

# Project Development Phase

## 1. Introduction

Date	20 February 2026
Team ID	LTVIP2026TMIDS91295
Project Name	Visualization Tool for Electric Vehicle Charge and Range Analysis
Maximum Marks	15 Marks

The “Visualization Tool for Electric Vehicle Charge and Range Analysis” project aims to analyze electric vehicle data using advanced visualization techniques. The main objective is to transform raw EV datasets into meaningful insights through interactive dashboards and storytelling.

### This project integrates:

- MySQL Workbench – for database management
- Tableau Desktop – for visualization and analytics
- Tableau Public – for publishing dashboards
- Flask – for web integration and hosting

## 2. Team Details

**Team Leader:** Naganaboyina Lakshmana Swamy

**Team Members:** Lokesh Pilla, Myla Venkaiah, Sangeetham Ganesh

Each member contributed to dataset preparation, dashboard design, story development, and web deployment.

## 3. Data Connectivity

Data connectivity is the process of linking data sources such as databases, CSV files, or cloud platforms with analytical tools to access and analyze information efficiently. In this project, the Electric Vehicle dataset was first imported into MySQL Workbench and then connected to Tableau Desktop using database credentials. This connection enabled seamless data flow between the database and visualization tool, allowing accurate analysis and dashboard creation.

### Importance of Data Connectivity

Data connectivity plays a vital role in maintaining data consistency, reducing manual work, and improving analysis efficiency. By connecting Tableau directly with the MySQL database, preprocessing and visualization could be performed on updated data without repeated file uploads. It also helped in building dynamic dashboards and integrating them into the Flask web application, ensuring users receive reliable and real-time insights.

## Data Sets

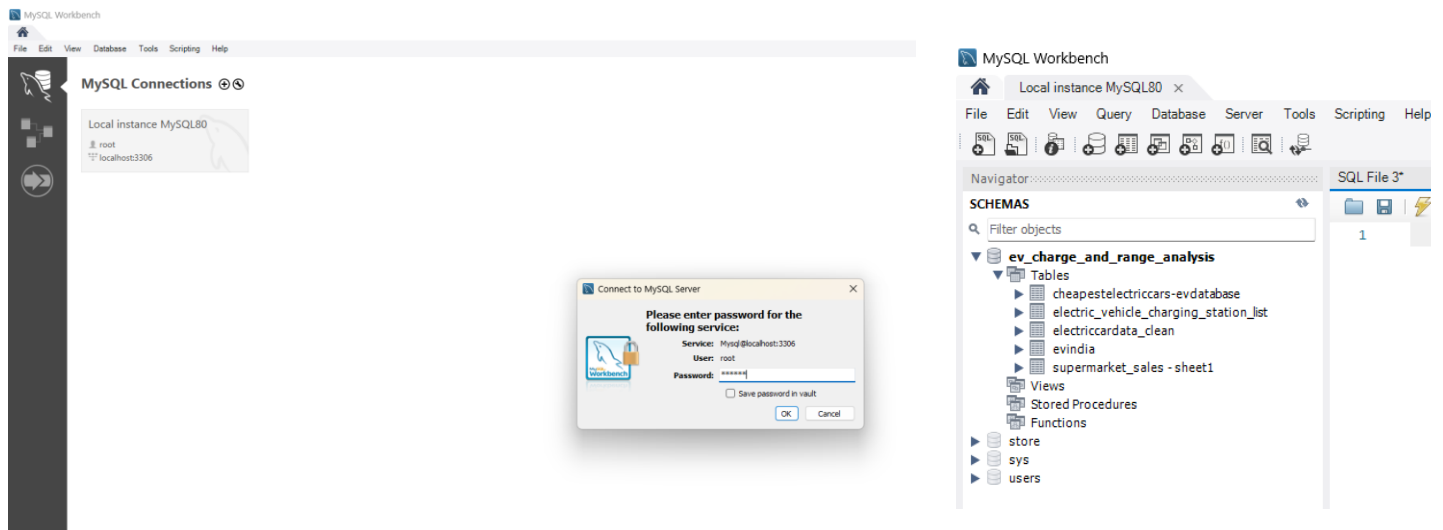
<https://drive.google.com/drive/folders/1ZuLoVufqDqoiWaJct99Yqu6ROZnxloql?usp=sharing>

## Steps Performed

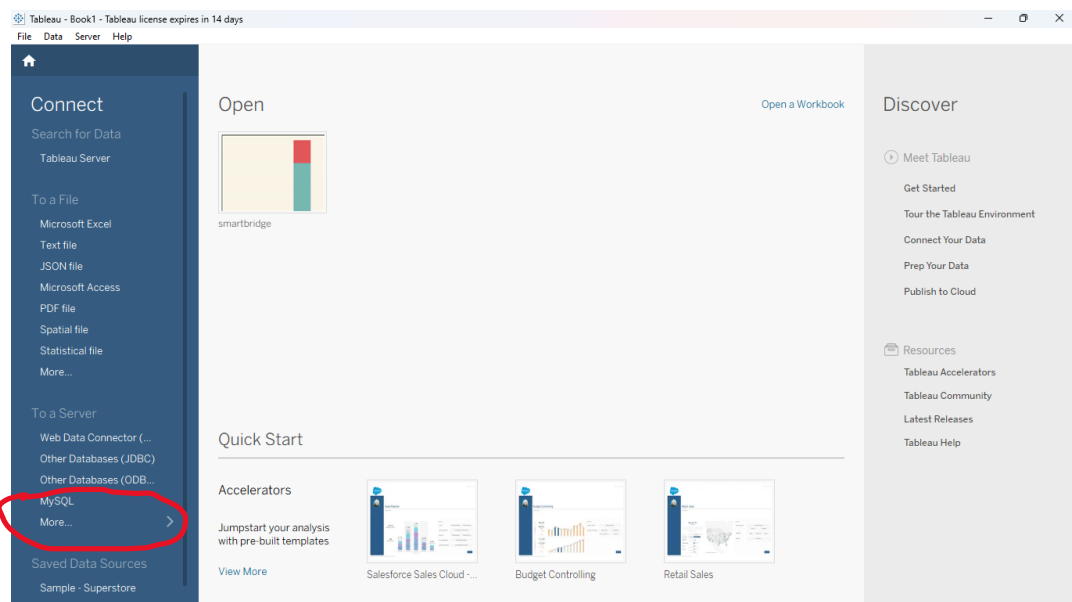
1. Collected Electric Vehicle dataset in CSV format.
2. Created a new database in MySQL Workbench.
3. Imported CSV data using Table Import Wizard.
4. Verified tables, columns, and records.
5. Opened Tableau Desktop and selected MySQL connection.
6. Entered database credentials.
7. Loaded dataset into Tableau workspace.

## Screenshot Placement Guide

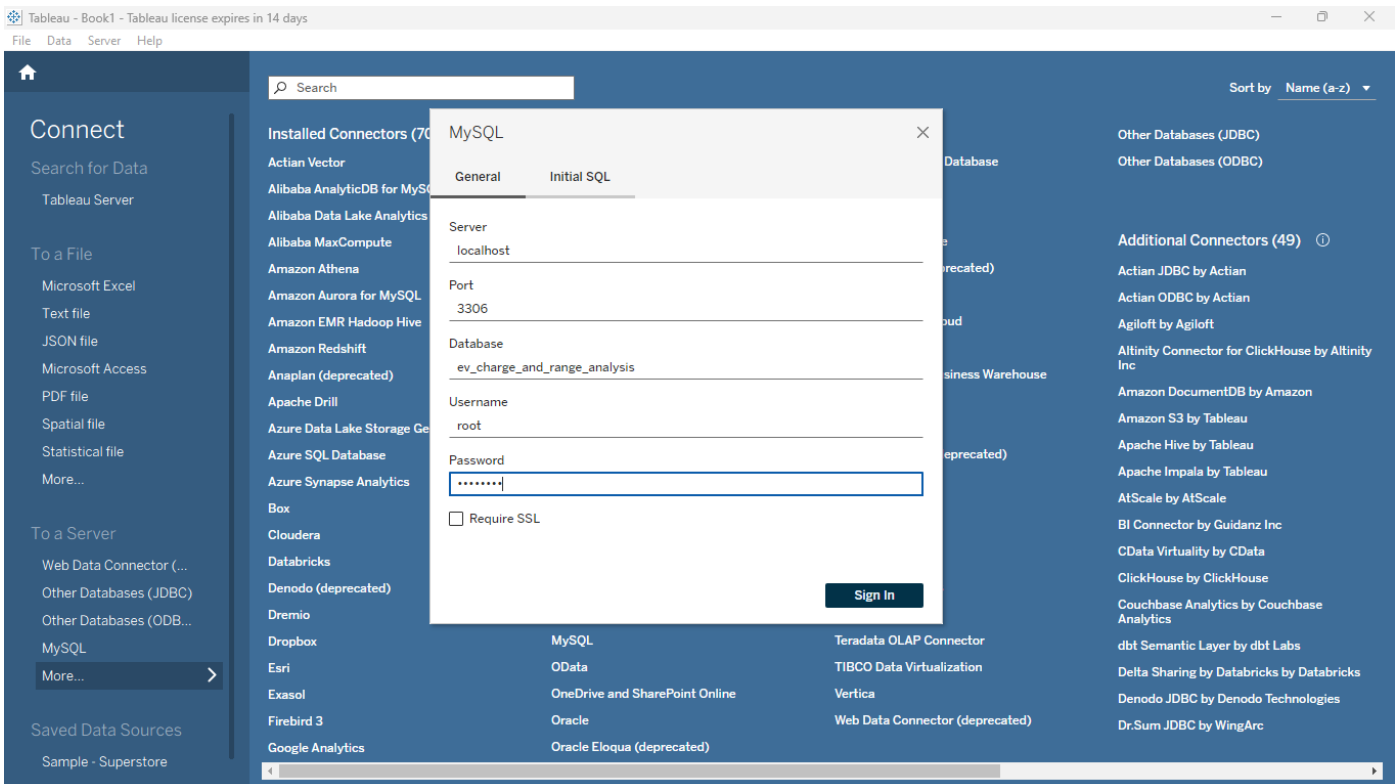
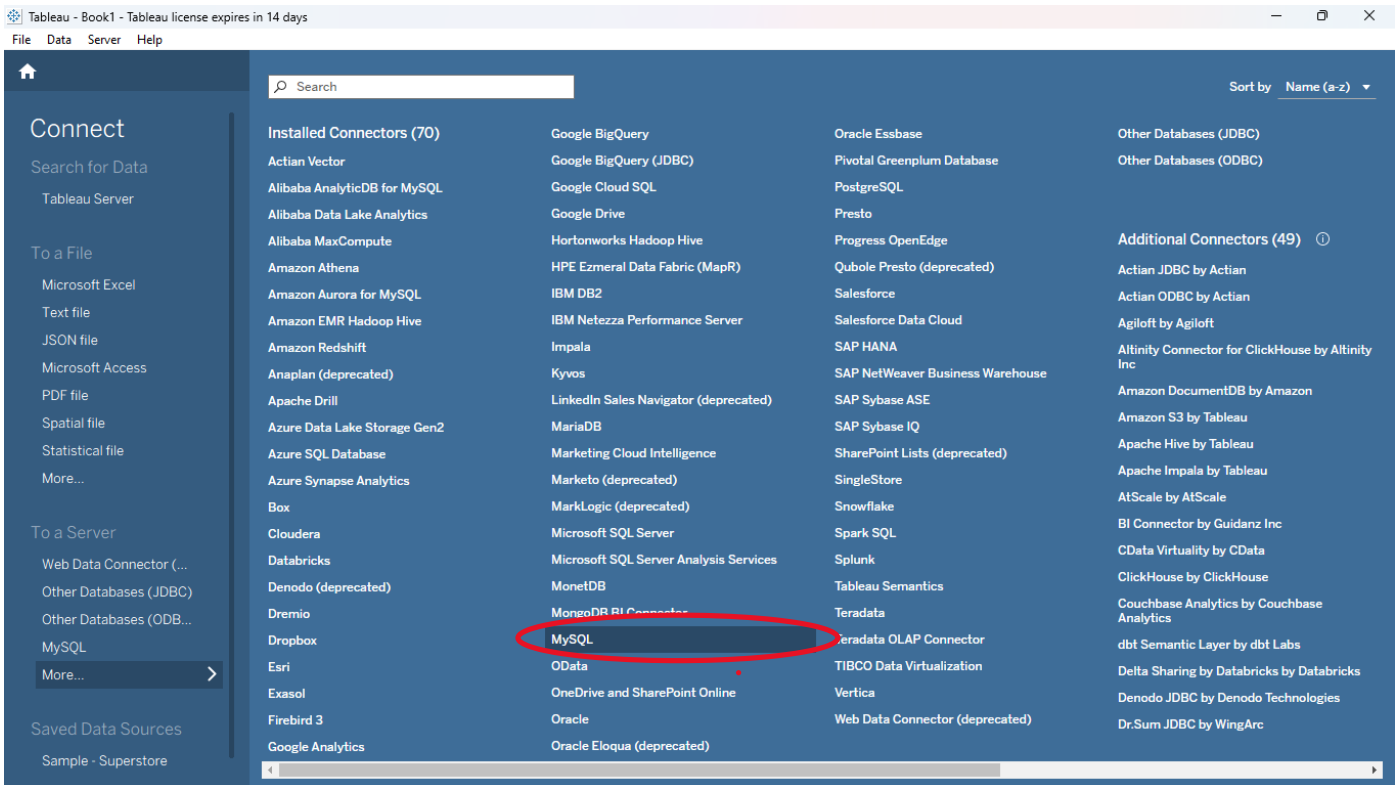
### MySQL Database Connection Screen



### Tableau MySQL Connection Window



- Click on MySQL or More



- Enter the server name, user name and password
- Click on Sign In

## 4. Data Preparation (Preprocessing)

The following preprocessing operations were performed:

- Removed null values and duplicates
- Renamed columns for clarity

- Changed incorrect data types
- Created calculated fields
- Applied geographic roles
- Added filters (BodyStyle, PowerTrain, Region)
- Sorted and formatted data fields

## Tableau Data Source Page showing cleaned data

The screenshot shows the Tableau Data Source page for a connection to 'localhost MySQL'. The database selected is 'ev\_charge\_and\_range\_analysis'. The table 'cheapestelectriccars-evdatabase+' is selected, showing 46 fields and 492 rows. The table structure is as follows:

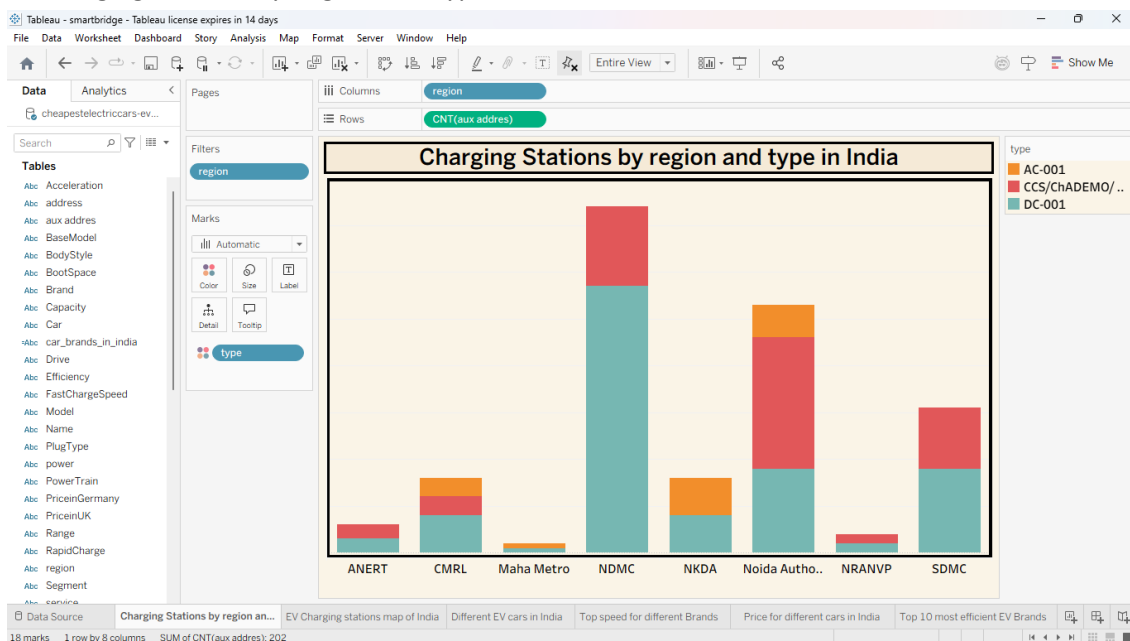
Name	Description	Type	Field Name	Physical Table	Rem...
cheapestelectriccars-evdatabase+	No description available.	Table	Name	cheapestelectriccars-evdatabase+	Name
		Table	Subtitle	cheapestelectriccars-evdatabase+	Subtitle
		Table	Acceleration	cheapestelectriccars-evdatabase+	Acceleration
		Table	TopSpeed	cheapestelectriccars-evdatabase+	TopSpeed
		Table	Range	cheapestelectriccars-evdatabase+	Range

The data preview shows the following rows:

Name	Subtitle	Acceleration	TopSpeed	Range
Opel Ampera-e	Battery Electric Vehicle   ...	7.3 sec	150 km/h	335 km
Renault Kangoo Maxi ZE 33	Battery Electric Vehicle   ...	22.4 sec	130 km/h	160 km
Nissan Leaf	Battery Electric Vehicle   ...	7.9 sec	144 km/h	220 km
Audi e-tron Sportback 55 qu...	Battery Electric Vehicle   ...	5.7 sec	200 km/h	375 km
Porsche Taycan Turbo S	Battery Electric Vehicle   ...	2.8 sec	260 km/h	390 km
Nissan e-NV200 Evalia	Battery Electric Vehicle   ...	14.0 sec	123 km/h	165 km
Volkswagen ID.3 Pure Perfor...	Battery Electric Vehicle   ...	8.9 sec	160 km/h	275 km
BMW iX3	Battery Electric Vehicle   ...	6.8 sec	180 km/h	385 km

## 5. Sheet Development

### Sheet 1 – Charging Stations By Region and Type in India



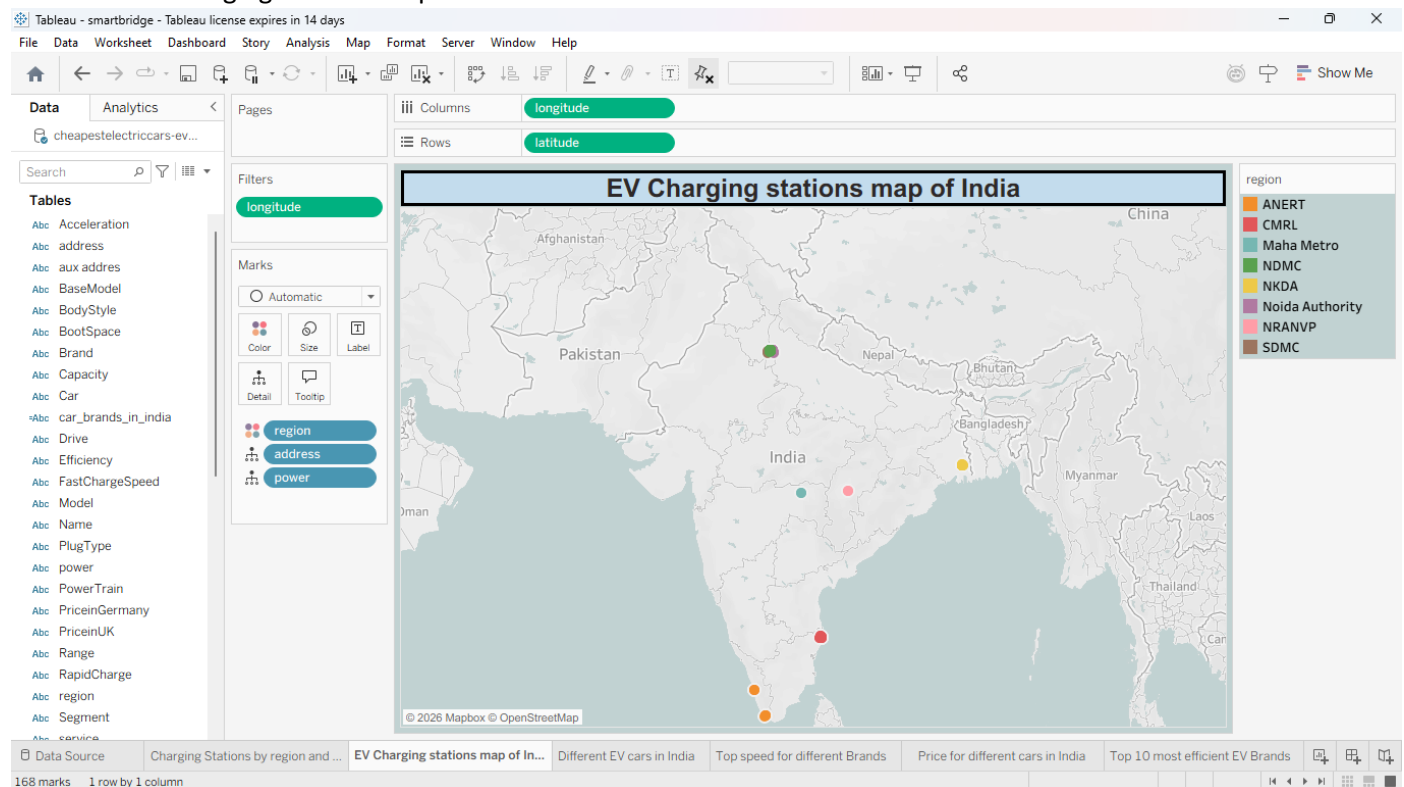
1. Drag **Region** field to the **Columns** shelf to display regions across the chart.

2. Drag **Aux Address** field to the **Rows** shelf.
3. Click the drop-down arrow on **Aux Address** → Convert to **Measure** → Select **Count Distinct (CNTD)** to show the number of unique charging stations.
4. Change the **Marks Type** to **Bar Chart** (if not automatic).
5. Drag **Type** field to **Color** in the Marks Card to differentiate charging station types such as AC-001, CCS/CHAdEMO, and DC-001.
6. Add a **Title** to the sheet:
  - Edit title text
  - Apply background color
  - Add border styling.
7. Format the Sheet:
  - Right-click on sheet → **Format**
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment.
8. Verify Sorting:
  - Ensure regions are arranged properly.
  - Check stacked color distribution for each charging type.

### Visualization Insight:

This completes the creation of the sheet “**Charging Stations by Region and Type in India.**”

### Sheet 2 – EV Charging stations map of India



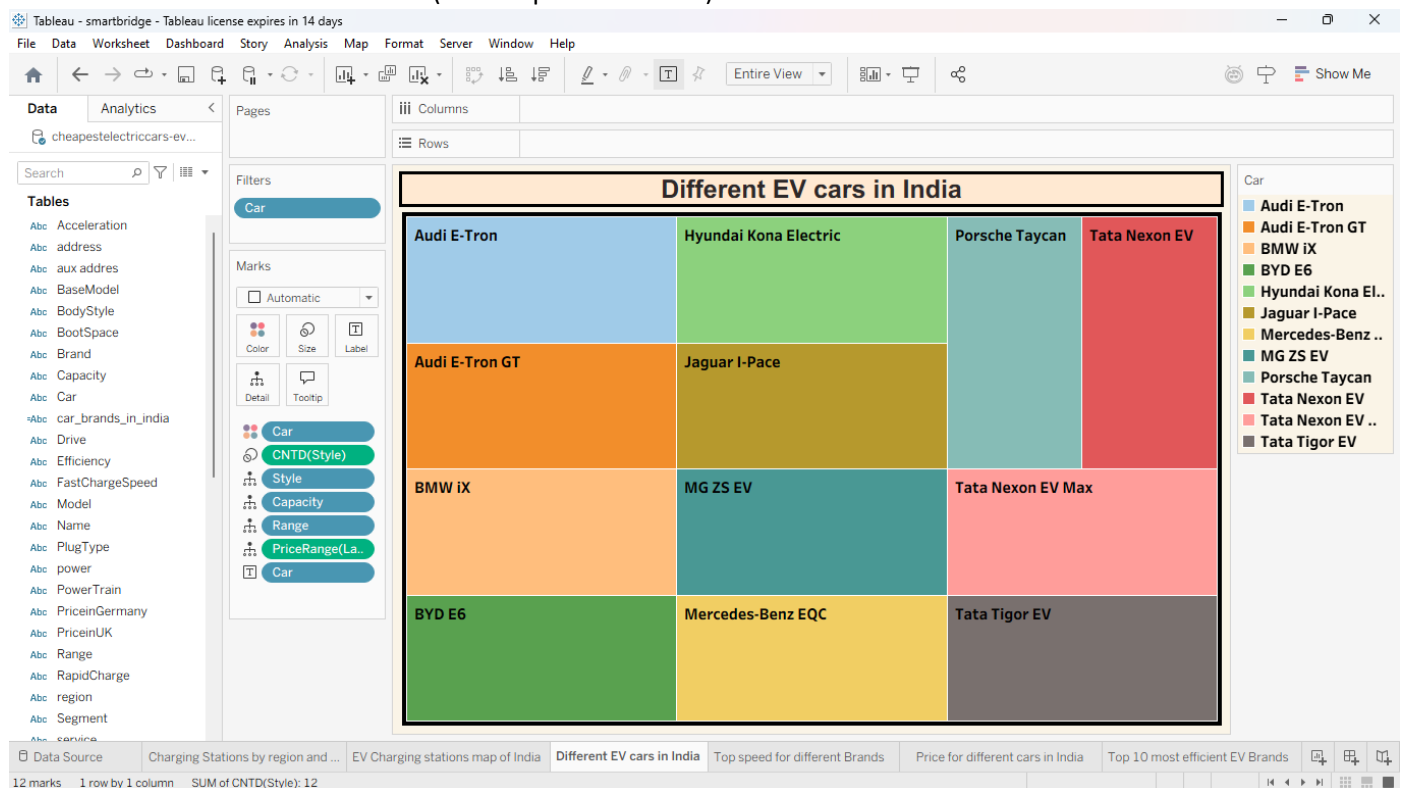
1. Drag **Longitude** field to the **Columns** shelf.
2. Drag **Latitude** field to the **Rows** shelf to generate the geographic map automatically.
3. Ensure both **Longitude** and **Latitude** are set as **Geographic Dimensions**.
4. Change the Marks Type to **Circle** to display charging station locations as bubbles on the map.

5. Drag **Region** field to **Color** in the Marks Card to differentiate charging stations by region.
6. Drag **Address** and **Power** fields to **Detail** to provide additional information for each location.
7. Customize Map Formatting:
  - Edit sheet title.
  - Add background color and borders.
  - Adjust font size and alignment.
8. Verify geographic positioning and ensure markers correctly represent charging station locations across India.

### Visualization Insight:

This sheet visualizes the geographical distribution of EV charging stations based on region, address, and power capacity.

### Sheet 3 – Different EV Cars in India (Treemap Visualization)



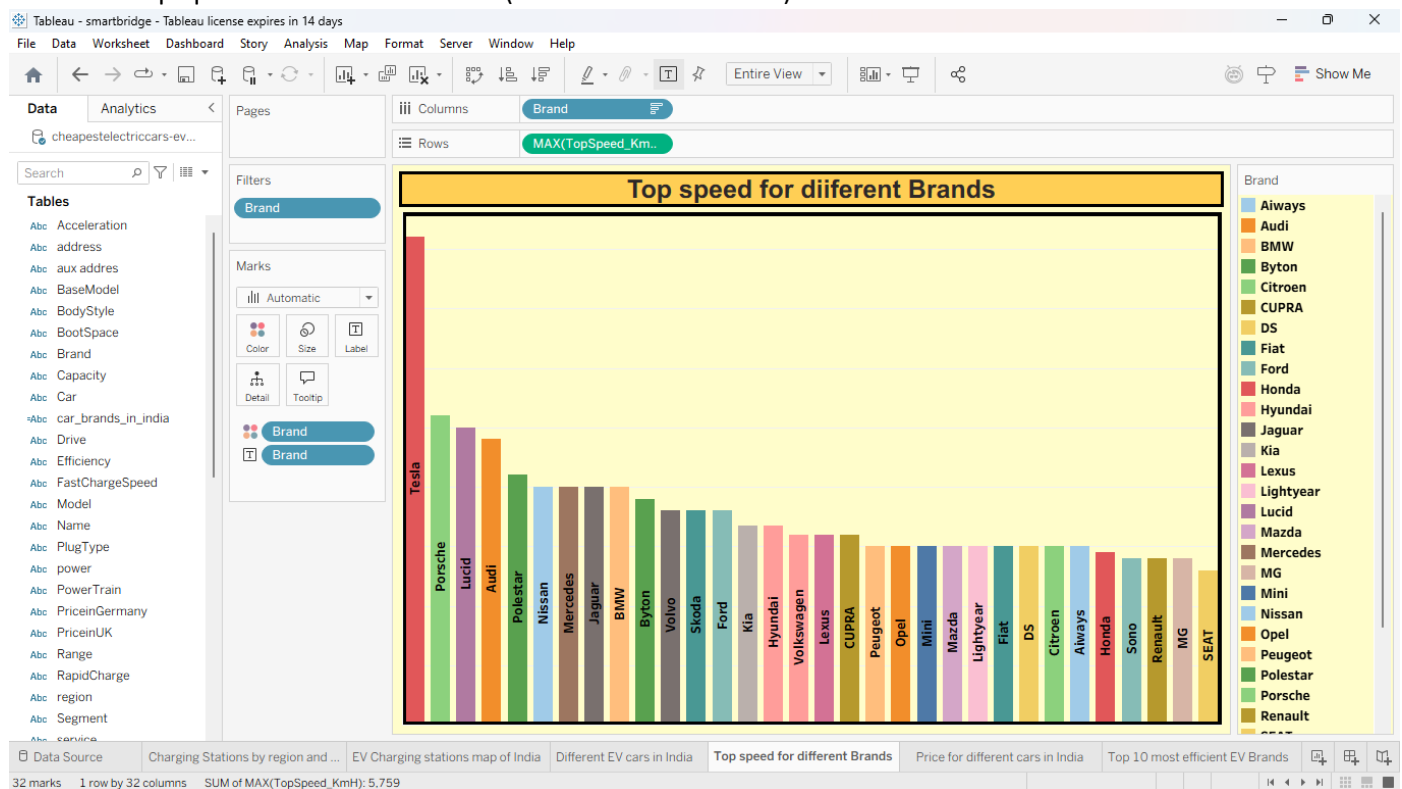
1. From the Show Me panel, select **Treemap** chart type.
2. Drag **Car** field to **Label** and **Color** in the Marks Card to display individual EV models with different colors.
3. Drag **Style** field to **Size**.
4. Convert **Style** to a measure:
  - Click drop-down on Style.
  - Select **Measure** → **Count Distinct (CNTD)** to represent the number of styles.
5. Drag the following fields to **Detail** to enrich information:
  - Style
  - Capacity
  - Range
  - Price Range
6. Edit Sheet Title:
  - Change title text to Different EV Cars in India.
  - Apply background color and border styling.
7. Format the Sheet:

- Right-click on the sheet → **Format**.
- Apply background shading.
- Add outer borders.
- Adjust font size, font color, and alignment for better readability.

### Visualization Insight:

This sheet visualizes different electric vehicle models available in India using a treemap layout, where the size represents distinct styles and colors represent individual car models.

### Sheet 4 – Top Speed for Different Brands (Bar Chart Visualization)

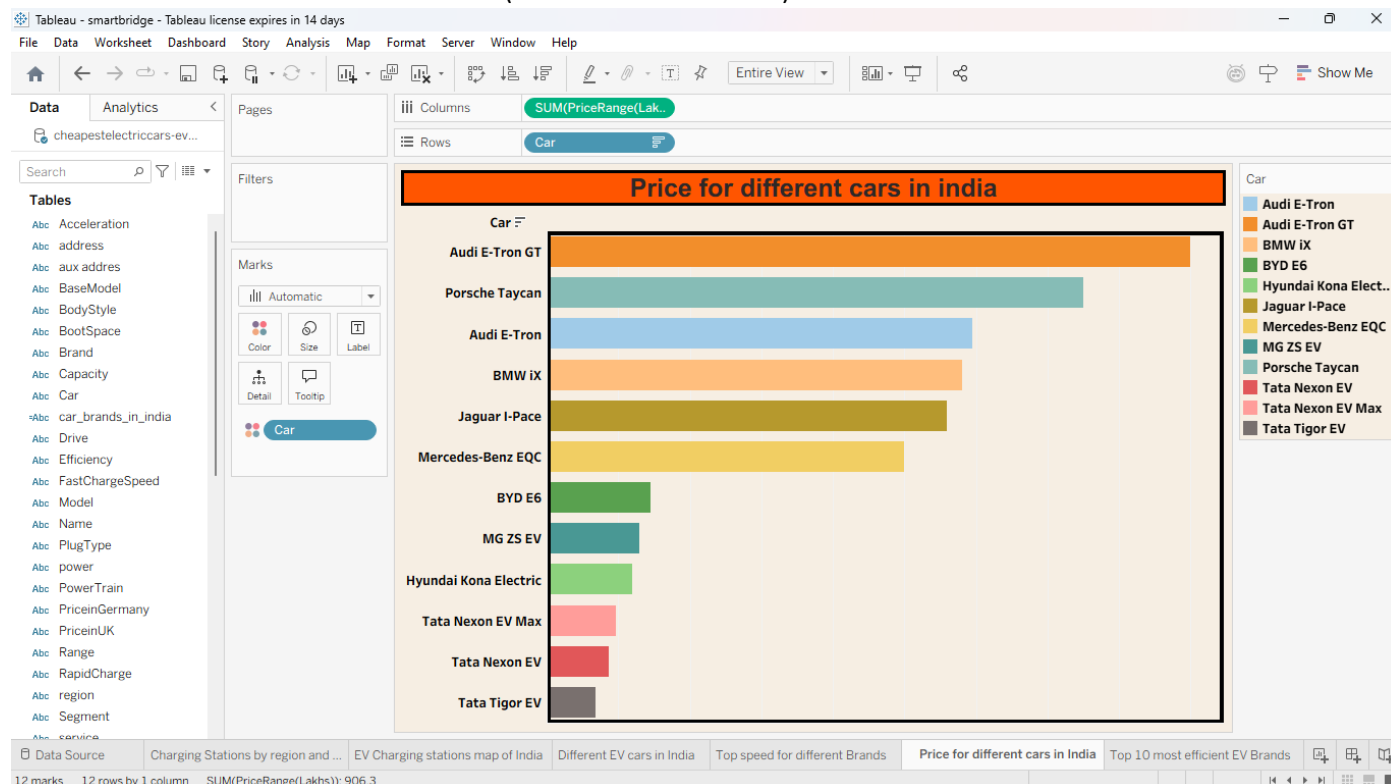


1. Drag **Brand** field to the **Columns** shelf.
2. Drag **TopSpeed (Km/h)** field to the **Rows** shelf.
3. Click the drop-down arrow on TopSpeed:
  - Select **Measure** → **Maximum (MAX)** to display the highest speed value for each brand.
4. Change Marks Type to **Bar Chart** if not selected automatically.
5. Drag **Brand** field to Color in the Marks Card to differentiate brands visually.
6. Sort the bars in descending order to highlight the fastest brands clearly.
7. Edit Sheet Title:
  - Change title text to Top Speed for Different Brands.
  - Apply background color and border styling.
8. Format the Sheet:
  - Right-click on sheet → **Format**.
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment for better readability.

### Visualization Insight:

This visualization compares the maximum top speed across different electric vehicle brands, helping users quickly identify high-performance EV manufacturers and analyze performance trends within the market.

## Sheet 5 – Price for Different Cars in India (Bar Chart Visualization)

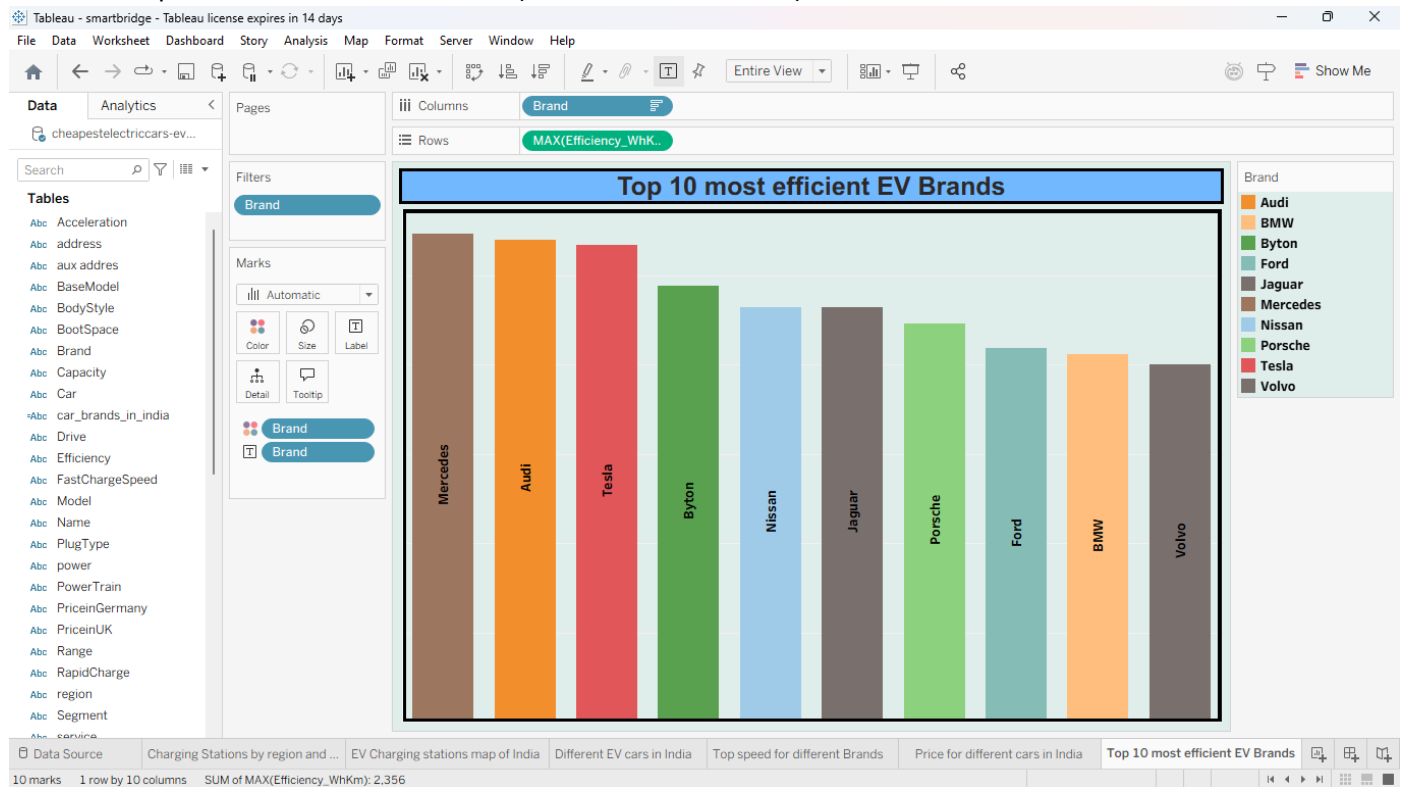


1. Drag **PriceRange (Lakhs)** field to the **Columns** shelf.
2. Drag **Car** field to the **Rows** shelf to display car models vertically.
3. Ensure aggregation of PriceRange is set to **SUM** to represent total price values.
4. Change Marks Type to **Bar Chart** (if not automatic).
5. Drag **Car** field to **Color** in the Marks Card to visually differentiate each vehicle.
6. Sort the bars in descending order to compare car prices easily.
7. Edit Sheet Title:
  - Change title text to Price for Different Cars in India.
  - Apply background color and border styling.
8. Format the Sheet:
  - Right-click on sheet → **Format**.
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment for better readability.

## Visualization Insight:

This visualization compares the price range of different electric cars available in India, helping users quickly identify premium and budget EV models and analyze pricing distribution across brands.

## Sheet 6 – Top 10 Most Efficient EV Brands (Bar Chart Visualization)

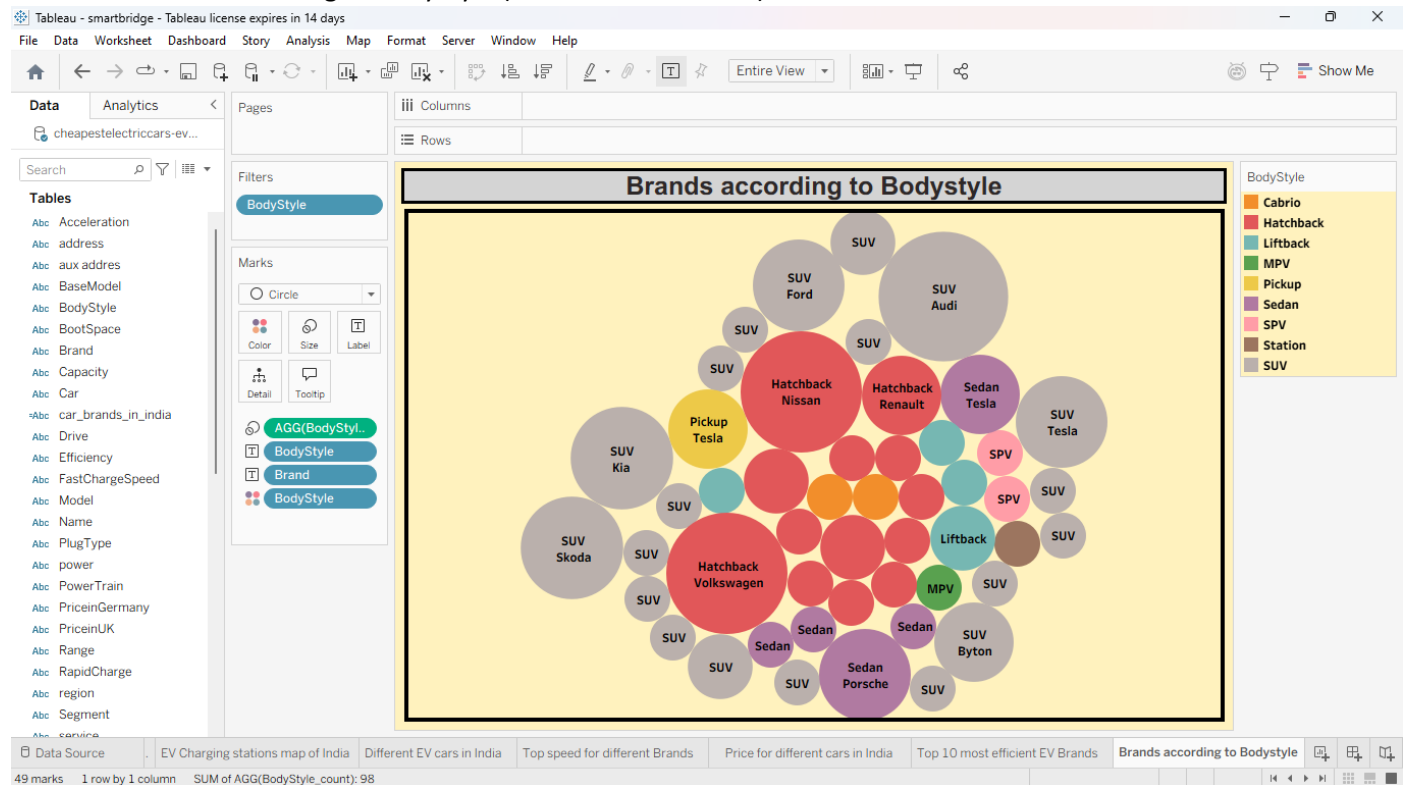


1. Drag **Brand** field to the **Columns** shelf.
2. Drag **Efficiency (Wh/Km)** field to the **Rows** shelf.
3. Click the drop-down arrow on Efficiency:
  - Select **Measure** → **Maximum (MAX)** to display the highest efficiency value for each brand.
4. Apply Top Filter:
  - Right-click on Brand → Filter → Top → Select **Top 10 by MAX(Efficiency)**.  
(OR)
  - Applied Top N filter and sorted efficiency values.
5. Change Marks Type to **Bar Chart** (if not automatic).
6. Drag **Brand** field to **Color** and **Label** in the Marks Card to display brand names on each bar.
7. Sort the bars in descending order to highlight the most efficient EV brands clearly.
8. Edit Sheet Title:
  - Change title text to Top 10 Most Efficient EV Brands.
  - Apply background color and border styling.
9. Format the Sheet:
  - Right-click on sheet → **Format**.
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment.

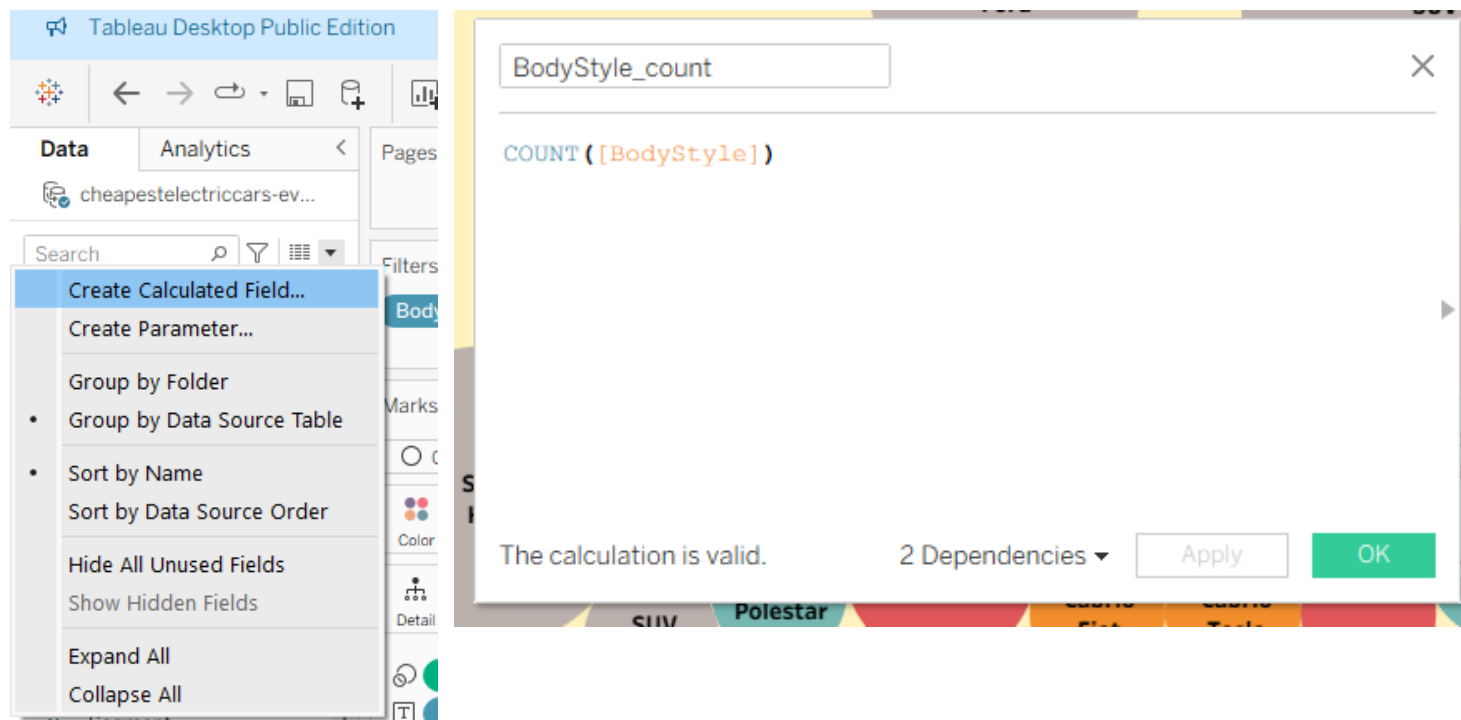
### Visualization Insight:

This visualization highlights the top 10 electric vehicle brands based on maximum efficiency, enabling users to compare energy performance and identify leading EV manufacturers.

## Sheet 7 – Brands According to BodyStyle (Packed Bubble Chart)



1. Click on **Show Me** and select **Packed Bubble** Chart to create a bubble-based visualization.
2. Drag **BodyStyle** field to **Color** in the Marks Card to differentiate vehicle body styles such as SUV, Sedan, Hatchback, etc.
3. Drag **Brand** field to **Label** in the Marks Card to display brand names inside the bubbles.
4. Create a Calculated Field named **BodyStyle\_count** with the formula:
  - `COUNT([BodyStyle])`



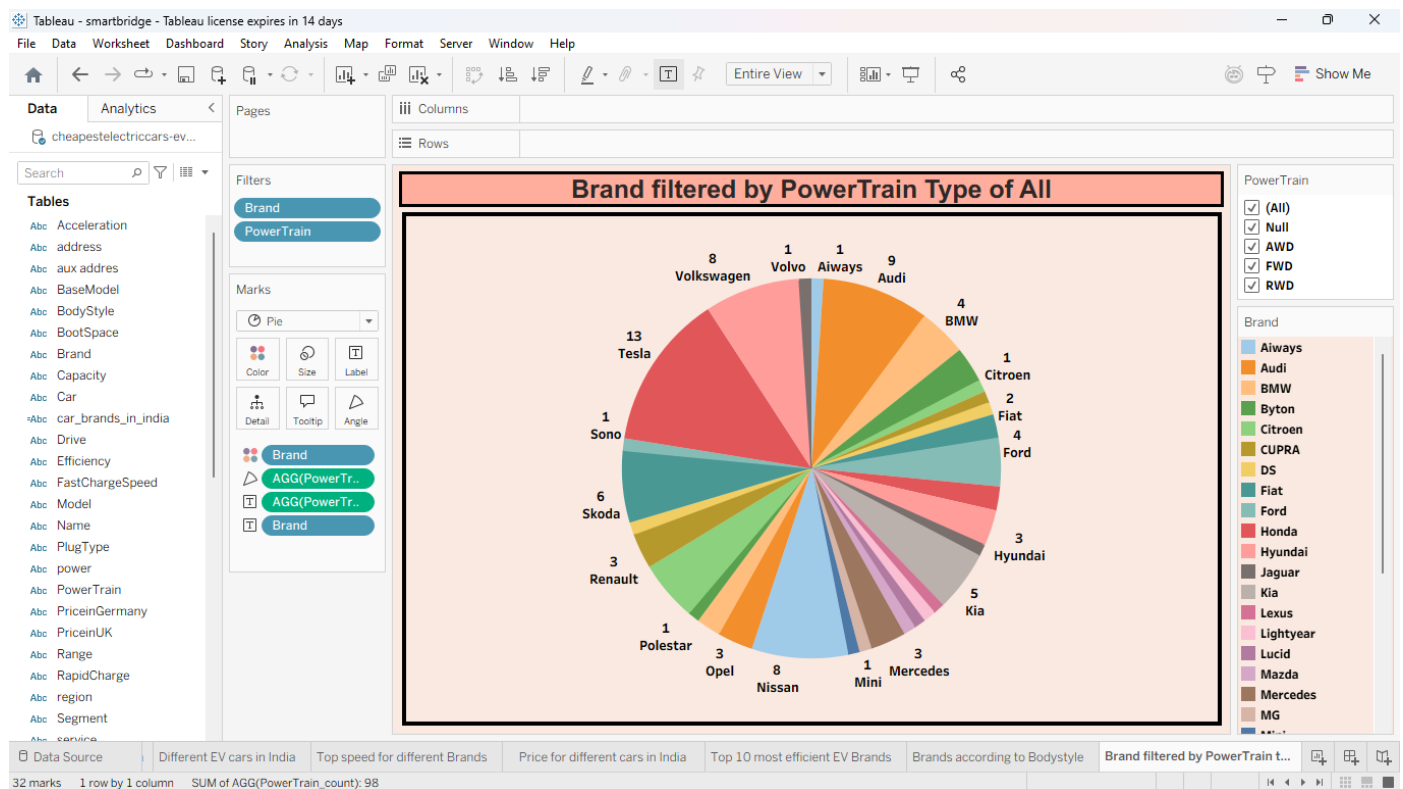
5. Drag the calculated field **BodyStyle\_count** to **Size** in the Marks Card so that bubble size represents the count of body styles.

6. Optionally, drag **BodyStyle** to **Detail** for better data representation.
7. Edit Sheet Title:
  - Change title text to Brands According to BodyStyle.
  - Apply background color and border styling.
8. Format the Sheet:
  - Right-click on the sheet → **Format**.
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment for better readability.

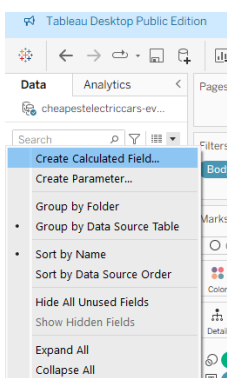
### Visualization Insight:

This visualization represents the distribution of electric vehicle brands based on different body styles. The bubble size indicates the count of body styles, while colors represent categories such as SUV, Sedan, Hatchback, and others, helping users easily compare brand diversity across body styles.

### Sheet 8 – Brand Filtered by PowerTrain Type (Pie Chart Visualization)



1. Create a **Calculated Field** named **PowerTrain\_count** with the formula:
  - COUNT([PowerTrain])

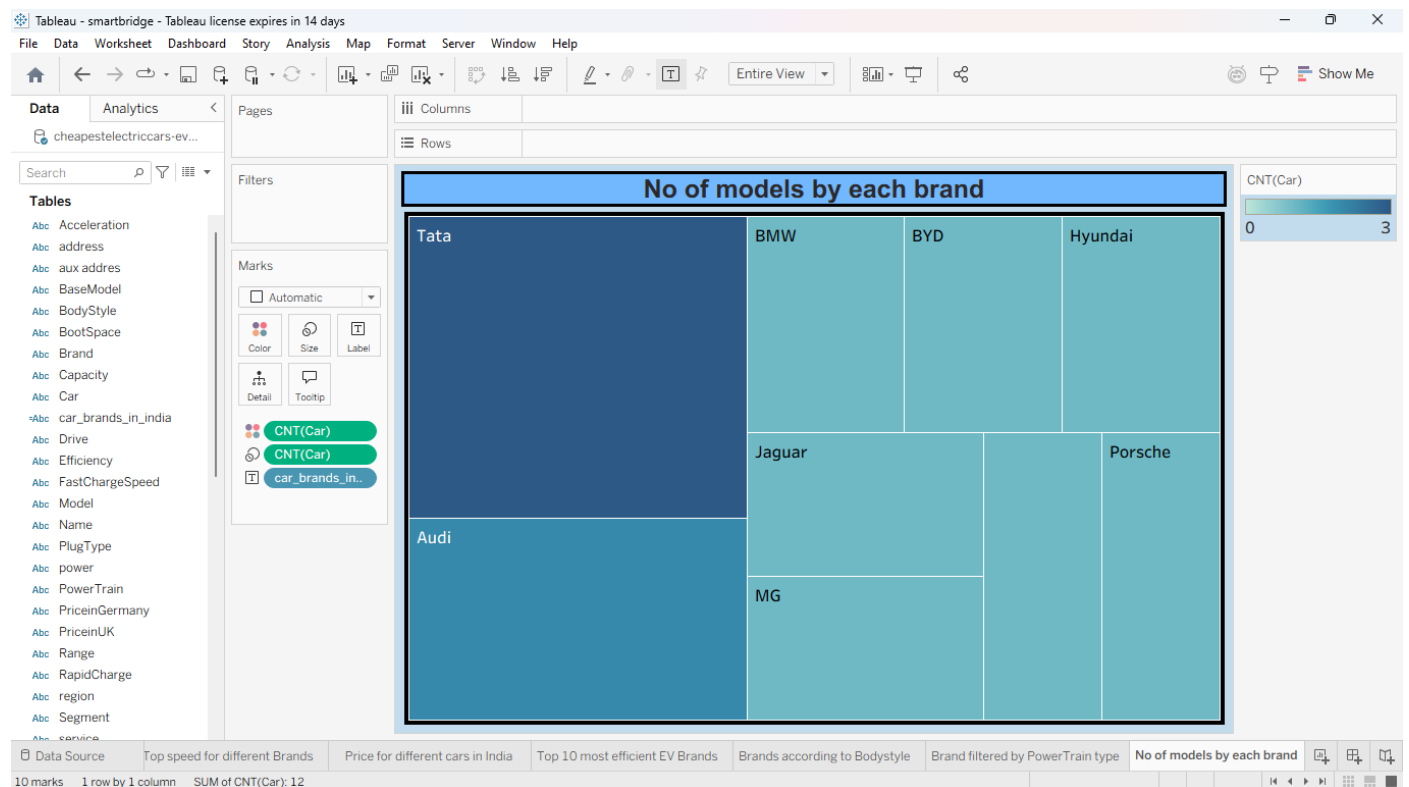


2. Change the Marks Type:
  - Click on **Automatic** in the Marks Card.
  - Select **Pie Chart**.
3. Drag **PowerTrain\_count** to:
  - **Angle** (to control slice size)
  - **Label** (to display count values)
4. Drag **Brand** field to:
  - **Color** to differentiate brands
  - **Label** to display brand names.
5. Optionally drag **PowerTrain** to **Detail** to improve slice segmentation.
6. Adjust the View:
  - Change view from **Standard** to **Entire View** for full layout visibility.
7. Edit Sheet Title:
  - Change title text to Brand Filtered by PowerTrain Type.
  - Apply background color and border styling.
8. Format the Sheet:
  - Right-click on sheet → **Format**.
  - Apply background shading.
  - Add borders.
  - Adjust font size, font color, and alignment. Change the view standard to entire view

### Visualization Insight:

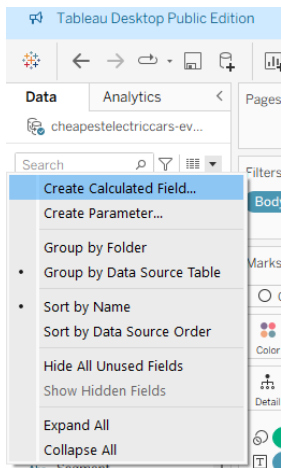
This visualization shows the distribution of electric vehicle brands based on different powertrain types such as AWD, FWD, and RWD, allowing users to understand drivetrain diversity across brands.

### Sheet 9 – Number of Models by Each Brand (Treemap Visualization)



1. Create a **Calculated Field** named **car\_brands\_in\_india** using the formula:

- `SPLIT([Car], " ", 1)`



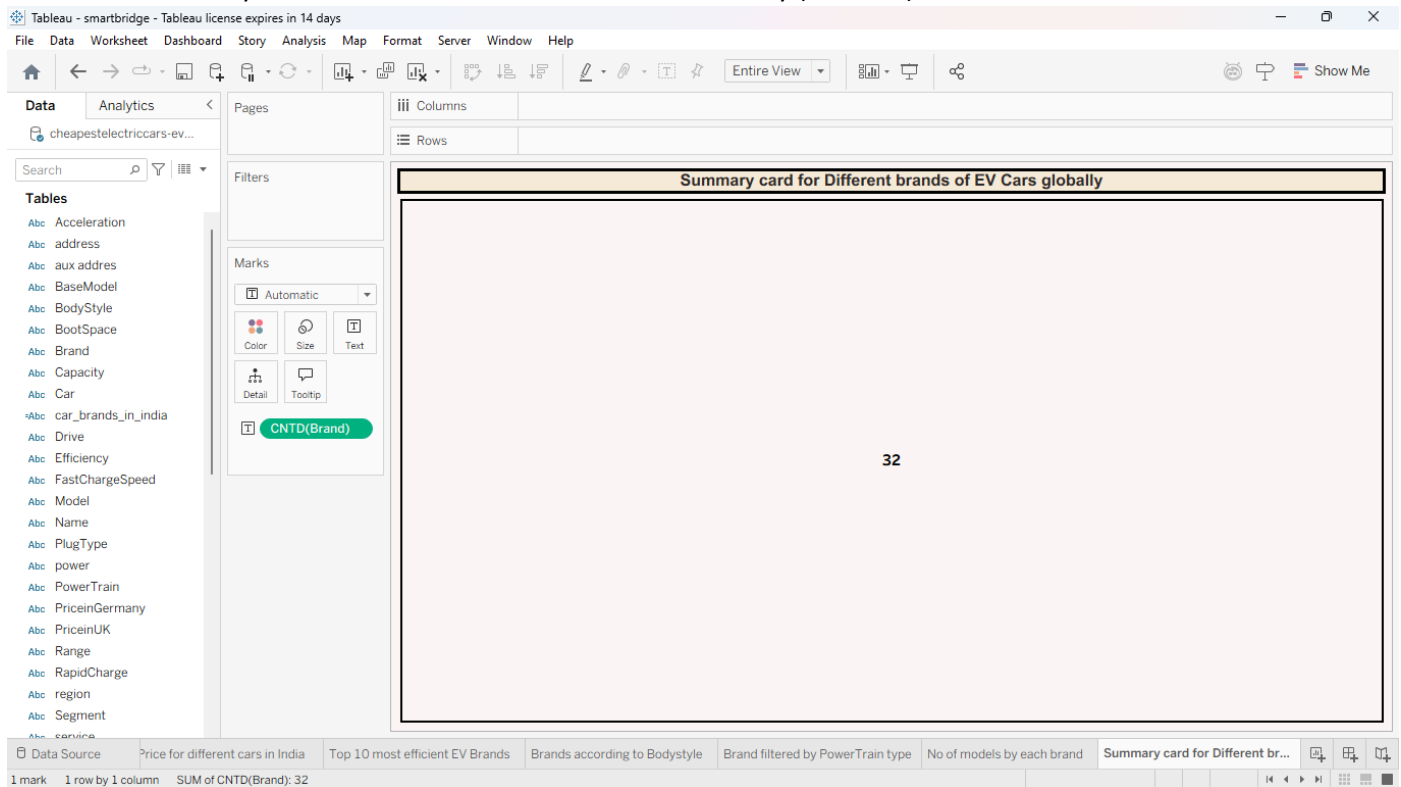
This calculation extracts the brand name from the car model text.

2. Select **Treemap** from the Show Me panel to visualize model distribution.
3. Drag Car field to:
  - **Color** to differentiate car categories.
  - **Size** and change aggregation to **COUNT (CNT)** to represent the number of models.
4. Drag **car\_brands\_in\_india** calculated field to **Label** to display brand names inside each block.
5. Ensure Marks Type is set to **Treemap** for proper visualization layout.
6. Edit Sheet Title:
  - Change title text to No of Models by Each Brand.
  - Apply background color and border styling.
7. Format the Sheet:
  - Right-click on sheet → **Format**.
  - Apply background shading.
  - Add outer borders.
  - Adjust font size, font color, and alignment.

### Visualization Insight:

This treemap shows the distribution of electric vehicle models by brand, where the size of each block represents the total number of models available, helping users quickly identify brands with higher model diversity.

## Sheet 10 – Summary Card for Different Brands of EV Cars Globally (KPI Card)

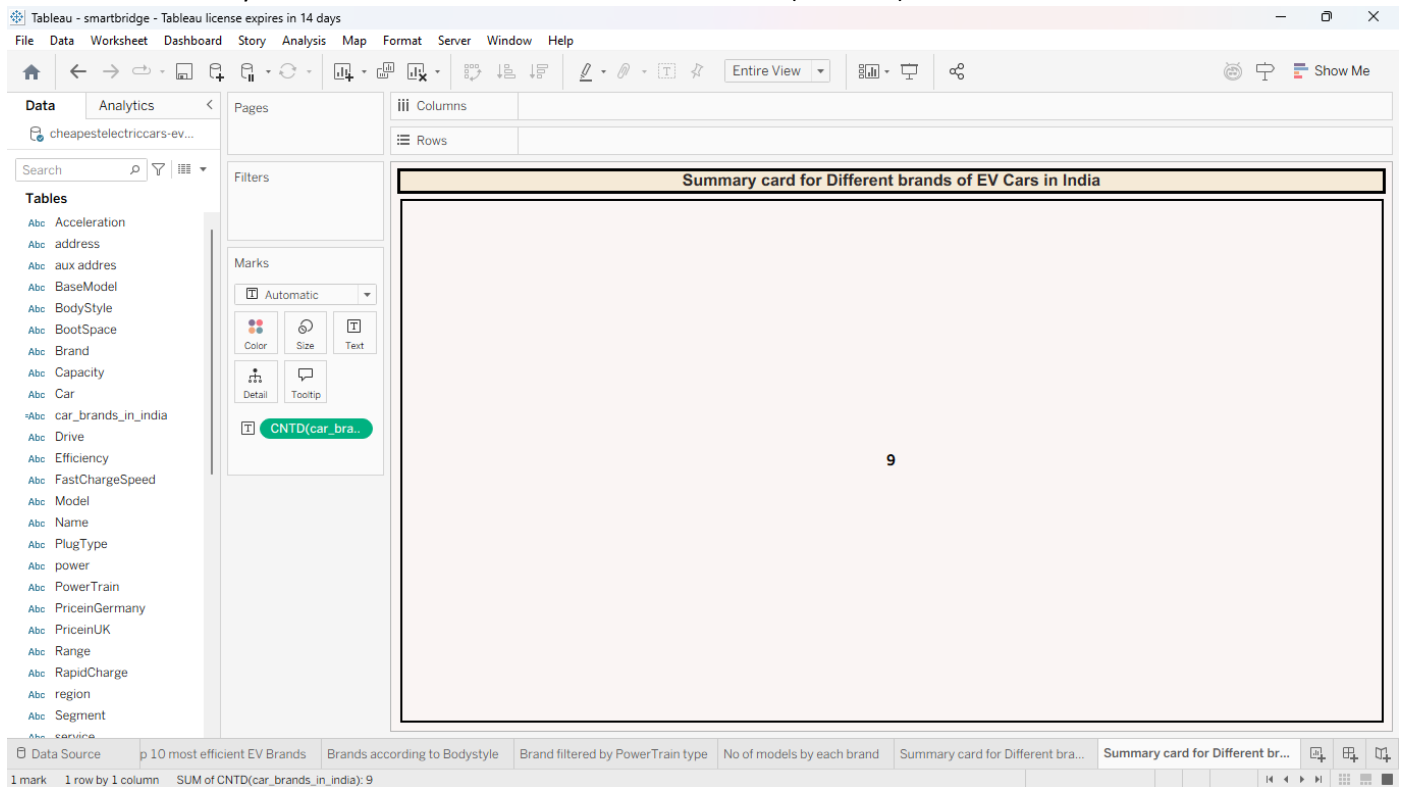


1. Drag **Brand** field to the **Text** section in the Marks Card.
2. Change aggregation:
  - Click the drop-down on **Brand**.
  - Select **Measure** → Count **Distinct (CNTD)** to display the total number of unique EV brands globally.
3. Change Marks Type to Text to create a KPI-style summary card.
4. Edit Sheet Title:
  - Change title text to Summary card for Different brands of EV Cars globally.
  - Apply background color and border styling.
5. Format the Sheet:
  - Increase font size of the text value to make it visually prominent.
  - Apply background shading.
  - Add outer borders.
  - Adjust alignment to center.

### Visualization Insight:

This summary card displays the total count of distinct electric vehicle brands available globally, providing a quick KPI overview that helps users understand overall market diversity at a glance.

## Sheet 11 – Summary Card for Different Brands of EV Cars in India (KPI Card)



1. Drag the calculated field **car\_brands\_in\_india** to the Text section in the Marks Card.
2. Change aggregation:
  - Click the drop-down on car\_brands\_in\_india.
  - Select **Measure** → **Count Distinct (CNTD)** to display the total number of EV brands available in India.
3. Change Marks Type to **Text** to create a KPI-style summary card.
4. Edit Sheet Title:
  - Change title text to Summary card for Different brands of EV Cars in India.
  - Apply background color and border styling.
5. Format the Sheet:
  - Increase font size of the numeric value.
  - Apply background shading.
  - Add borders.
  - Align the text to the center for better visibility.

### Visualization Insight:

This KPI card displays the total number of distinct electric vehicle brands available in India, providing a quick overview of market presence within the country.

## 6. Dashboard Development – Electric Cars Analytics Dashboard

The **Electric Cars Analytics Dashboard** was developed to combine multiple visualizations into a single interactive interface that provides a comprehensive overview of electric vehicle analytics. The dashboard is designed with a structured layout, allowing users to easily explore EV brand performance, efficiency, body styles, and market distribution through dynamic filters and clear visual hierarchy.

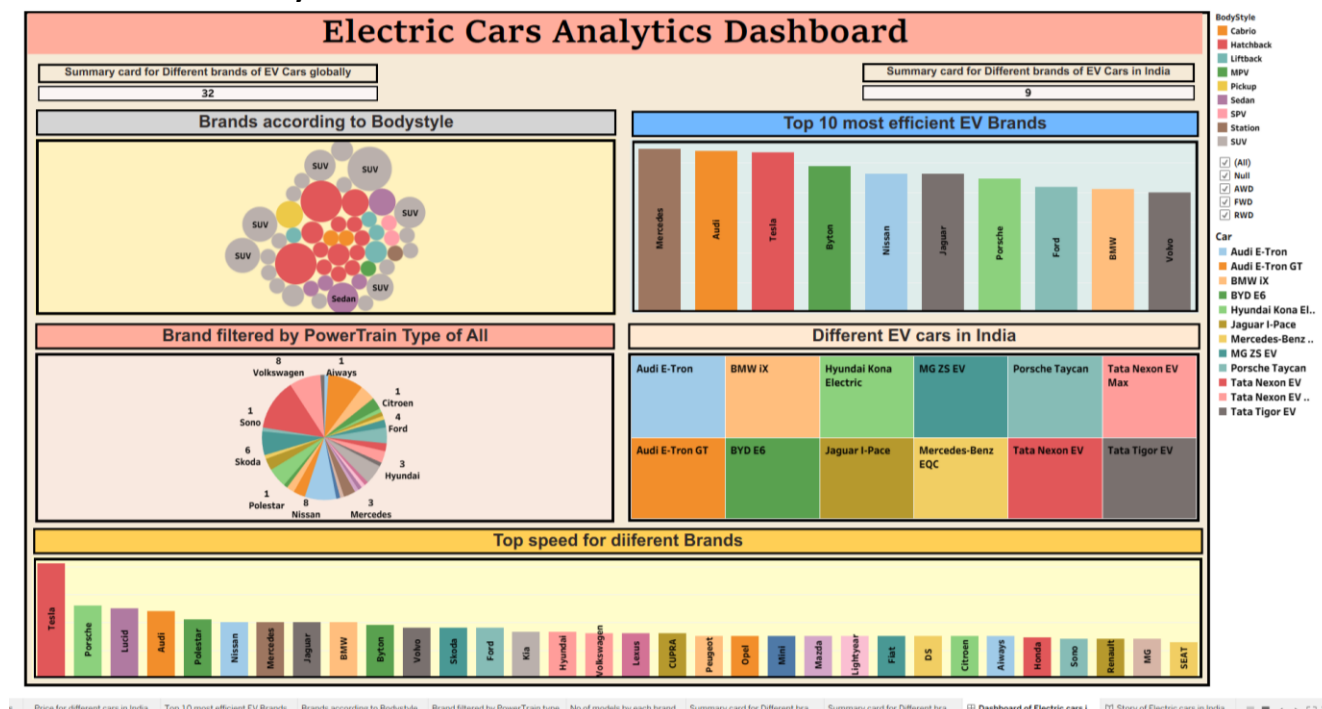
### Dashboard Components

- Global Summary Card
- India Summary Card
- Brands According to BodyStyle (Packed Bubble Chart)
- Top 10 Most Efficient EV Brands (Bar Chart)
- Brand Filtered by PowerTrain Type (Pie Chart)
- Different EV Cars in India (Treemap)
- Top Speed Comparison for Different Brands (Bar Chart)

### Design and Development Steps

1. Created a new dashboard in Tableau Desktop Public Edition.
2. Added Vertical and Horizontal Containers to organize the layout structure and maintain alignment between charts.
3. Inserted all required sheets into the dashboard and arranged them according to analytical priority.
4. Added interactive Filters on the right panel, including BodyStyle, PowerTrain, and Car model filters, allowing users to dynamically control the dashboard view.
5. Customized the visual appearance by applying consistent fonts, background colors, borders, and titles to match the project theme.
6. Adjusted sheet sizes and spacing to ensure readability and professional presentation.
7. Tested interactivity to confirm that filters update all related visualizations correctly and provide a seamless user experience.

### Full Electric Cars Analytics Dashboard



The final dashboard presents electric vehicle analytics in a visually appealing and user-friendly manner, enabling users to analyze trends, compare brands, and explore EV performance metrics efficiently.

## 7. Story Development – Story of Electric Cars in India

The **Story of Electric Cars in India** was created in Tableau to present analytical insights in a structured, step-by-step narrative format. Unlike dashboards, which display multiple visualizations simultaneously, the story feature guides users through different analytical perspectives sequentially, helping them understand trends and conclusions more clearly.

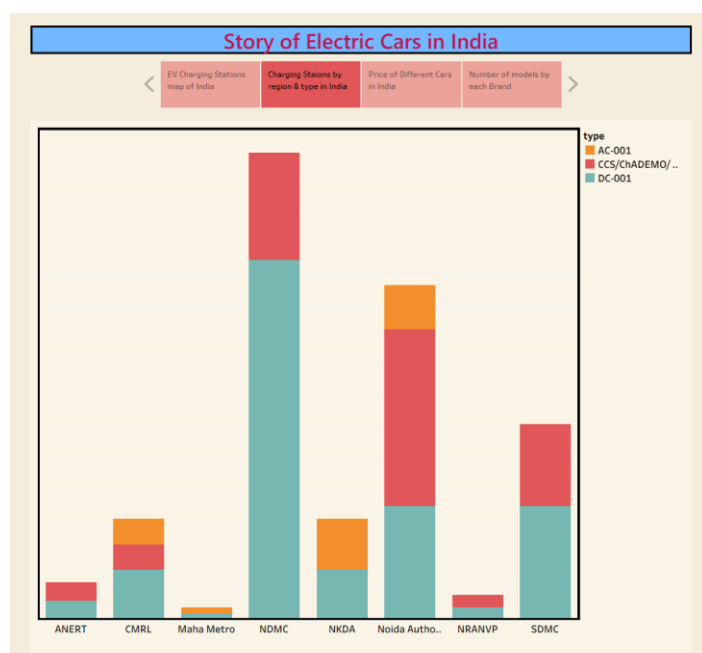
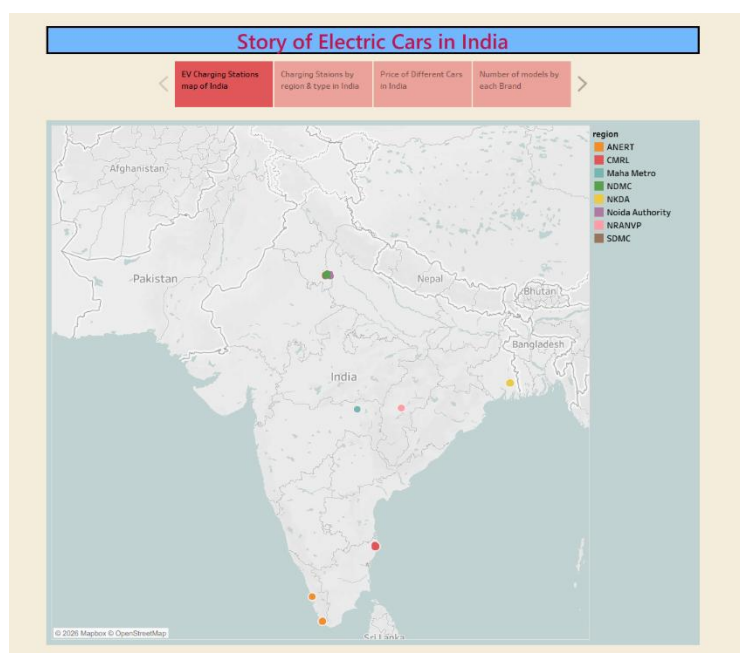
### Story Points

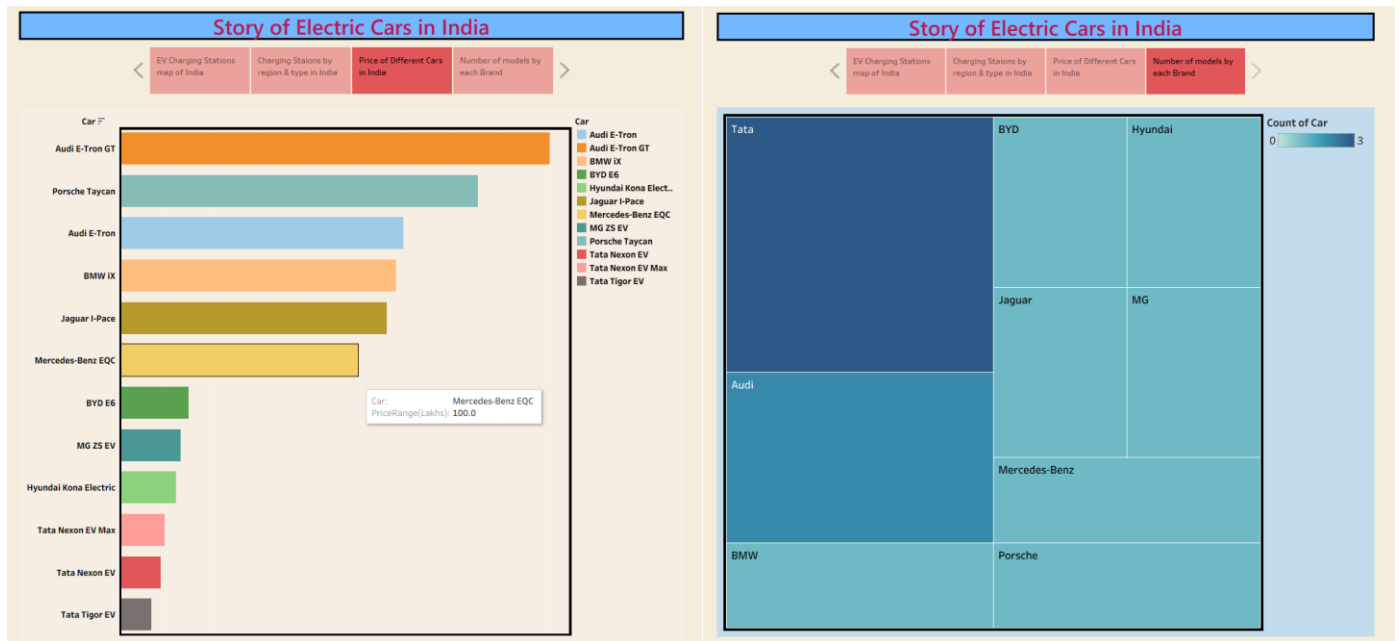
- EV Charging Stations Map of India
- Charging Stations by Region & Type
- Price of Different Cars in India
- Number of Models by Brand

Each story point highlights a specific aspect of electric vehicle analytics, allowing users to move through the analysis logically using navigation buttons.

### Development Steps

1. Created a new Story in Tableau Desktop Public Edition.
2. Added sheets and visualizations as individual Story Points to represent different analytical stages.
3. Organized the sequence of story points to follow a logical analytical flow, starting from geographic insights and moving toward pricing and brand distribution.
4. Added titles, captions, and navigation tabs to make the story easy to follow and visually engaging.
5. Maintained consistent formatting, including fonts, colors, colors, borders, and background styling to match the dashboard theme.
6. Adjusted layout spacing and alignment to ensure clarity and readability across all story slides.
7. Tested navigation arrows and interactions to confirm that users can smoothly move between story points.





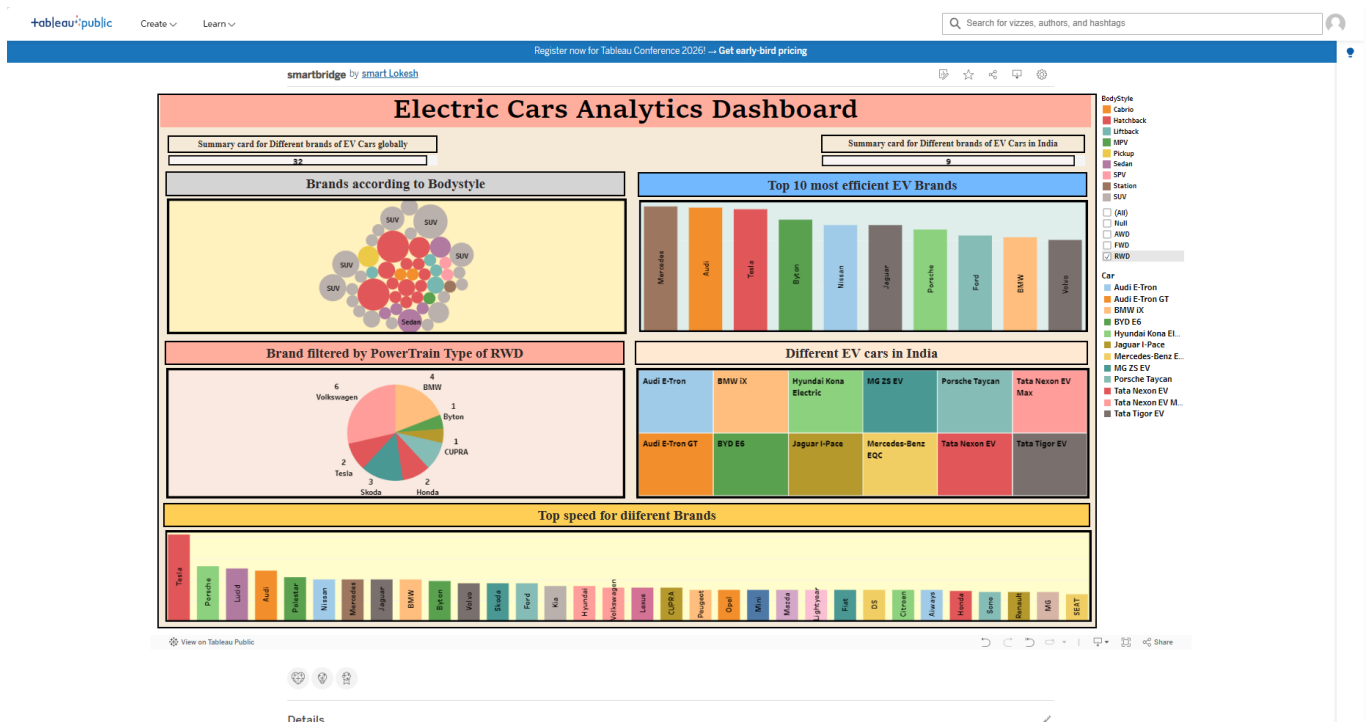
The final story provides a guided analytical journey, enabling users to explore electric vehicle insights progressively, from charging infrastructure distribution to pricing trends and brand diversity within the Indian EV market.

## 8. Publishing to Tableau Public

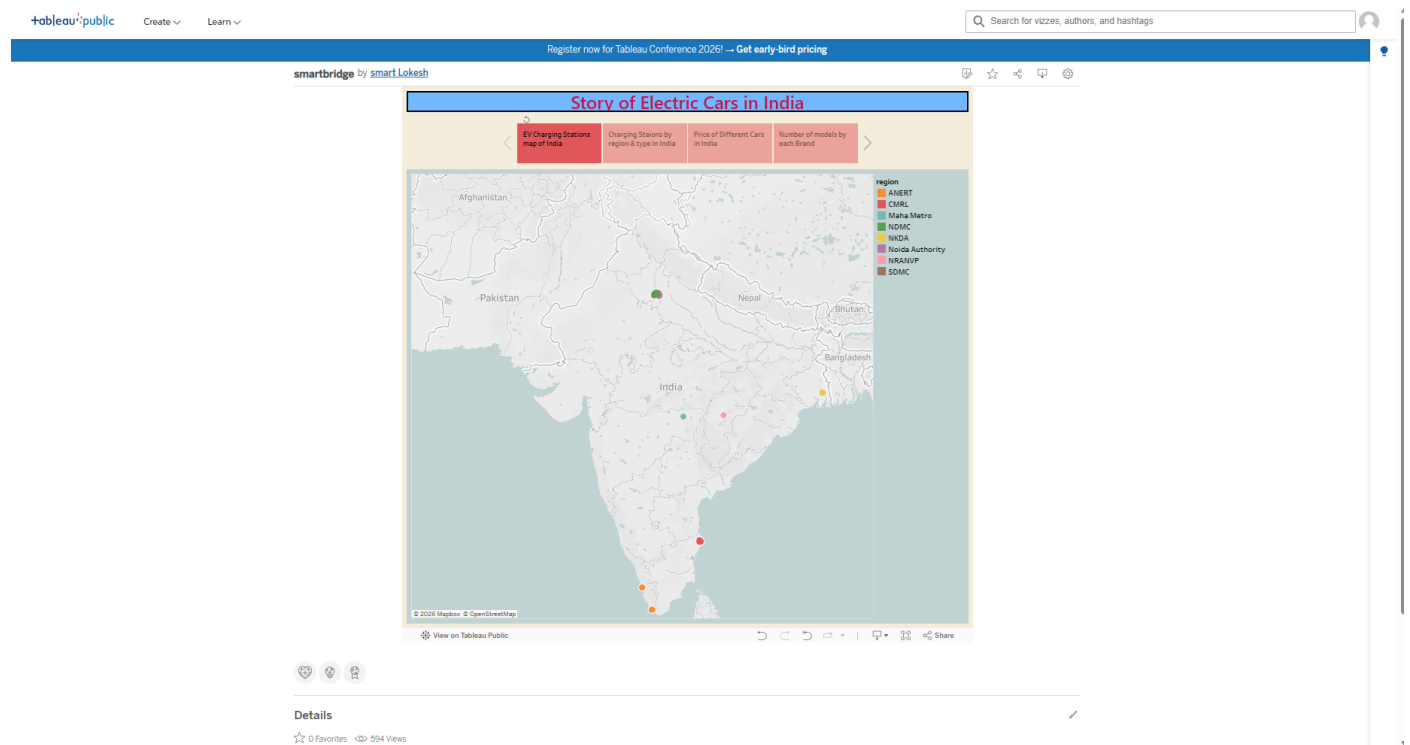
### Steps:

- Click File → Save to Tableau Public.
- Login using Tableau Public account.
- Publish Dashboard and Story.
- Copy embed links.

### Published Dashboard Online



## Published Story Online

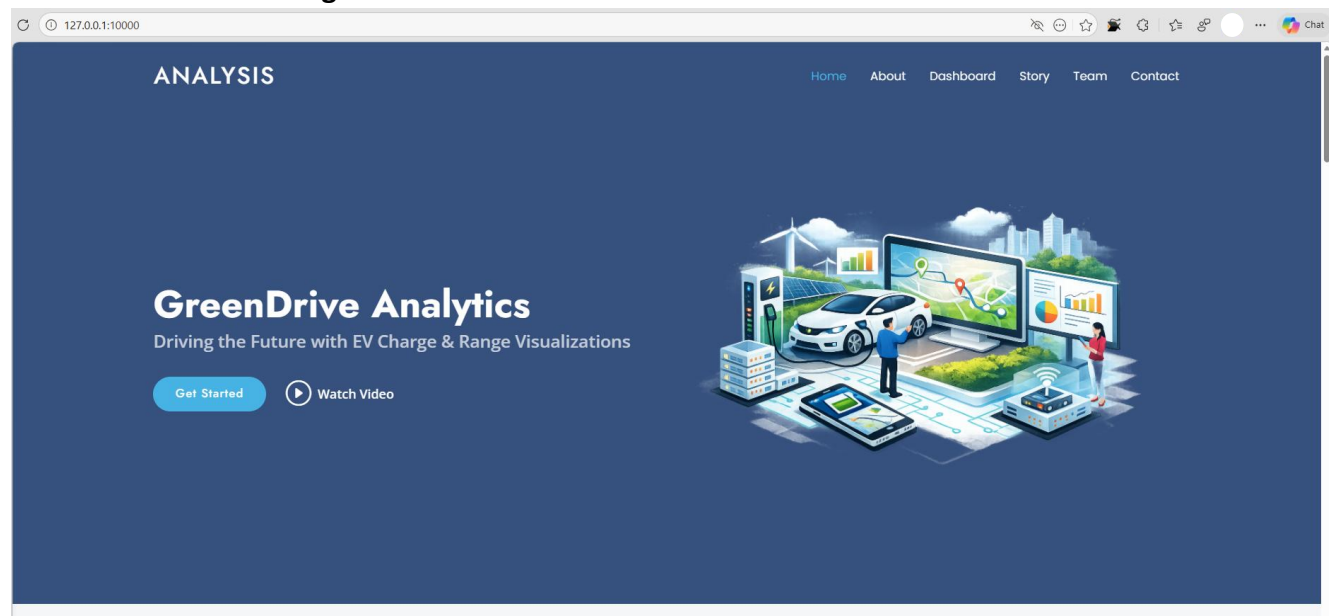


## 9. Flask Web Application Integration

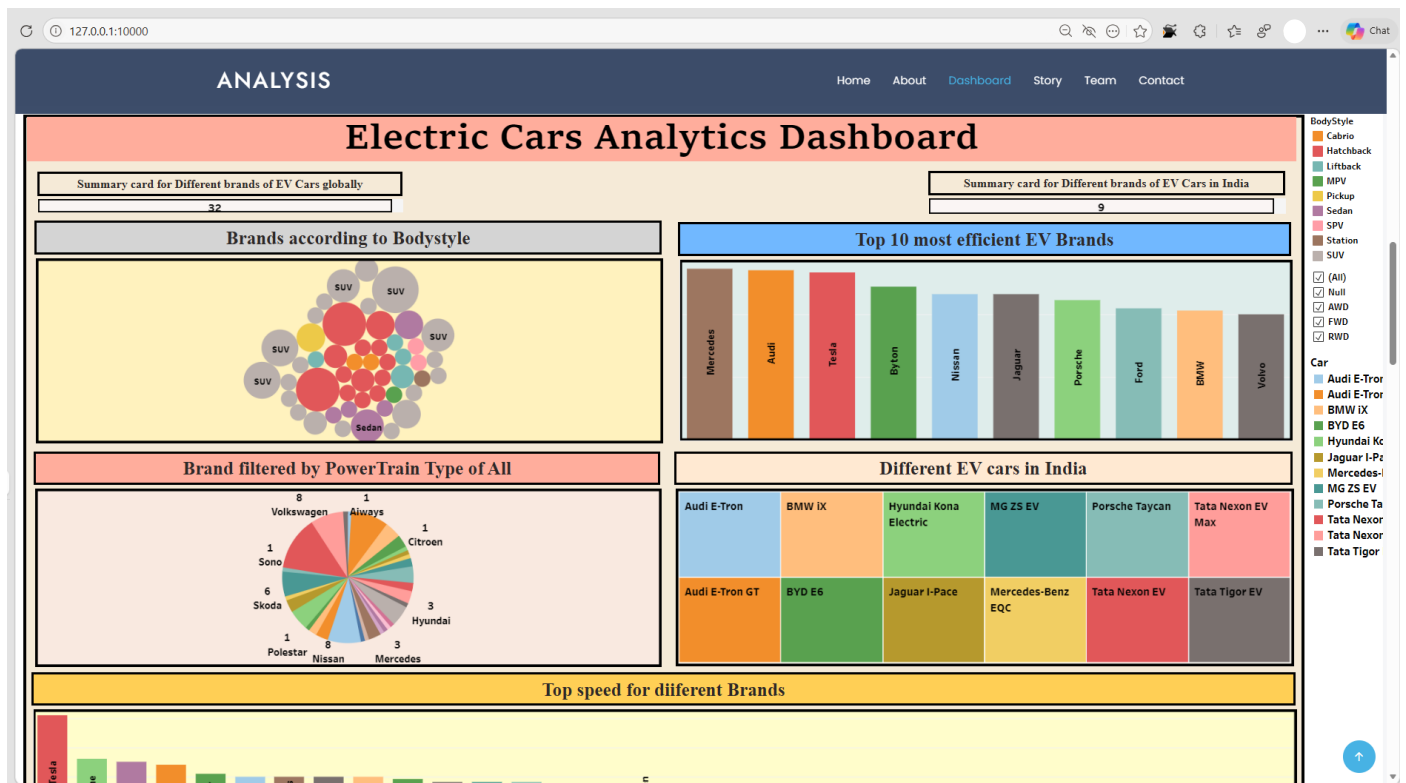
### Steps

- Created Flask application.
- Designed HTML pages for dashboard and story.
- Embedded Tableau Public iframe links.
- Added navigation menu and styling.
- Tested locally using:
- python app.py
- Opened website in browser.

### Flask Website Home Page



## Embedded Dashboard in Flask



## 10. Hosting the Flask Application

### Steps:

- Created requirements.txt file.
- Uploaded project to GitHub.
- Deployed using Render / PythonAnywhere.
- Configured start command.
- Verified live URL.

### Live Hosted Website

SmartInternz\_Web\_Integration

Service ID: srv-d6a6j4r85hc73dno3dg

Lokesh1430 / SmartInternz\_Web\_Integration

<https://smartinternz-web-integration.onrender.com>

Your free instance will spin down with inactivity, which can delay requests by 50 seconds or more. [Upgrade now](#)

February 23, 2026 at 8:48 PM Live

dc21be0 Update index.html

All logs Search Feb 23, 8:47 PM - 8:52 PM GMT+5:30

```
Feb 23
08:50:13 PM --> Uploaded in 10.2s. Compression took 0.1s
08:50:13 PM --> Build successful
08:50:34 PM --> Deploying...
08:50:34 PM --> Setting WEB_CONCURRENCY=1 by default, based on available CPUs in the instance
08:51:34 PM [85x5x] --> Running 'gunicorn app:app'
08:51:37 PM [85x5x] [2026-02-23 15:21:37 +0000] [50] [INFO] Starting gunicorn 26.1.0
08:51:37 PM [85x5x] [2026-02-23 15:21:37 +0000] [50] [INFO] Listening at: http://0.0.0.0:10000 (50)
08:51:37 PM [85x5x] [2026-02-23 15:21:37 +0000] [50] [INFO] Using worker: sync
08:51:37 PM [85x5x] [2026-02-23 15:21:37 +0000] [50] [INFO] Control socket listening at /opt/render/project/src/gunicorn.ctl
08:51:39 PM --> Your service is live
08:51:39 PM --> Available at your primary URL https://smartinternz-web-integration.onrender.com
08:51:39 PM --> Need better ways to work with logs? Try the Render CLI, Render MCP Server, or set up a log stream integration
```

## 11. Creativity and Design

- Consistent color theme applied.
- Professional font styling used.
- Interactive filters added.
- KPI summary cards designed.
- Structured dashboard layout maintained.

## 12. Source Code Repository and Live Web Application

### GitHub Source Code Repository

The complete source code for the Electric Cars Analytics project is maintained in a GitHub repository to ensure version control, collaboration, and easy access to project files. The repository includes the Flask application structure, HTML templates, static assets, and configuration files used for deployment. Hosting the project on GitHub provides transparency, enables future enhancements, and allows others to review the implementation details of the dashboard integration.

#### GitHub Repository Link:

[https://github.com/Lokesh1430/SmartInternz\\_Web\\_Integration](https://github.com/Lokesh1430/SmartInternz_Web_Integration)

## 13. Live Web Application

The final Flask application is successfully deployed online, allowing users to access the Electric Cars Analytics Dashboard and Story through a web browser. The live website integrates Tableau Public visualizations using embedded links, providing an interactive and user-friendly experience. This deployment demonstrates the end-to-end workflow of the project, from data processing and visualization to web integration and cloud hosting.

#### Live Application URL:

<https://smartinternz-web-integration.onrender.com>

The live deployment enables real-time access to the project and showcases how data visualization tools can be combined with web technologies to deliver an interactive analytics platform.

## 14. Conclusion

The **Electric Cars Analytics Dashboard and Story** project successfully demonstrates how data visualization and web integration can be combined to analyze electric vehicle trends effectively. By connecting MySQL Workbench with Tableau Desktop, the project enabled structured data management, preprocessing, and the creation of interactive visualizations that highlight EV performance, pricing, body styles, efficiency, and brand distribution.

Through the development of multiple sheets, an integrated dashboard, and a guided story, complex electric vehicle data was transformed into meaningful insights that are easy to understand. Publishing the visualizations on Tableau Public and integrating them into a Flask web application further enhanced accessibility, allowing users to explore analytics through a live web interface.

Overall, this project showcases an end-to-end workflow that includes data connectivity, visualization design, dashboard development, storytelling, and web deployment. It highlights the importance of modern analytics tools in supporting decision-making and provides a scalable foundation for future enhancements in electric vehicle data analysis.