specifications:**

- **Model Year:** Year the vehicle was manufactured.
- **Make:** Manufacturer of the vehicle (e.g., Tesla, Nissan).
- **Model:** Specific model name (e.g., Model 3, Leaf).
- **Electric Vehicle Type:** Indicates if the vehicle is a Battery Electric Vehicle (BEV) or a Plug-in Hybrid Electric Vehicle (PHEV).
- **Electric Range:** Maximum electric-only range (in miles) of the vehicle.

#### 4. **Eligibility and Location Attributes:**

- **CAFV Eligibility:** Indicates eligibility for the Clean Alternative Fuel Vehicle program.
- **Legislative District:** The legislative district associated with the registration.
- **Electric Utility:** The electric utility provider serving the registration location.
- **2020 Census Tract:** Census tract information for demographic analysis.

### **Potential Research Questions:**

1. **CAFV Program Eligibility:** What percentage of vehicles are eligible for CAFV programs, and what are the characteristics of these eligible vehicles?
2. **Geographic Distribution:** How are EVs distributed across counties, cities, and legislative districts? Are there certain areas with notably higher or lower EV adoption rates?
3. **Electric Range:** What is the average electric range of vehicles in this dataset? How does it differ between BEVs and PHEVs?
4. **EV Adoption and Utilities:** Are there patterns in EV adoption rates among different electric utility service areas?

### **Methodology:**

The project will involve data cleaning, exploratory data analysis (EDA), and visualization to uncover trends and insights. Descriptive statistics will summarize key characteristics, while geographic analysis will help visualize the distribution of EVs across Washington. Advanced analysis could involve regression or machine learning models to predict EV adoption rates or eligibility for fuel programs based on various factors.

### **Significance:**

As Washington State transitions to sustainable energy sources, understanding EV adoption patterns can help policymakers, utility providers, and automotive companies make informed decisions regarding EV infrastructure, incentives, and support services. This project also contributes to understanding barriers to EV adoption and the impact of eligibility programs on promoting cleaner energy usage.

# Add Excel data to Tableau :

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## Step 1: Open Tableau

1. Launch Tableau on your computer.

## Step 2: Connect to Data

1. On the start page, you'll see several options for connecting to data.
2. Under the **"Connect"** section, click on **"Microsoft Excel."**

## Step 3: Select the Excel File

1. A file dialog will appear. Navigate to the location where your Excel file is saved.
2. Select the Excel file containing your EV vehicles data and click **"Open."**

## Step 4: Choose the Worksheet

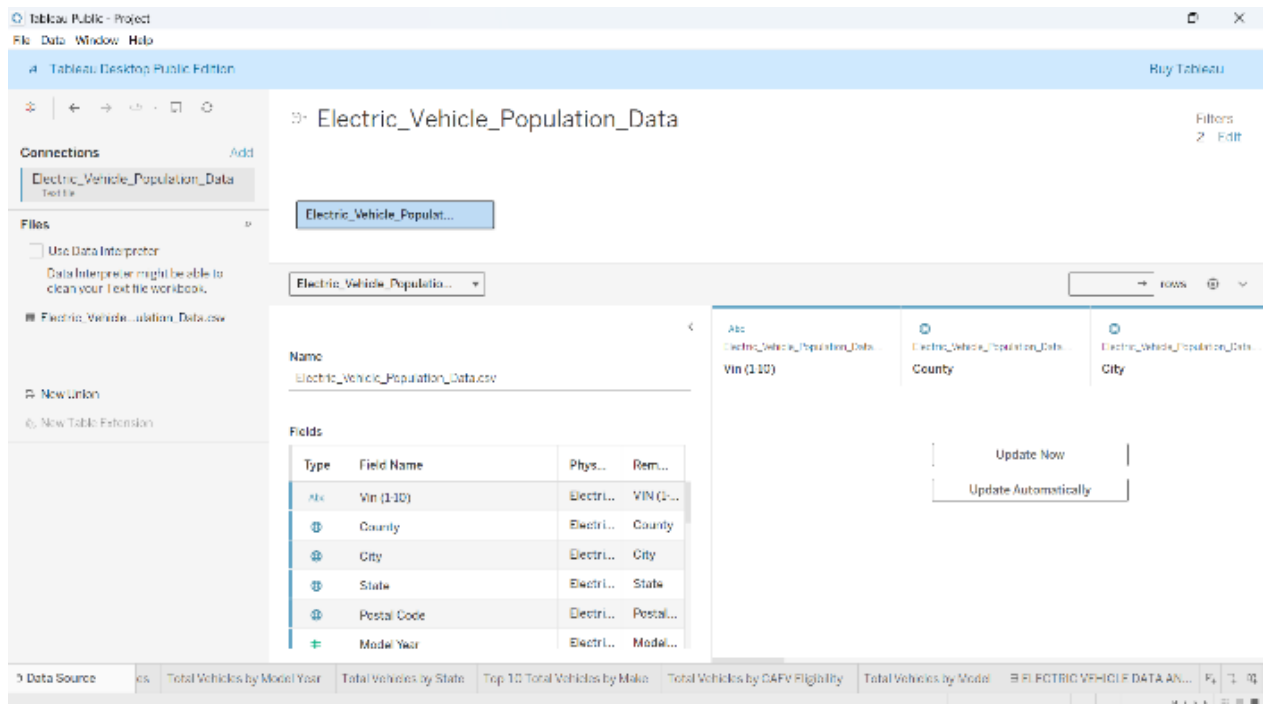
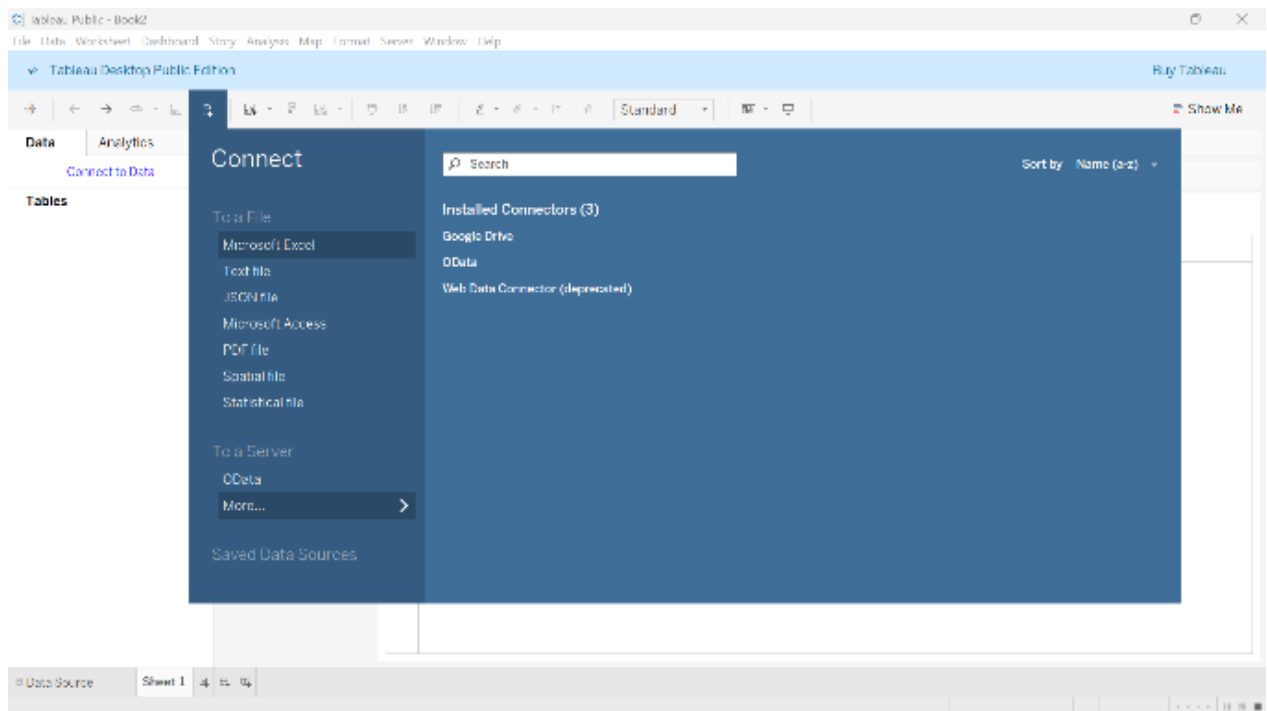
1. After opening the file, Tableau will display the sheets available in the Excel file on the left side.
2. Drag the desired worksheet(s) from the left pane to the **"Drag sheets here"** area in the middle.

## Step 5: Review Data

1. Tableau will automatically load a preview of your data. You can review it to ensure the data is correct.
2. Make sure the data types (e.g., string, number, date) are recognized correctly. If not, you can adjust them by clicking on the data type icon in the column header.

## Step 6: Go to Sheet

1. Once you've confirmed your data, click on the **"Sheet 1"** tab at the bottom to start creating your visualizations.
2. Tableau will take you to the worksheet view, where you can begin dragging fields to
3. create your visualizations.

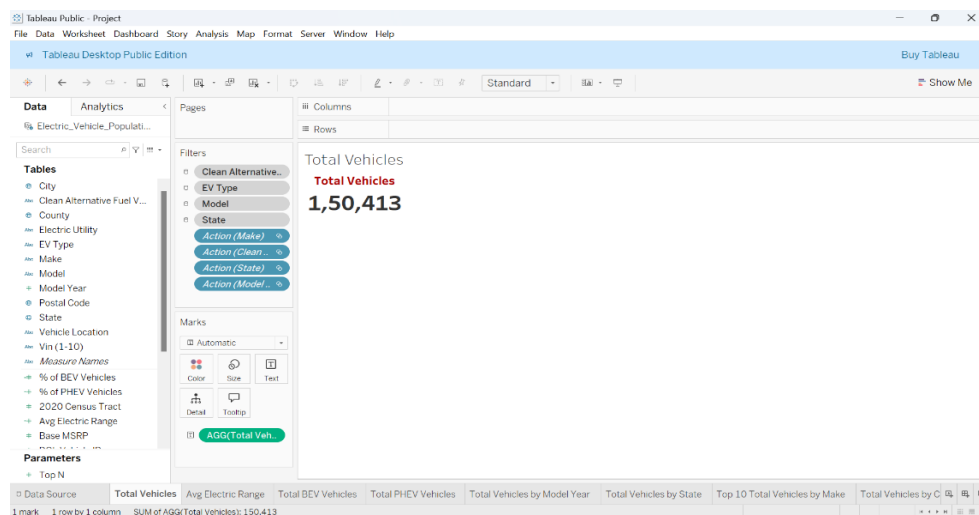


## Sheet 1: Total Vehicles –

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### Steps:

1. **Open Sheet 1:** Click on the "Sheet 1" tab.
2. **Add Data Source Filter:**
  - In the Data pane, right-click on the data source and select "**Edit Data Source Filter.**"
  - Add a filter for "**Model Year.**"
  - Set the filter range to include values starting from **2011** to the current year, **2024** (automatically updated each year).
  - Click "**OK**" to apply the filter.
3. **Create a Calculated Field:**
  - Go to "**Analysis**" > "**Create Calculated Field...**"
  - Name it "**Total Vehicles.**"
  - Enter the formula:  
$$= \text{COUNTD}([\text{DOL Vehicle ID}])$$
  - Click "**OK.**"
4. **Add to Worksheet:**
  - Drag "**Total Vehicles**" from the Data pane to the **Text** shelf on the Marks card.
5. **View Result:** The total number of distinct vehicles, filtered by model year, will be displayed.
6. **Format Text (Optional):** Customize the text appearance for better visibility.

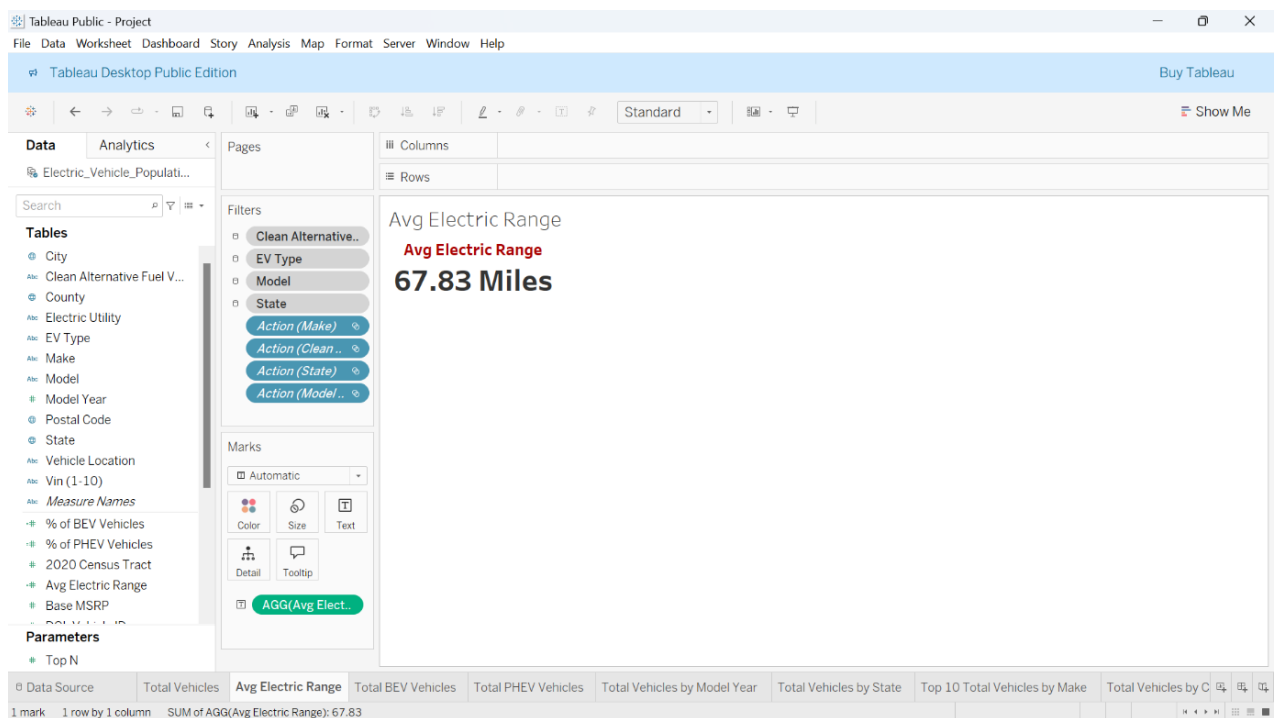


## Sheet 2: Avg Electric Range –

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### Steps:

1. **Open Sheet 2:** Click on the "Sheet 2" tab.
2. **Create a Calculated Field:**
  - Go to "Analysis" > "Create Calculated Field..."
  - Name it "Avg Electric Range."
  - Enter the formula:  
$$=AVG([Electric\ Range])$$
  - Click "OK."
3. **Add to Worksheet:**
  - Drag "Avg Electric Range" from the Data pane to the Text shelf on the Marks card.
4. **View Result:** The average electric range of the vehicles will be displayed.
5. **Format Text (Optional):** Customize the text appearance for better visibility.



## Sheet 3: Total BEV Vehicles and % of Total BEV Vehicles -

### Steps:

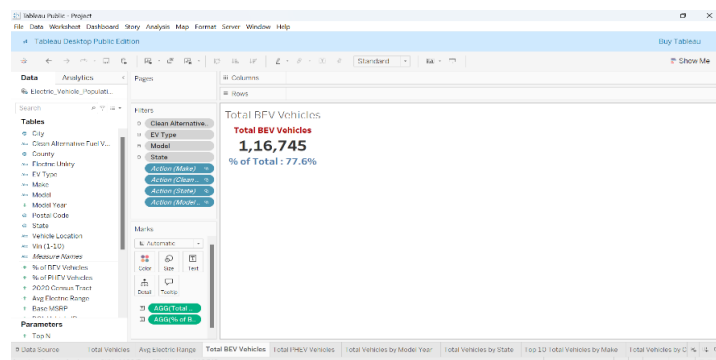
1. **Open Sheet 3:** Click on the "Sheet 3" tab.
2. **Create a Calculated Field for Total BEV Vehicles:**
  - Go to "Analysis" > "Create Calculated Field..."
  - Name it "Total BEV Vehicles."
  - Enter the formula:

= COUNTD(IF [Electric Vehicle Type] = "Battery Electric Vehicle (BEV)" THEN [DOL Vehicle ID] END)

- Click "OK."
3. **Add to Worksheet:**
    - Drag "Total BEV Vehicles" from the Data pane to the **Text** shelf on the Marks card.
  4. **Create a Calculated Field for Percentage of Total BEV Vehicles:**
    - Go to "Analysis" > "Create Calculated Field..."
    - Name it "Percentage of Total BEV Vehicles."
    - Enter the formula:

= [Total BEV Vehicles] / [Total Vehicles] \* 100

- Click "OK."
5. **Add Percentage to Worksheet:**
    - Drag "Percentage of Total BEV Vehicles" from the Data pane to the **Text** shelf on the Marks card, next to the total count of BEV vehicles.
  6. **View Results:** The total number of BEVs and their percentage of total electric vehicles will be displayed.
  7. **Format Text (Optional):** Customize the text appearance for better visibility.





## Sheet 4: Total PHEV Vehicles and % of Total PHEV Vehicles -

### Steps:

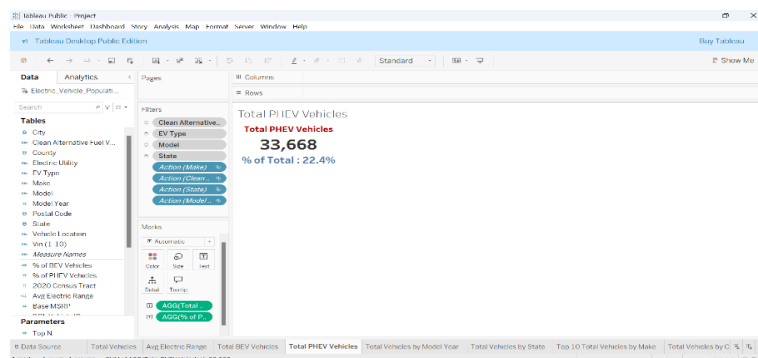
1. **Open Sheet 4:** Click on the "Sheet 4" tab.
2. **Create a Calculated Field for Total PHEV Vehicles:**
  - Go to "Analysis" > "Create Calculated Field..."
  - Name it "Total PHEV Vehicles."
  - Enter the formula:

**= COUNTD(IF [Electric Vehicle Type] = "Plug-in Hybrid Electric Vehicle (PHEV)" THEN [DOL Vehicle ID] END)**

- Click "OK."
3. **Add to Worksheet:**
    - Drag "Total PHEV Vehicles" from the Data pane to the **Text** shelf on the Marks card.
  4. **Create a Calculated Field for Percentage of Total PHEV Vehicles:**
    - Go to "Analysis" > "Create Calculated Field..."
    - Name it "Percentage of Total PHEV Vehicles."
    - Enter the formula:

**= [Total PHEV Vehicles] / [Total Vehicles] \* 100**

- Click "OK."
5. **Add Percentage to Worksheet:**
    - Drag "Percentage of Total PHEV Vehicles" from the Data pane to the **Text** shelf on the Marks card, next to the total count of PHEV vehicles.
  6. **View Results:** The total number of PHEVs and their percentage of total electric vehicles will be displayed.
  7. **Format Text (Optional):** Customize the text appearance for better visibility.



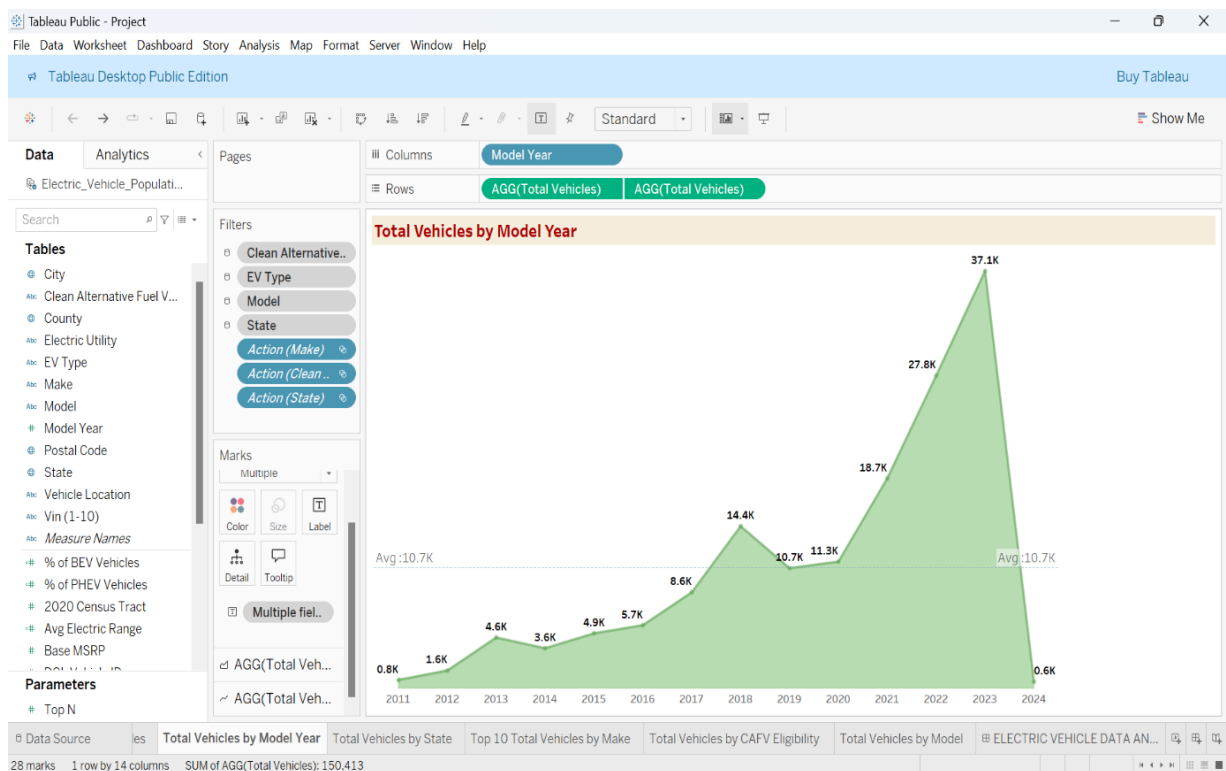
## Sheet 5: Total Vehicles by Model Year (From 2010 Onwards) –

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### Steps:

1. **Open Sheet 5:** Click on the "Sheet 5" tab.
2. **Add Model Year and Total Vehicles:**
  - Drag "Model Year" to the **Columns** shelf.
  - Drag "Total Vehicles" to the **Rows** shelf.
3. **Create an Area Chart:**
  - From the **Show Me** panel, select the **Area Chart** option.
4. **Limit Model Year Range:**
  - Right-click on the **Model Year** pill in the Columns shelf and select "**Edit Filter.**"
  - Set a fixed range starting from **2011** to the current year (automatically update).
5. **Duplicate Total Vehicle Rows:**
  - Hold down **Ctrl** (or Command on Mac) and drag the **Total Vehicles** pill from the Rows shelf to create a duplicate.
6. **Change the Duplicate to Line Chart:**
  - Click on the **drop-down** menu on the duplicate **Total Vehicles** pill and select "**Line Chart.**"
7. **Combine Area and Line Charts:**
  - Right-click on the duplicate line chart's axis and select "**Dual Axis.**"
  - Right-click on either axis and choose "**Synchronize Axis.**"
8. **Hide Header:**

Right-click on the **Make** header and select "**Hide Header**" to make the chart cleaner.
9. **Add Total Vehicles in Label:**
  - Click on the **Text** shelf in the Marks card for the line chart and drag the **Total Vehicles** field into the **Label** shelf.
  - Set the **alignment** of the label to **vertical** and position it to the **top**.



## Sheet 6: Total Vehicles by State –

### Steps:

1. **Open Sheet 6:** Click on the "Sheet 6" tab.
2. **Add Longitude and Latitude:**
  - Drag "Longitude (generated)" to the **Columns** shelf.
  - Drag "Latitude (generated)" to the **Rows** shelf.
3. **Add State to Detail:**
  - Drag "State" from the Data pane to the **Detail** shelf on the Marks card.
4. **Set Map Location to the United States:**
  - Right-click on the **State** field on the Marks card, select "Edit Locations."
  - Set the country/region to "United States" and click "OK."
5. **Change to Shape Map:**
  - From the **Marks** drop-down menu, change the mark type to "Map."

## 6. Add Total Vehicles to Color:

- Drag **"Total Vehicles"** to the **Color** shelf on the Marks card to color the map based on vehicle count.

## 7. Exclude States with Low Values:

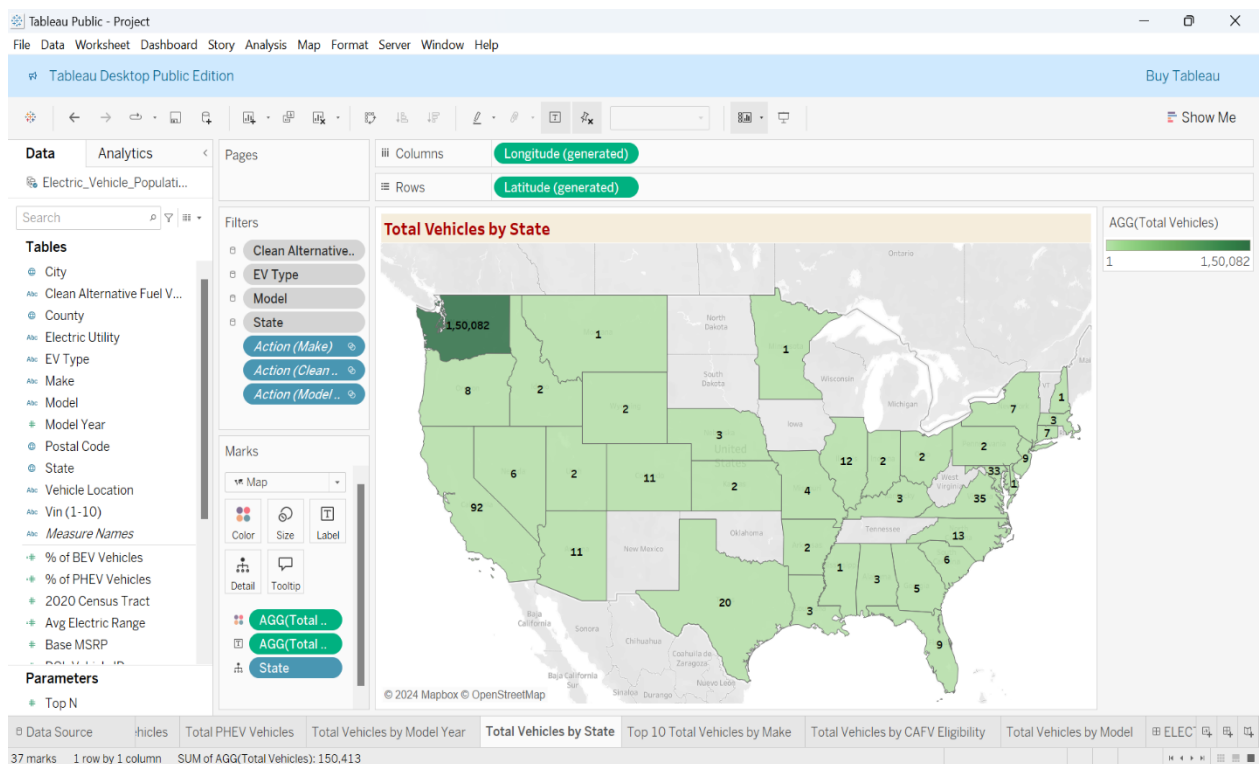
- Drag **"Total Vehicles"** to the **Filters** shelf and exclude states that have only **1 vehicle** by setting a filter condition to remove these values.

## 8. Fit the Map to View:

- Go to the **"Map"** menu and choose **"Fit to View"** to adjust the map's display to fit within the dashboard view.

## 9. Add Total Vehicles to Labels:

- Drag **"Total Vehicles"** to the **Label** shelf on the Marks card to display the total vehicle count for each state on the map.



## Sheet 7: Top 10 Total Vehicles by Make -

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### Steps:

1. **Open Sheet 7:** Click on the "Sheet 7" tab.
2. **Add Make and Total Vehicles:**
  - Drag "Make" to the **Rows** shelf.
  - Drag "Total Vehicles" to the **Columns** shelf.
3. **Sort by Total Vehicles:**
  - Right-click on the **Total Vehicles** axis and choose "**Sort Descending**" to sort the manufacturers by the number of vehicles in descending order.
4. **Add Filter for Top N Makes:**
  - Drag "Make" to the **Filters** shelf.
  - Go to the "Top" tab, select "**By Field**", and set it to show the **Top N** by **Total Vehicles**.
5. **Create a Parameter for Top N:**
  - Go to **Analysis > Create Parameter...**
  - Name the parameter "**Top N**".
  - Set the **Current Value** to **10**.
  - Set the **Range of Values** with a minimum of **1** and a maximum of **15**.
  - Click "**OK**."
6. **Apply Top N Parameter:**
  - In the **Filters** shelf, select "**Make**", go to the **Top** tab, and link it to the newly created "**Top N**" parameter.
  - Click "**Apply**."
7. **Fit to Entire View:**
  - Go to the "**Worksheet**" menu and select "**Fit**" > "**Entire View**" to display the full bar chart.
8. **Hide Header:**
  - Right-click on the **Make** header and select "**Hide Header**" to make the chart cleaner.

## 9. Add Total Vehicles to Labels:

- Drag **"Total Vehicles"** to the **Label** shelf on the Marks card to display the total number of vehicles on each bar.

## 10. Add Percentage of Total Vehicles:

- Optionally, create a calculated field for **Percentage of Total Vehicles** and add it to the label for additional context.

## 11. Edit Title:

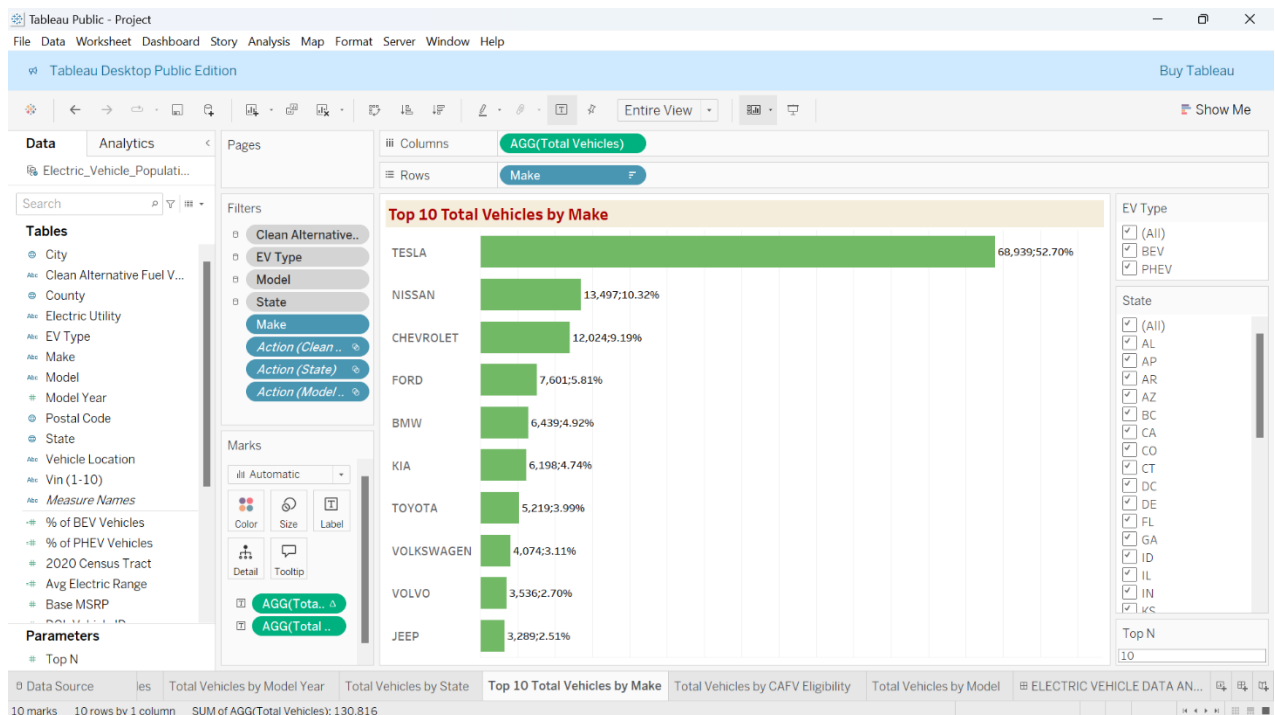
- Edit the chart title to:  
**Top <Parameter.Top N> Total Vehicles by Make.**

## 12. Add Filters for State and Electric Vehicle Type:

- Drag **"State"** and **"Electric Vehicle Type"** to the **Filters** shelf.
- Set both filters to **"Use All"** values and check **"Apply Show Filter"** to make these filters visible on the dashboard.
- Right-click on the filters and select **"Add to Context"** for better filter interaction.

## 13. Format and Finalize:

- Adjust formatting as needed for labels and axis.
- Ensure the bar chart is clean and visually appealing.



## Sheet 8: Total Vehicles by CAFV Eligibility –

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### Steps:

1. **Open Sheet 8:** Click on the "Sheet 8" tab.
2. **Add CAFV Eligibility Field:**
  - Drag "CAFV Eligibility" to the **Colors** shelf on the Marks card to differentiate eligible and non-eligible vehicles by color.
3. **Create a Pie Chart:**
  - Set the **Marks** type to **Pie**.
  - Drag "Total Vehicles" to the **Angle** shelf to adjust the slice sizes based on vehicle count.
4. **Adjust the View:**
  - Go to the "Worksheet" menu and select "Fit" > "Entire View" to make the pie chart fit the whole canvas.
5. **Create Donut Chart (Dual-Axis Pie):**
  - Double-click in the **Rows** shelf and type **AVG(0)** to create a placeholder axis.
  - Hold **Ctrl** and drag the created field to the right to duplicate it, creating two identical pie charts.
6. **Modify the Second Pie Chart:**
  - On the second **Marks** card (for the duplicated axis), remove all fields (angles, colors, labels) to leave it as a blank pie.
7. **Dual Axis and Synchronize:**
  - Right-click on the second **AVG(0)** axis and select "Dual Axis" to merge both pies into one.
  - Right-click on the axis again and choose "Synchronize Axis" for alignment.
8. **Adjust Pie Sizes:**
  - Increase the size of the first pie chart (outer circle) using the **Size** shelf on the Marks card.
  - Increase the size of the second pie chart (inner circle) to create the donut effect.

## 9. Hide Axis Headers:

- Right-click on the headers for both axes and choose **"Hide Header"** to remove unnecessary labels.

## 10. Style the Donut Chart:

- On the second (inner) pie chart, set the **Color** to **white** to match the background, creating a hole in the middle.

## 11. Add Labels:

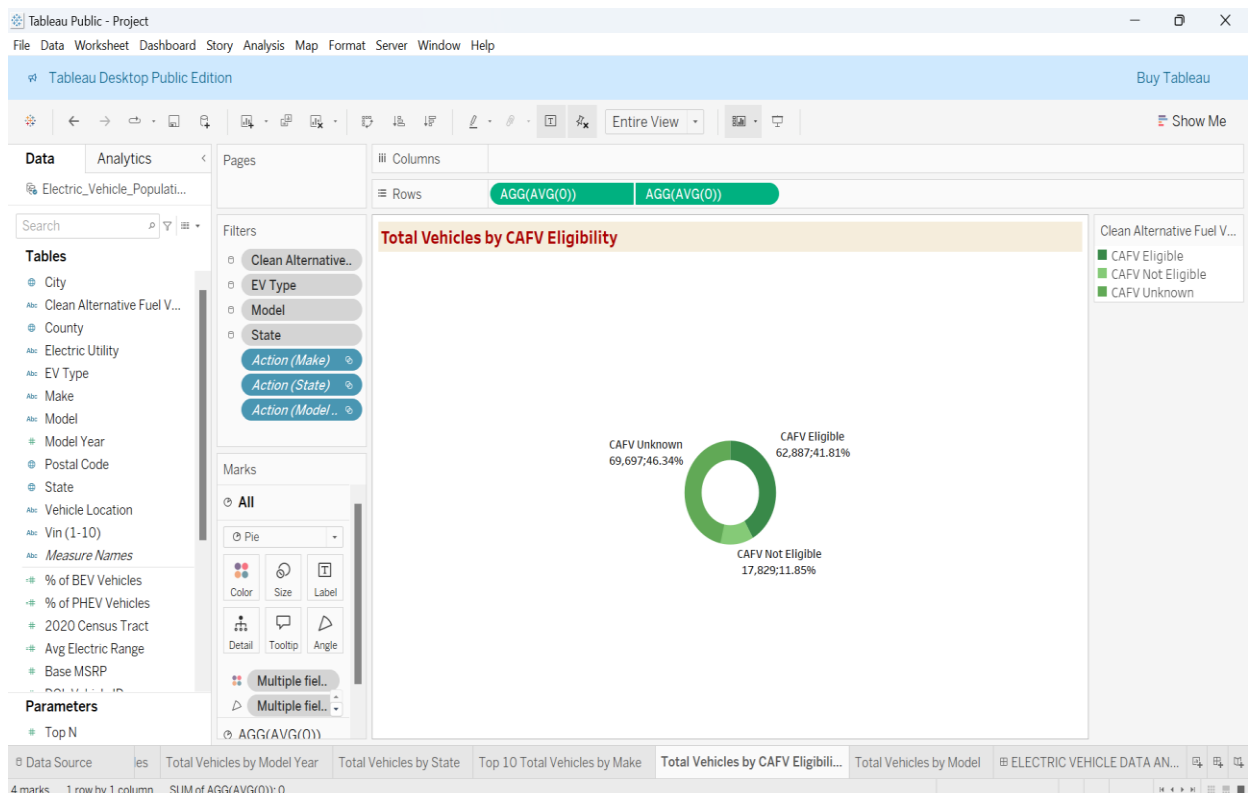
- Drag **"Total Vehicles"** to the **Label** shelf on the first pie chart to display the vehicle count.
- Drag **"Total Vehicles"** again to show the percentage of each slice.
- Add **"CAFV Eligibility"** to the **Label** shelf to display eligibility status.
- Format the labels as needed, adjusting the font size and position for clarity.

## 12. Alias the CAFV Names:

- Right-click on the **CAFV Eligibility** values and select **"Edit Alias"** to simplify or customize the labels for better readability.

## 13. Final Adjustments:

- Format the chart for clarity and aesthetic appeal, ensuring that labels are legible and the pie chart is proportionally balanced.





## Sheet 9: Top 10 Total Vehicles by Model -

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### Steps:

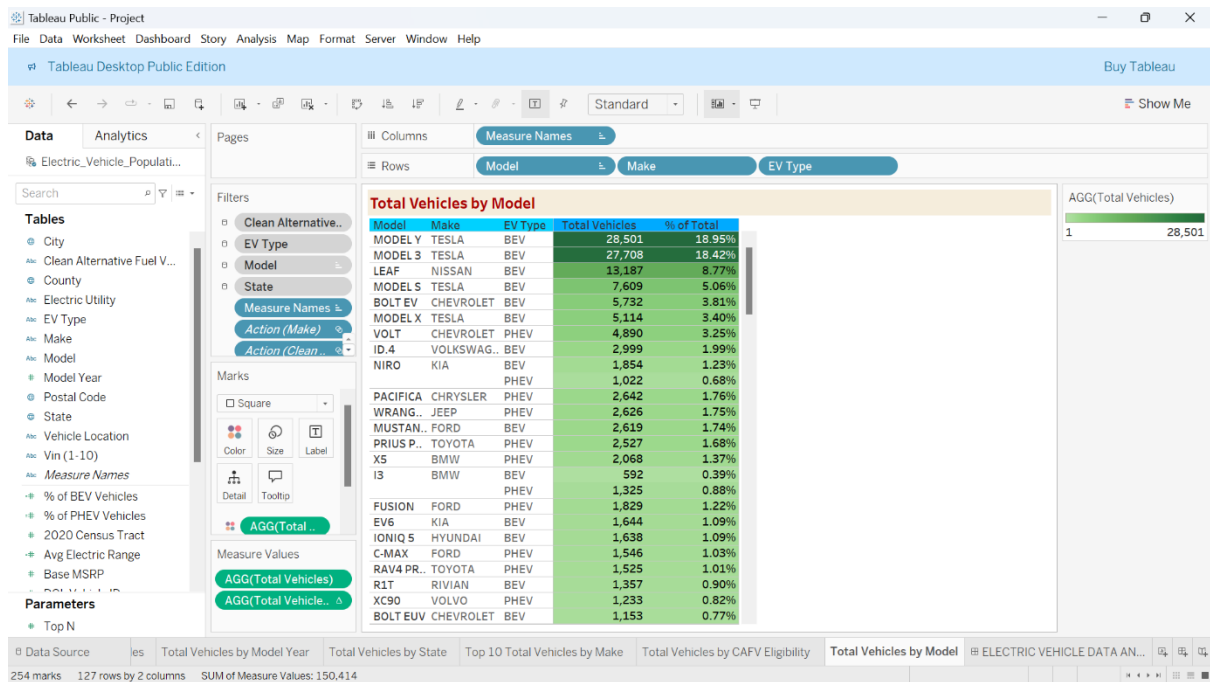
1. **Open Sheet 9:** Click on the "Sheet 9" tab.
2. **Add Data Fields:**
  - Drag "**Model**", "**Make**", and "**Electric Vehicle Type**" into the **Rows** shelf to represent vehicle models and types.
  - Drag "**Total Vehicles**" into the **Text** shelf to display the total count of vehicles for each model.
3. **Sort Models:**
  - Click on the "**Model**" field and choose **Sort Descending** to list the models based on total vehicle count in descending order.
4. **Add Color:**
  - Drag "**Total Vehicles**" again into the **Color** shelf to color-code the vehicles based on the number of units.
5. **Calculate Percentage of Total:**
  - Drag "**Total Vehicles**" again into the **Text** shelf and set it to display the **percentage of total vehicles** to give context to each model's share in the market.
6. **Adjust the Visualization to Tree Map:**
  - Go to the **Marks** card and set the **Chart Type** to **Squares** to create a **Tree Map**.
7. **Limit to Top 10 Models:**
  - Add the "**Model**" field to the **Filters** shelf.
  - In the filter options, go to **Top > By Field**.
  - Select "**Top 10 by Total Vehicles**" to limit the tree map to only the top 10 models based on vehicle count.
8. **Aliases for Electric Vehicle Type:**
  - Right-click on the "**Electric Vehicle Type**" field and choose "**Edit Alias**" to simplify the labels (e.g., "BEV" for Battery Electric Vehicles, "PHEV" for Plug-in Hybrid Electric Vehicles).

## 9. Formatting:

- Adjust the size, colors, and labels for clarity, ensuring each block of the tree map is easy to interpret.
- Customize the font for **Total Vehicles** and **Percentage** for better readability.

## 10. Final Adjustments:

- Ensure the tree map is fit to **Entire View** for optimal visualization.
- Hide unnecessary headers to make the tree map cleaner.



## Dashboard: ELECTRIC VEHICLE DATA ANALYSIS –

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### 1. Initial Setup:

- Create a new dashboard.
- Change the size to **PowerPoint dimensions (1600x900)**.
- Edit the dashboard title to **ELECTRIC VEHICLE DATA ANALYSIS**.

### 2. Horizontal Container for KPIs:

- Add a **horizontal container** to the dashboard.
- Place a blank at the bottom for reference (remove it later).
- Add **Sheet 1 (Total Vehicles)**, **Sheet 2 (Avg Electric Range)**, **Sheet 3 (Total BEV Vehicles)**, and **Sheet 4 (Total PHEV Vehicles)** into the container.
- Distribute content evenly using the **Distribute Content** event for equal spacing.
- Hide the titles for each sheet, set them to **Fit Width**, and center align them.
- Apply background formatting and padding.

### 3. Left Vertical Container (Formatting):

- Add a **vertical container** on the left.
- Apply color formatting and padding for design consistency.

### 4. Horizontal Container for Line and Map Charts:

- Add another **horizontal container**.
- Add **Sheet 5 (Map Chart - Total Vehicles by State)** and **Sheet 6 (Line Chart - Total Vehicles by Model Year)** into the container.
- Apply quick formatting and shading to ensure a polished look.

### 5. Horizontal Container for Top 10 Charts and Pie Chart:

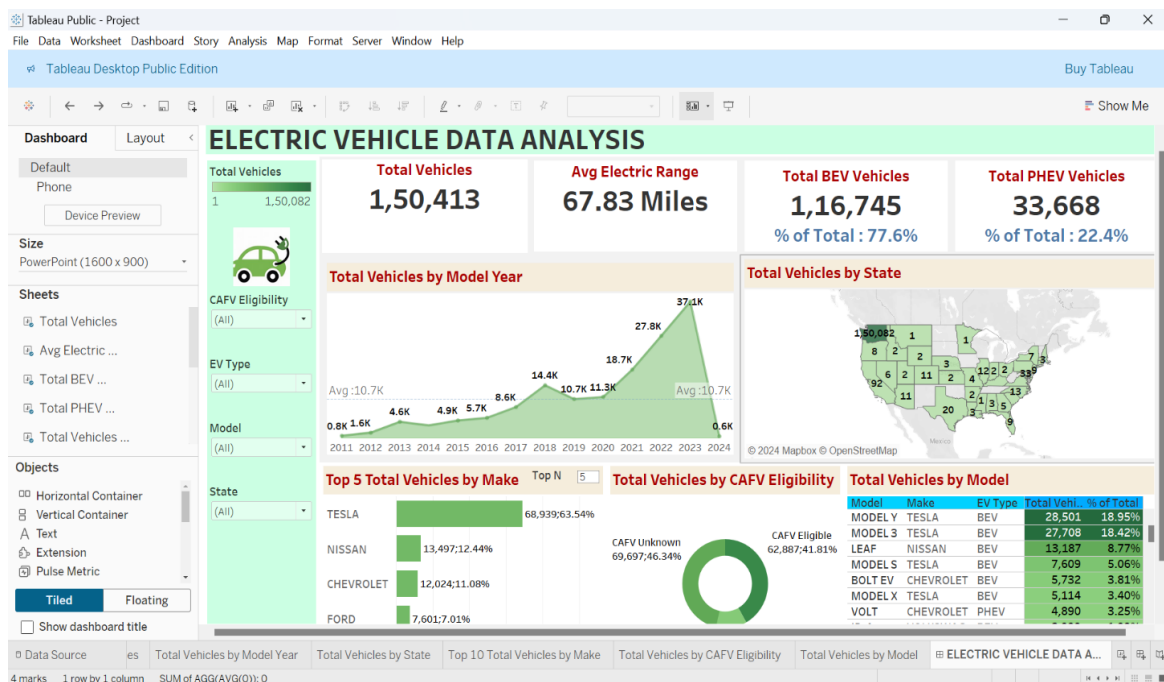
- Add a third **horizontal container**.
- Add **Sheet 7 (Top 10 Total Vehicles by Make)**, **Sheet 8 (CAFV Eligibility Pie Chart)**, and **Sheet 9 (Top 10 Total Vehicles by Model - Tree Map)** into the container.
- Ensure proper fitting, quick formatting, and shading for alignment and presentation.
- In **Sheet 9 (Total Vehicles by Model)**, set it to **Fit Width** and apply aliases.

## 6. Adding Filters (Vertical Container):

- Add a **vertical container** for filters.
- In the **Top 10 Vehicles** chart, add **CAFV**, **EV Type**, **Model**, and **State** filters to context.
- Apply these filters to all worksheets using the same data source.
- In the **Dashboard**, add the following filters to **Total Vehicles by Models**:
  - **Clean Alternative Fuel Vehicle (CAFV) Eligibility**
  - **EV Type**
  - **Model**
  - **State**
- Set all filters to **Multiple Value Breakdown**.
- Use blanks to distribute equal context spacing.

## 7. Final Touches:

- Add an image to the top of the vertical container (from internal storage) and format it for branding.
- Click on every chart and set them to **Use Filter**, ensuring they interact with one another. Clicking on specific chart values updates the corresponding charts dynamically based on that selection.



# Publishing the Dashboard to Tableau Public -

## 1. Sign Up on Tableau Public:

- Go to the Tableau Public website.
- Click **Sign Up** if you don't have an account, or **Sign In** if you already do.

## 2. Save the Dashboard:

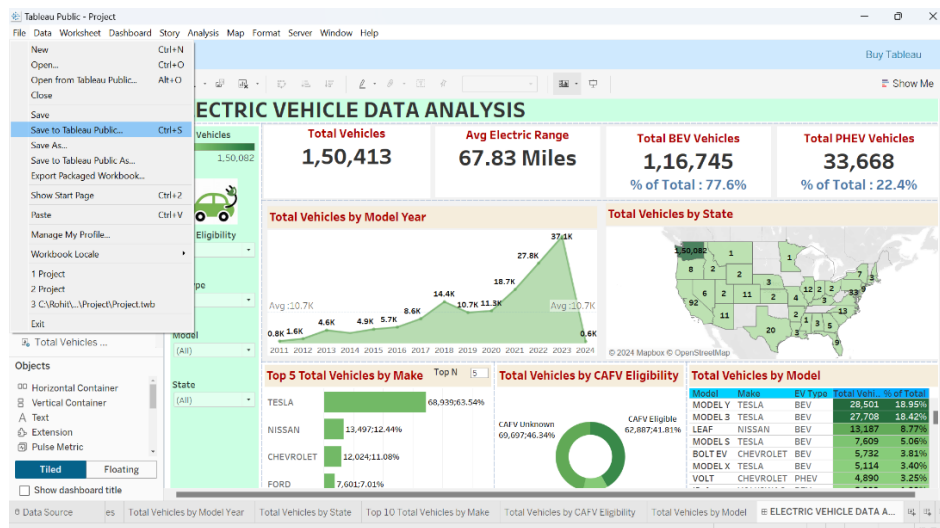
- In Tableau Desktop, after finishing the dashboard, go to **File**.
- Select **Save to Tableau Public As**.
- If prompted, log in with your Tableau Public credentials.

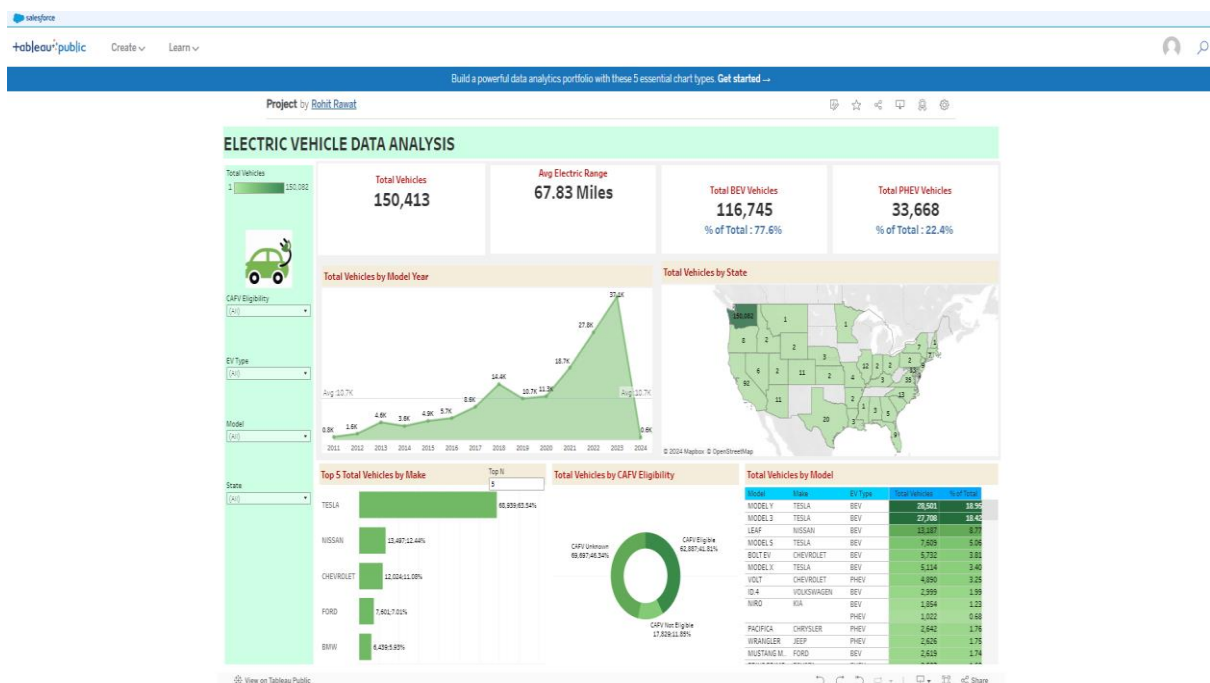
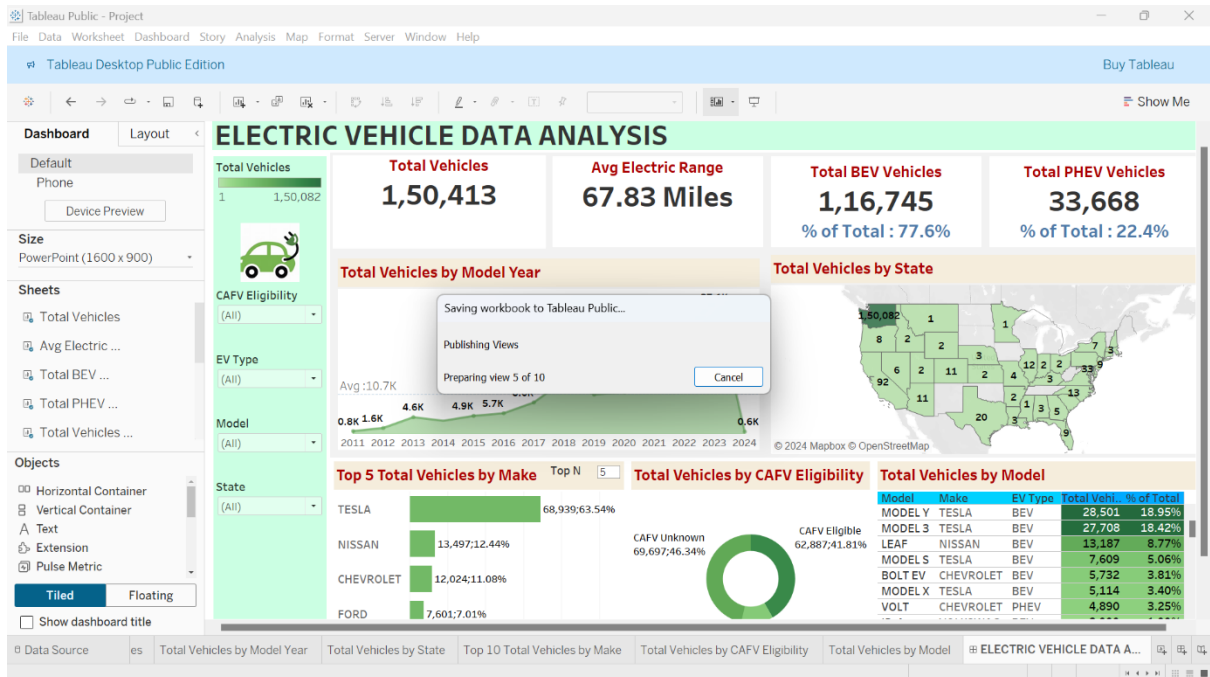
## 3. Publishing the Dashboard:

- Name the dashboard appropriately (e.g., "Electric Vehicle Data Analysis").
- Click **Save**. Tableau will upload the workbook to your Tableau Public profile.
- Once uploaded, you'll be able to see the dashboard in your Tableau Public profile.

## 4. Access the Dashboard Locally:

- After publishing, you can access the dashboard anytime online.
- To access the dashboard locally or share it:
  - Go to your **Tableau Public Profile**.
  - Open the dashboard and copy the **URL**.
  - You can now share this URL with others to view the dashboard.
  - Alternatively, you can embed the dashboard into websites or blogs by using the embed code provided.





## Analysis -

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### Trends and Patterns :

#### 1. Growth of EV Registrations:

- Analyze the number of electric vehicles registered each year. Is there a steady increase, a surge in certain years, or a decline?
- You might observe a significant growth in EV registrations over recent years, likely influenced by increased environmental awareness, state incentives, or advancements in EV technology.

#### 2. EV Type Preferences (BEV vs. PHEV):

- Examine the proportion of Battery Electric Vehicles (BEVs) compared to Plug-in Hybrid Electric Vehicles (PHEVs). You may find a higher adoption rate of BEVs, possibly due to improvements in charging infrastructure and greater awareness of sustainability benefits.
- Consider discussing trends in the range of BEVs versus PHEVs, as BEVs generally offer a longer electric-only range.

#### 3. Geographic Distribution:

- Analyze the distribution of EVs by county, city, or legislative district. Are EVs more prevalent in urban areas compared to rural areas? For instance, higher EV registration numbers in metropolitan areas like Seattle may reflect better access to charging stations and a greater emphasis on sustainability.
- You may also notice certain counties or cities that lead in EV adoption, potentially due to local policies, incentives, or socioeconomic factors.

#### 4. CAFV Program Eligibility:

- Look into the data on Clean Alternative Fuel Vehicle (CAFV) eligibility. Vehicles eligible for CAFV programs may exhibit higher adoption rates in certain regions, indicating the effectiveness of this program in promoting EV adoption.
- Discuss any patterns in CAFV-eligible vehicles based on their make, model, or range, which might help policymakers understand which types of vehicles benefit most from the program.

#### 5. Electric Range Trends:

- Examine trends in electric range for registered vehicles. Over time, EVs with longer ranges may become more common as battery technology advances, which could reduce range anxiety among users.

## **Comparative Analysis:**

### **1. Comparison of EV Models:**

- Compare the popularity of different EV models. For example, is there a specific brand or model that dominates the EV market in Washington? If so, what could be the reasons—cost, range, brand reputation?
- Additionally, analyze how the market share of popular models has changed over time.

### **2. State-Wide vs. County/City-Wide Comparisons:**

- Compare the adoption rates of EVs in Washington State with neighboring states (if data is available) to contextualize the findings. Are there notable differences in EV adoption?
- Within Washington, compare urban areas like Seattle to rural regions to assess the impact of local infrastructure and policies on EV adoption rates.

### **3. Electric Utility Service Area:**

- Compare EV registrations across different electric utility service areas. Some providers may offer special rates or incentives for EV owners, which could influence the distribution.
- Investigate if certain utility areas have a higher concentration of EVs, which may suggest the utility's commitment to supporting EV infrastructure or user incentives.

## **Recommendations:**

Based on your findings, offer actionable recommendations for stakeholders such as state policymakers, utility companies, and car manufacturers.

### **1. Infrastructure Development:**

- Recommend expanding charging infrastructure in areas with high EV concentrations and areas with lower EV adoption rates to encourage new users. Focus on regions with longer commute distances where EV range may be a concern.

### **2. CAFV Program Optimization:**

- Suggest targeted improvements to the CAFV program based on eligibility patterns, such as including more models or offering higher incentives for BEVs with greater ranges, to accelerate adoption.

### **3. Utility Company Collaboration:**

- Recommend that electric utility companies introduce or expand EV-friendly incentives (e.g., discounted charging rates, off-peak pricing). These measures could support higher adoption in underserved areas.



#### **4. Public Awareness Campaigns:**

- Based on observed patterns, propose a campaign to educate residents in regions with lower EV adoption. Focus on cost savings, environmental benefits, and long-term incentives that make EV ownership appealing.

#### **5. Further Analysis and Monitoring:**

- Encourage continuous data collection and monitoring to keep track of EV adoption trends and assess the impact of infrastructure and incentives on EV growth. Real-time analysis can support agile adjustments to policies as the EV market evolves.

## **Conclusion -**

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### **Key Takeaways :**

#### **1. Adoption Trends:**

- Highlight the overall growth in EV registrations, mentioning if certain years or periods saw significant increases, possibly due to new policies or technological advancements.

#### **2. Geographic Concentration:**

- Summarize findings on geographic distribution, noting areas with the highest EV adoption. Mention if any regions displayed unexpectedly high or low adoption rates.

#### **3. Influence of CAFV Program:**

- Emphasize the role of CAFV eligibility on EV adoption, underscoring if the program effectively drives EV adoption or if there are areas for improvement.

#### **4. Range and Utility Impact:**

- Conclude with remarks on electric range trends and the influence of utility providers. Mention if long-range EVs appear to be favored and how this preference varies by area.

## **Limitations:**

### **1. Data Gaps or Inaccuracies:**

- Note if any data fields were incomplete, such as missing ZIP codes or model names, which could affect geographic or model-specific insights.

### **2. Scope of Analysis:**

- Mention if the analysis is limited to specific counties or types of EVs (e.g., BEVs only) and doesn't account for external influences like gasoline prices or non-CAFV incentives.

### **3. Assumptions and External Factors:**

- Highlight any assumptions made, such as equating higher adoption with sufficient infrastructure, and acknowledge external factors (e.g., economic conditions, local policy changes) that may have influenced trends.

## **Potential Areas for Further Research :**

### **1. Longitudinal Analysis:**

- Recommend a longitudinal study to monitor changes in EV adoption trends over a longer period, providing more robust insights into policy and infrastructure impacts.

### **2. Comparative Regional Analysis:**

- Suggest comparing Washington's EV trends with other states or regions to understand broader patterns and identify best practices.

### **3. Behavioral Analysis:**

- Propose studying user behavior, such as typical commute distances, charging habits, or price sensitivity, to develop policies that cater to local driving needs.

### **4. Environmental Impact Study:**

- Recommend further research into the environmental impact of increased EV adoption, such as reductions in carbon emissions and improvements in air quality across Washington.