

# ANALYSIS OF **EV** STATIONS ACROSS THE U.S.



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Business Intelligence & Data Visualization



# Business Problem

- Drive growth by targeting underserved regions based on data-driven trends.
- Identify gaps in sustainability efforts and promote the adoption of eco-friendly energy solutions in the EV charging network.
- Are there enough fast charging stations to meet the growing demand?
- Are charging stations dominated by a particular category of owners?



# Dataset Used

- Source: U.S. Department of Energy – Alternative Fuels Data Center.
- URL: <https://afdc.energy.gov>
- Records Count: 78,837

The screenshot shows the homepage of the Alternative Fuels Data Center (AFDC) website. The header features the U.S. Department of Energy logo and the text 'Energy Efficiency & Renewable Energy'. Below this is a green banner with the title 'Alternative Fuels Data Center'. A navigation bar contains links for 'FUELS & VEHICLES', 'CONSERVE FUEL', 'LOCATE STATIONS', 'LAWS & INCENTIVES', 'Maps & Data', and 'Case Studies'. The main content area shows a breadcrumb trail 'EERE » AFDC » Tools' and a section titled 'Data Downloads' with the instruction 'To download data related to alternative fuels and advanced vehicles, follow the steps below.' The first step is 'Step 1. Choose data to download', with the instruction 'Choose the dataset you want to download.' Below this is a dropdown menu labeled 'Dataset' with 'Alternative fuel stations' selected.

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy

## Alternative Fuels Data Center

FUELS & VEHICLES   CONSERVE FUEL   LOCATE STATIONS   LAWS & INCENTIVES   Maps & Data   Case Studies

[EERE](#) » [AFDC](#) » [Tools](#)

### Data Downloads

To download data related to alternative fuels and advanced vehicles, follow the steps below.

#### Step 1. Choose data to download

Choose the dataset you want to download.

★ Dataset   Alternative fuel stations



# Team Plan

- Data collection and cleaning.
- EDA and feature engineering.
- Dashboard design and visualization.
- Advanced analytics.
- Aesthetic Refinements.



# EDA

- Null Value Check for Key Columns
- Understanding the data distribution
- Duplicate Check
- Colab file link :  
[https://colab.research.google.com/drive/1oG\\_bJiAL5pFXMYQX18IJMk7y0tL6lrln?usp=sharing#scrollTo=faJbRYog4uvo](https://colab.research.google.com/drive/1oG_bJiAL5pFXMYQX18IJMk7y0tL6lrln?usp=sharing#scrollTo=faJbRYog4uvo)

# Null Value Check for Key Columns



## Missing Data Overview:

|                             | Missing Count | Missing Percentage |
|-----------------------------|---------------|--------------------|
| EV On-Site Renewable Source | 78907         | 99.485595          |
| EV Level1 EVSE Num          | 78617         | 99.119965          |
| Federal Agency Name         | 78290         | 98.707685          |
| Federal Agency ID           | 78290         | 98.707685          |
| Federal Agency Code         | 78290         | 98.707685          |
| Access Detail Code          | 74822         | 94.335246          |
| Expected Date               | 73700         | 92.920633          |
| Cards Accepted              | 71518         | 90.169577          |
| Restricted Access           | 66811         | 84.235012          |
| EV DC Fast Count            | 66799         | 84.219883          |
| EV Pricing                  | 63782         | 80.416063          |
| Facility Type               | 59921         | 75.548131          |
| Owner Type Code             | 58318         | 73.527076          |
| EV Level2 EVSE Num          | 11389         | 14.359201          |
| EV Network Web              | 9639          | 12.152808          |
| Access Days Time            | 7986          | 10.068713          |
| Open Date                   | 441           | 0.556011           |
| Date Last Confirmed         | 156           | 0.196684           |
| Street Address              | 34            | 0.042867           |
| EV Workplace Charging       | 11            | 0.013869           |
| City                        | 4             | 0.005043           |
| Station Name                | 3             | 0.003782           |
| Status Code                 | 0             | 0.000000           |
| Updated At                  | 0             | 0.000000           |
| State                       | 0             | 0.000000           |
| Access Code                 | 0             | 0.000000           |
| Longitude                   | 0             | 0.000000           |
| Latitude                    | 0             | 0.000000           |
| ID                          | 0             | 0.000000           |
| Geocode Status              | 0             | 0.000000           |
| Fuel Type Code              | 0             | 0.000000           |
| EV Network                  | 0             | 0.000000           |
| EV Connector Types          | 0             | 0.000000           |
| Country                     | 0             | 0.000000           |
| ZIP                         | 0             | 0.000000           |



# Data Distribution (1)

Descriptive Statistics for Numerical Columns:

|       | EV Level2    | EVSE Num     | Latitude     | Longitude \ |
|-------|--------------|--------------|--------------|-------------|
| count | 79315.000000 | 79315.000000 | 79315.000000 |             |
| mean  | 2.551291     | 37.870088    | -96.199288   |             |
| min   | 1.000000     | 18.009854    | -162.286348  |             |
| 25%   | 2.000000     | 34.043346    | -117.881102  |             |
| 50%   | 2.000000     | 38.596430    | -91.068251   |             |
| 75%   | 2.551291     | 41.591639    | -78.656218   |             |
| max   | 338.000000   | 64.852466    | -65.756678   |             |
| std   | 3.357435     | 5.041741     | 19.380892    |             |

|       | Date Last Confirmed           | ID \          |
|-------|-------------------------------|---------------|
| count | 79159                         | 79315.000000  |
| mean  | 2024-09-07 19:18:28.346492416 | 220069.654038 |
| min   | 2019-12-12 00:00:00           | 1517.000000   |
| 25%   | 2024-10-11 00:00:00           | 165452.500000 |
| 50%   | 2024-12-02 00:00:00           | 205580.000000 |
| 75%   | 2024-12-02 00:00:00           | 308834.500000 |
| max   | 2024-12-02 00:00:00           | 372237.000000 |
| std   | NaN                           | 85900.785636  |

|       | Open Date                     | EV Workplace Charging |
|-------|-------------------------------|-----------------------|
| count | 78874                         | 79315.000000          |
| mean  | 2021-03-28 11:03:17.631665408 | 0.019268              |
| min   | 1995-08-30 00:00:00           | 0.000000              |
| 25%   | 2020-06-12 00:00:00           | 0.000000              |
| 50%   | 2021-10-23 00:00:00           | 0.000000              |
| 75%   | 2023-06-16 00:00:00           | 0.000000              |
| max   | 2025-01-15 00:00:00           | 1.000000              |
| std   | NaN                           | 0.137455              |

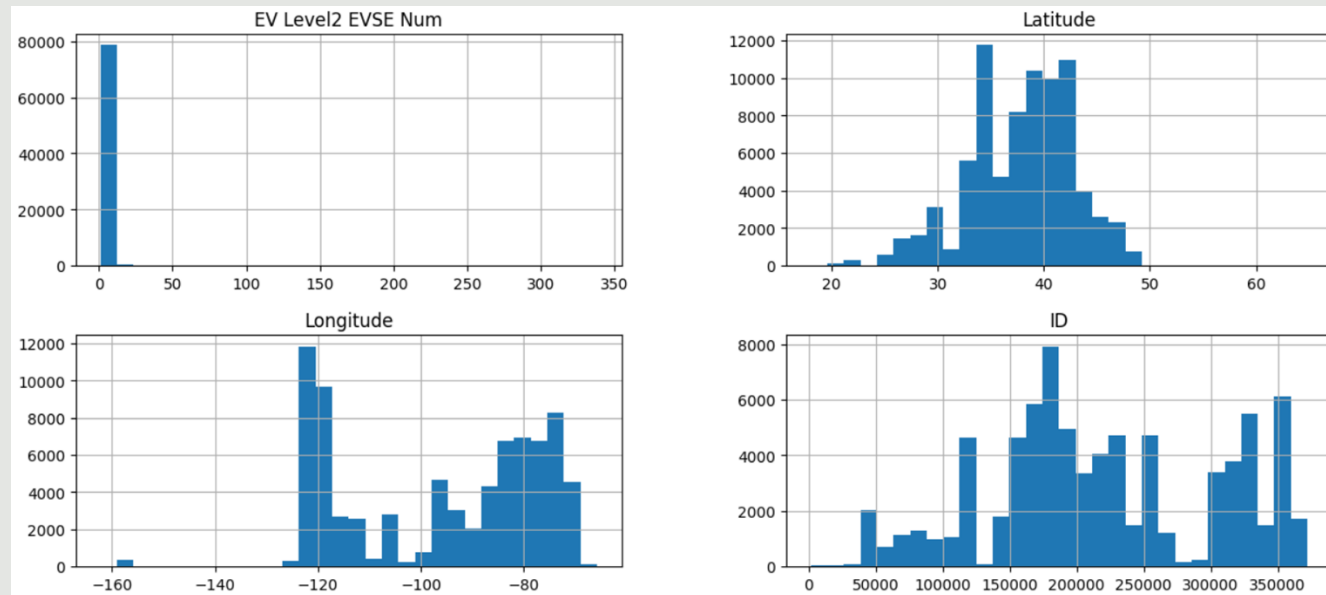


# Data Distribution (2)



```
import matplotlib.pyplot as plt

# Plot histograms for all numerical columns
df_cleaned.select_dtypes(include=['float64', 'int64']).hist(figsize=(15, 10), bins=30)
plt.suptitle("Histograms for Numerical Columns", fontsize=16)
plt.show()
```







# Duplicates Check

```
# Check for duplicate rows
print(f"Number of duplicate rows before removal: {df_cleaned.duplicated().sum()}")

# Remove duplicate rows
df_no_duplicates = df_cleaned.drop_duplicates()

# Display results
print(f"Shape before duplicate removal: {df_cleaned.shape}")
print(f"Shape after duplicate removal: {df_no_duplicates.shape}")
```

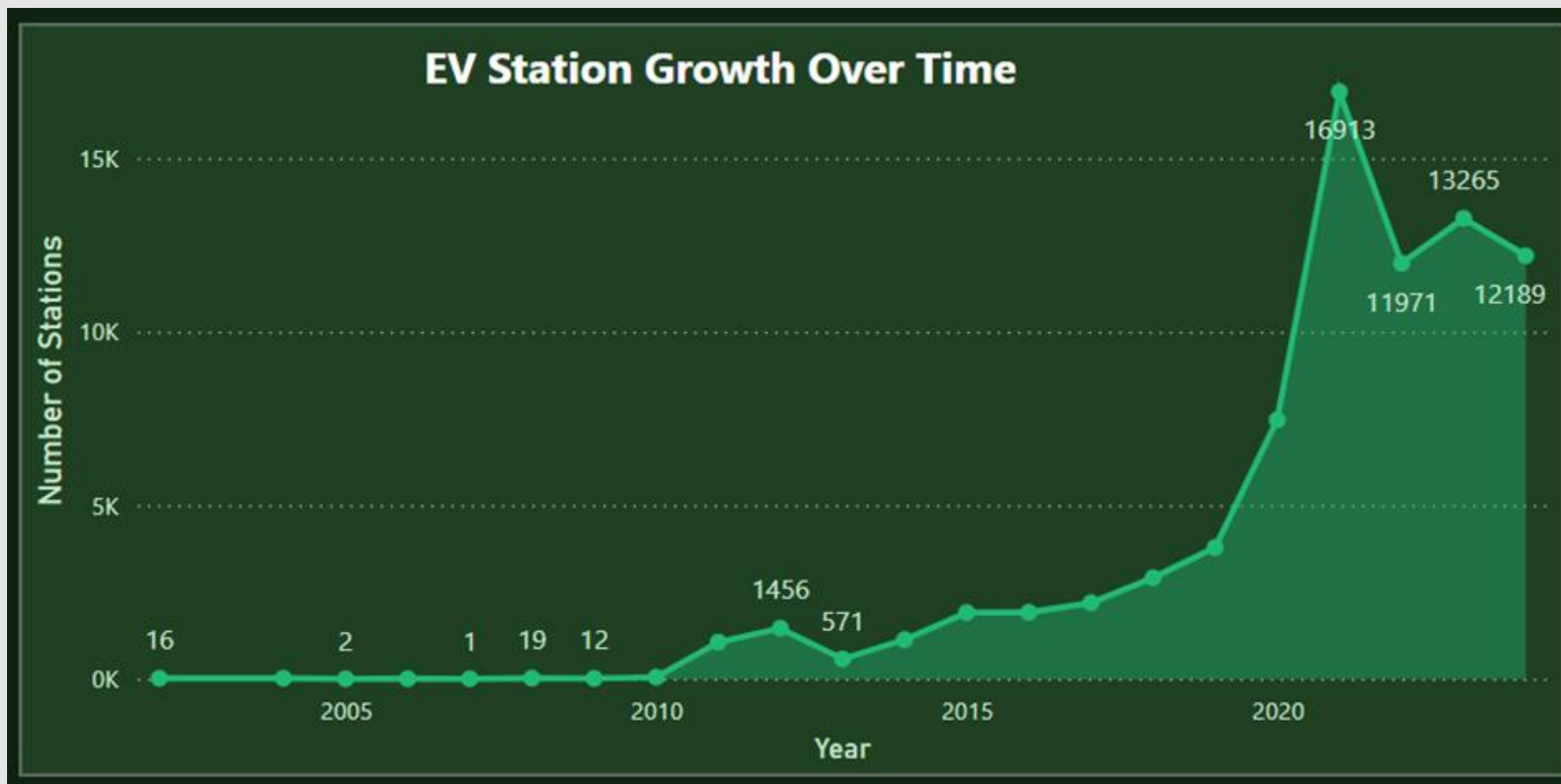
```
Number of duplicate rows before removal: 0
Shape before duplicate removal: (79315, 22)
Shape after duplicate removal: (79315, 22)
```



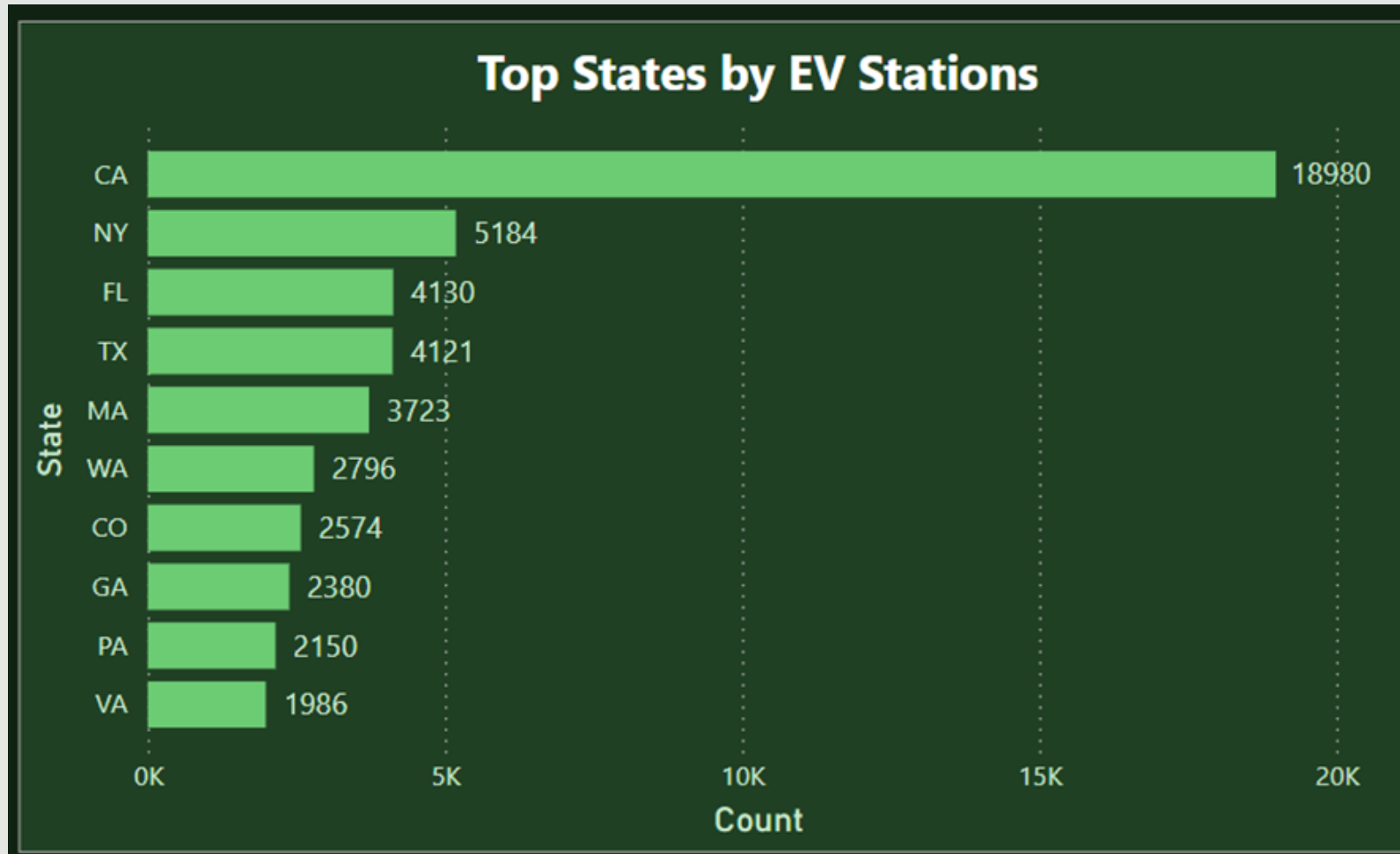
# Analysis Performed

- Trend Analysis over Time.
- Access Type Distribution.
- Top States by EV Station Utilization
- Availability of Fast Chargers.
- Classification of Key Stakeholders.
- ML Forecasting of Future Expansion.

# Area Chart



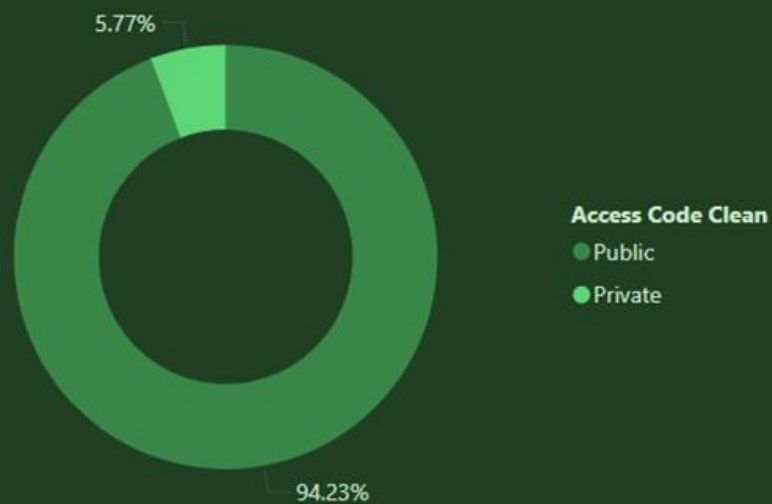
# Bar Chart



# Donut Chart & Tree Map



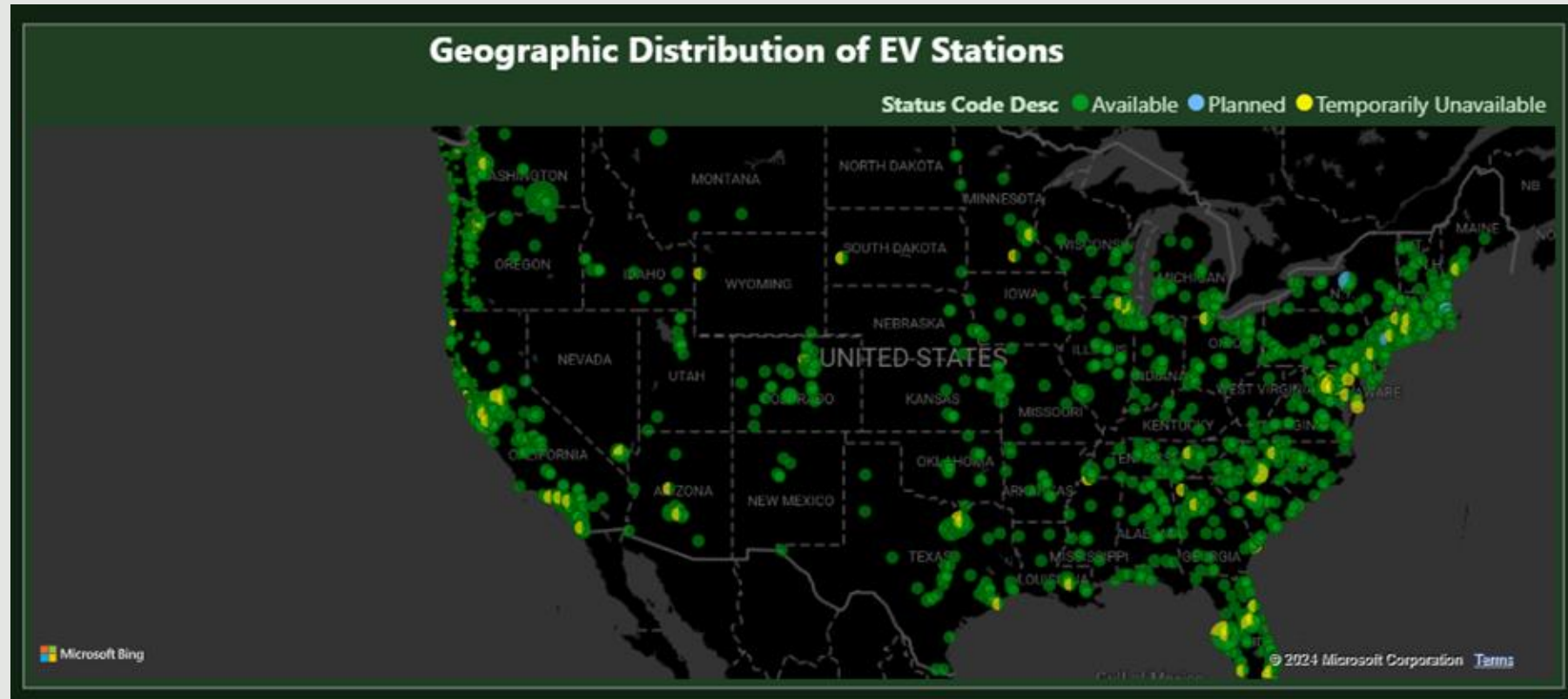
Access Type Distribution: Public vs Private



Distribution of Owner by Station



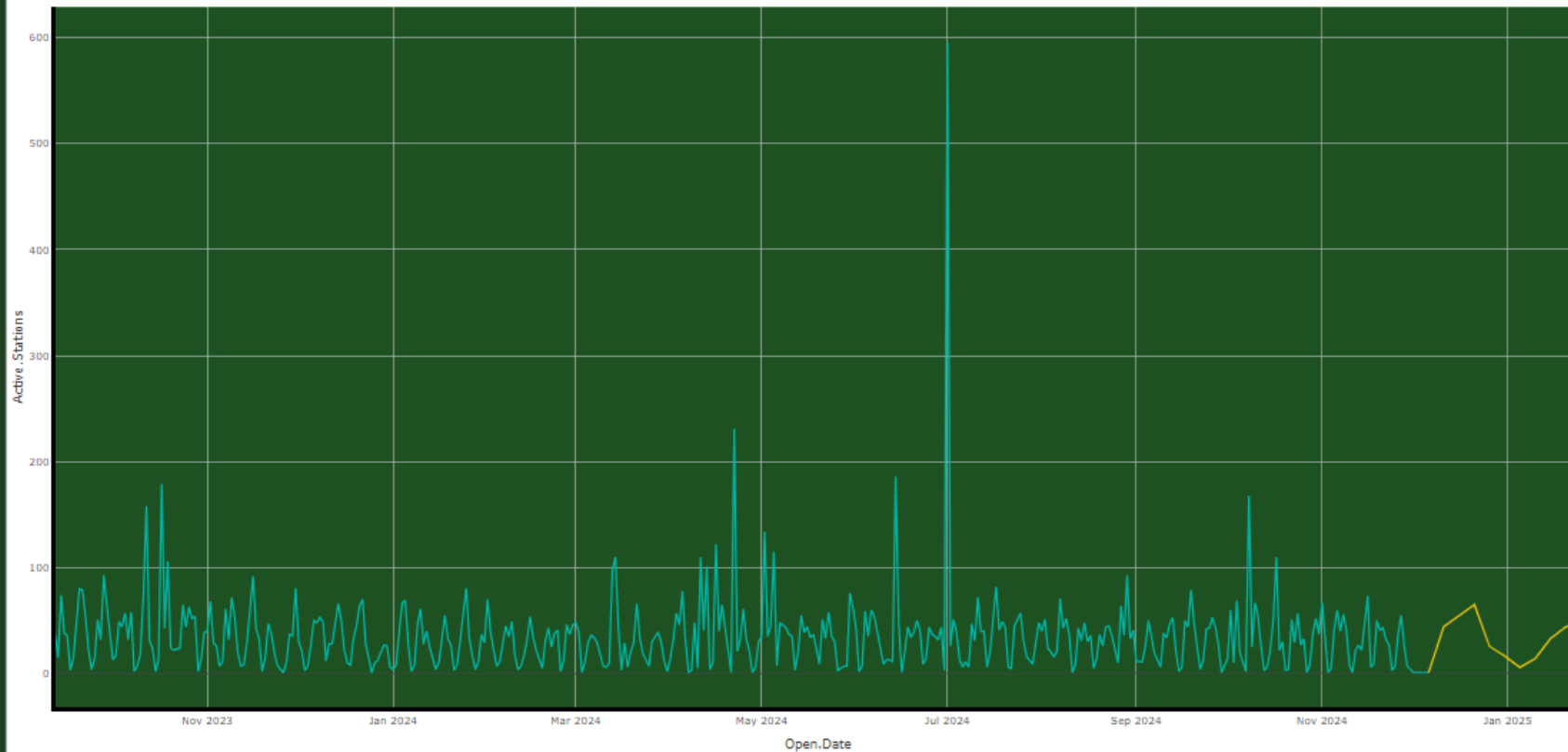
# Geospatial Map





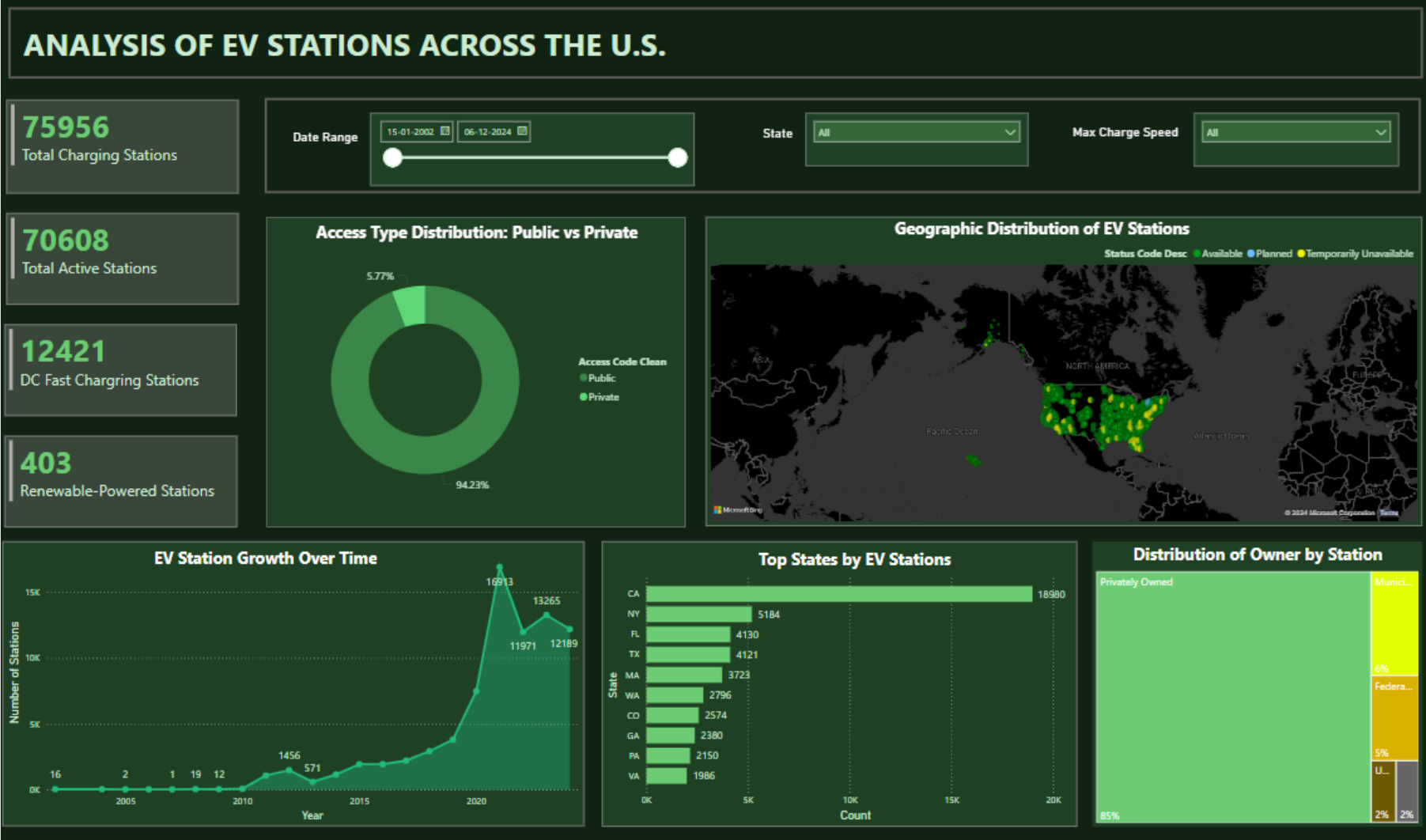
# ML Prediction using MAQ Chart

## ■ Number of Station Prediction using R





# Dashboard View (Page 1)





# Additional Features - Q & A



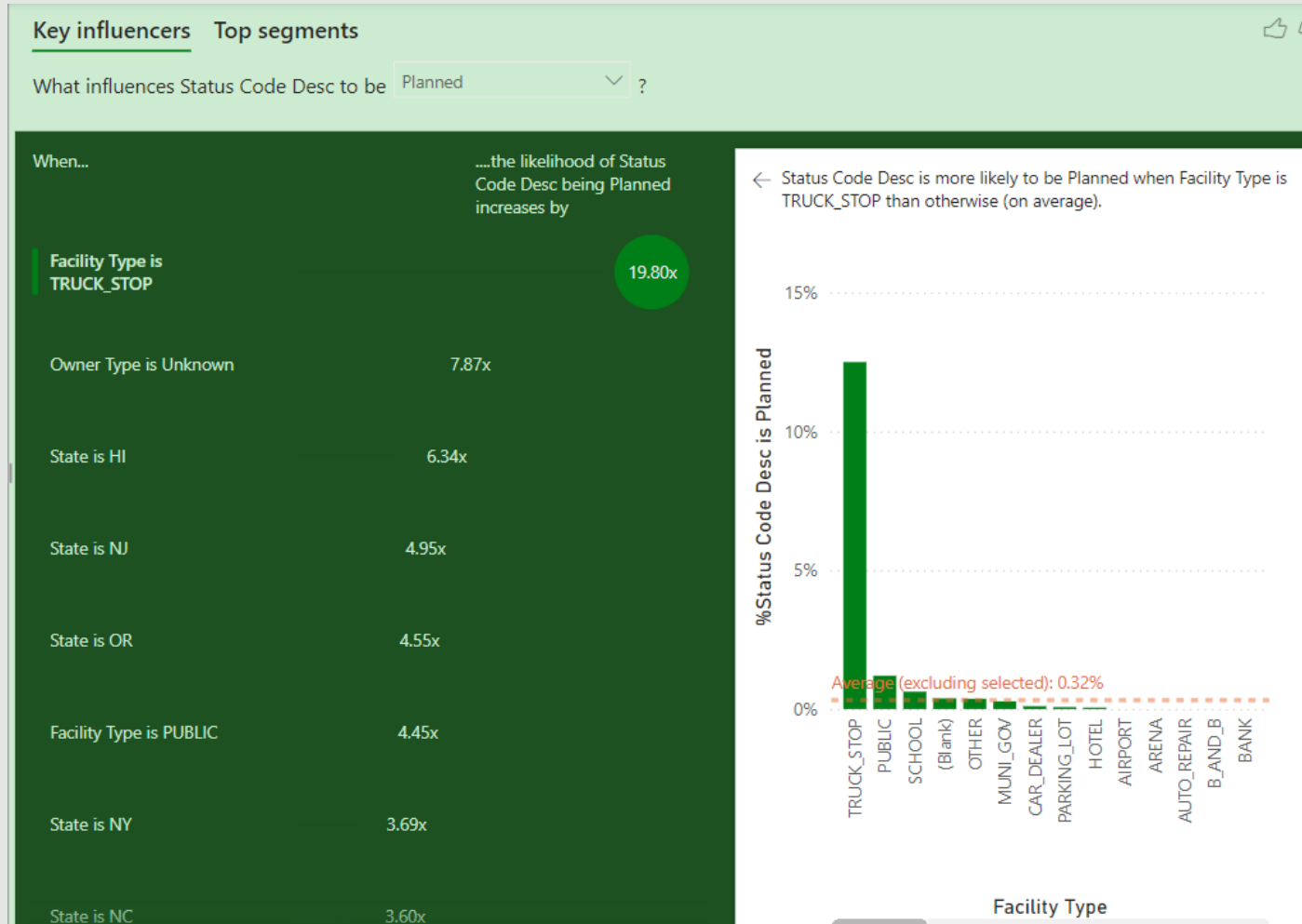
Which state has maximum EV network stations?

Showing results for *Top state of EV stations data by active stations of those EV stations data*

State

CA

# Additional Features - Key Influencers



# Additional Features - Decomposition Tree



# Dashboard View (Page 2)



## ADDITIONAL FEATURES

Which state has maximum EV network stations?

Showing results for Top state of EV stations data by active stations of those EV stations data

State  
CA

### Key Influencer

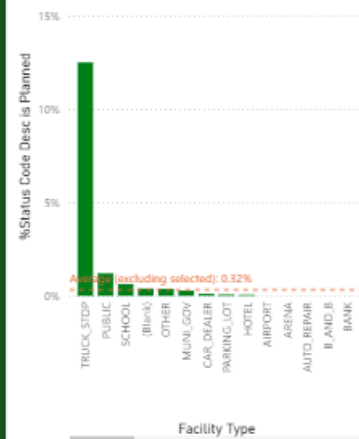
Key influencers Top segments

What influences Status Code Desc to be Planned

When... Facility Type is TRUCK\_STOP ...the likelihood of Status Code Desc being Planned increases by 19.80x

|                         |       |
|-------------------------|-------|
| Owner Type is Unknown   | 7.87x |
| State is HI             | 6.34x |
| State is HI             | 4.95x |
| State is OR             | 4.55x |
| Facility Type is PUBLIC | 4.45x |
| State is NY             | 3.69x |
| State is NC             | 3.60x |

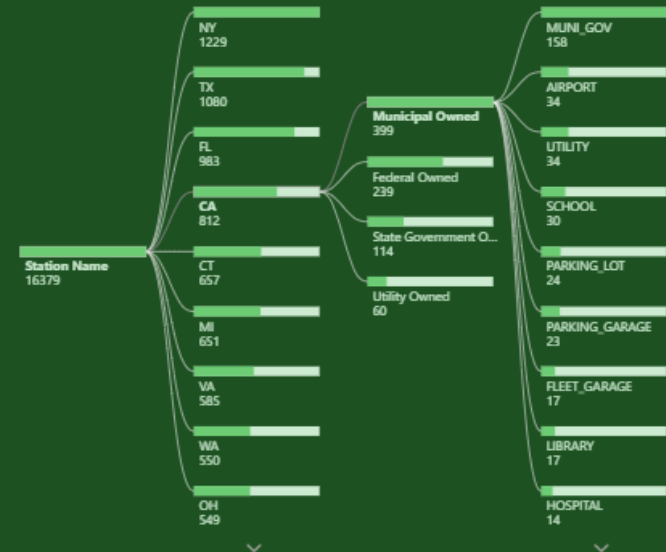
Status Code Desc is more likely to be Planned when Facility Type is TRUCK\_STOP than otherwise (on average).



Only show values that are influencers

### Decomposition Tree

State CA Owner Type Municipal Owned Facility Type



# Demonstration



<https://app.powerbi.com/groups/me/reports/2df8ca23-ccda-44ce-bf88-e7c20369b9b2/56dcbb3684d7de188dac?experience=power-bi>



# Advanced Features

- DAX Metrics
- Q&A Feature
- Key Influencers
- Decomposition Tree





# Conclusion

- California leads the U.S. in EV charging stations, showcasing its commitment to EV infrastructure.
- 95% of stations are publicly accessible, ensuring wide user access.
- EV charging stations have grown steadily since 2010, with a significant surge after 2019.
- Over 85% are privately owned, emphasizing the role of private entities in expansion.
- Only 18% offer DC Fast Charging, and less than 1% use renewable energy, highlighting opportunities for improvement in speed and sustainability.



# Future Scope

- Integration with Real-Time Data to monitor station utilization and downtime.
- Use geo-spatial analysis and clustering techniques for recommending optimal locations for new stations.
- Incorporate user reviews for service improvements.



**Thank You !**