A comparative analysis of Electric Vehicle charging stations across United States of America

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1 - Introduction

The adoption of electric vehicles (EVs) is crucial for transitioning to sustainable energy systems by reducing fossil fuel dependency and integrating renewable energy. A robust EV charging network is vital to this shift. This analysis evaluates the distribution of EV charging stations across U.S. states, offering insights for policymakers, businesses, and organizations. It identifies regions with advanced infrastructure, highlights best practices, and pinpoints areas for strategic development to support EV growth.

2 - Used Data

Source Name	Source Link	Hosted at:
USA EV charging station locations	cfahlgren1/us-ev-charging…	Link
USA county maps	GitHub - kjhealy/us-coun…	Link
USA vehicle population	Alternative Fuels Data C…	Link

Table 2.1: Data Sources

The datasets for this analysis were sourced from multiple platforms. All data falls under the Open-Source licensing and reference to all data sources is mentioned in the above tables.

USA EV charging station locations and county maps, retrieved as JSON objects, underwent **data preparation** to extract essential information. The USA vehicle population data, obtained as an open-access HTML table, was scraped and converted into a JSON object. While datasets were used as provided, data from official websites was manually downloaded and stored on a custom self-hosting platform for testing. During **data integration**, county maps were used to create polygons and multi-polygons representing U.S. boundaries. Charging station coordinates and vehicle population data were mapped to these boundaries to determine state-wise distributions.

The final database structure comprised the following fields:

- state_name → Name of the State
- count_of_ev_charging_stations → Count of EV Charging Stations in the State
- count_of_ev_vehicles → Count of “Chargeable” EV Vehicles registered in the State in 2023

3 - Analysis

The primary objective of this analysis was to examine the distribution of electric vehicle (EV) infrastructure across the United States, focusing on three key aspects: the number of EV charging stations, the ratio of EV vehicles to charging stations, and the spatial distribution of EV vehicles relative to charging stations in each state.

3.1 - Data Selection

Key indicators pertaining to EV infrastructure were identified and extracted. These indicators included:

1. Polygons and multi-polygons representing U.S. state boundaries, along with corresponding state names.
2. Longitude and latitude coordinates of individual EV charging stations.
3. Counts of chargeable and semi-chargeable EV vehicles for each state.

3.2 - Data Visualization

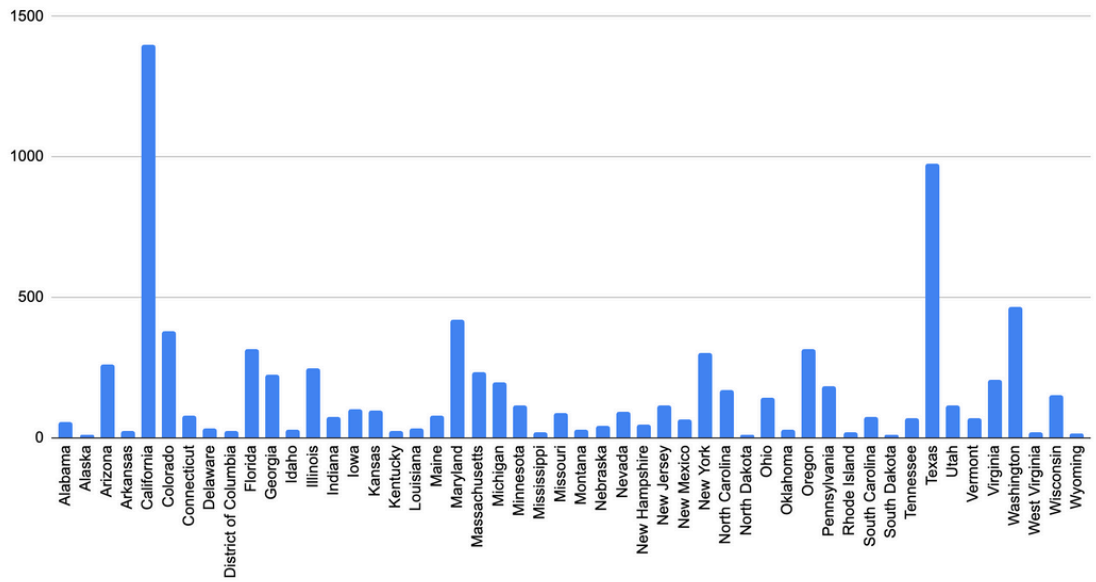
To effectively present the findings, the following visualizations were employed:

1. A scatter plot to illustrate the distribution of EV vehicles in relation to charging stations, highlighting outliers and identifying trends.
2. A column chart to depict the total number of EV charging stations per state and the ratio of EV vehicles to charging stations, providing insights into infrastructure investments and their utility across states.

4 - Results

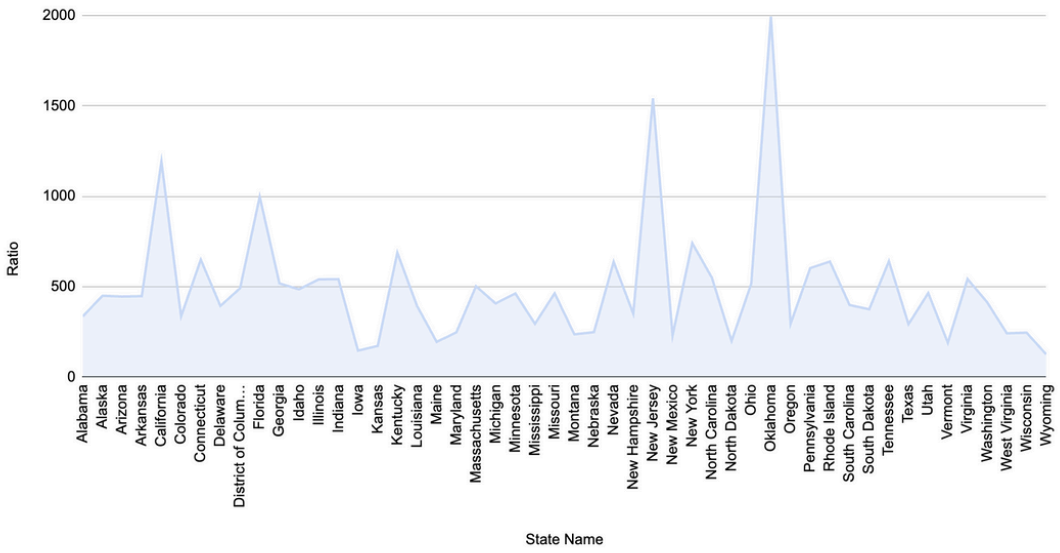
4.1 - Count of EV charging stations in each state

The provided chart illustrates the count of EV charging stations across various U.S. states. The data reveals a relatively uniform distribution of investments in EV infrastructure across most states, with notable outliers such as Texas and California, which have significantly higher counts of charging stations.



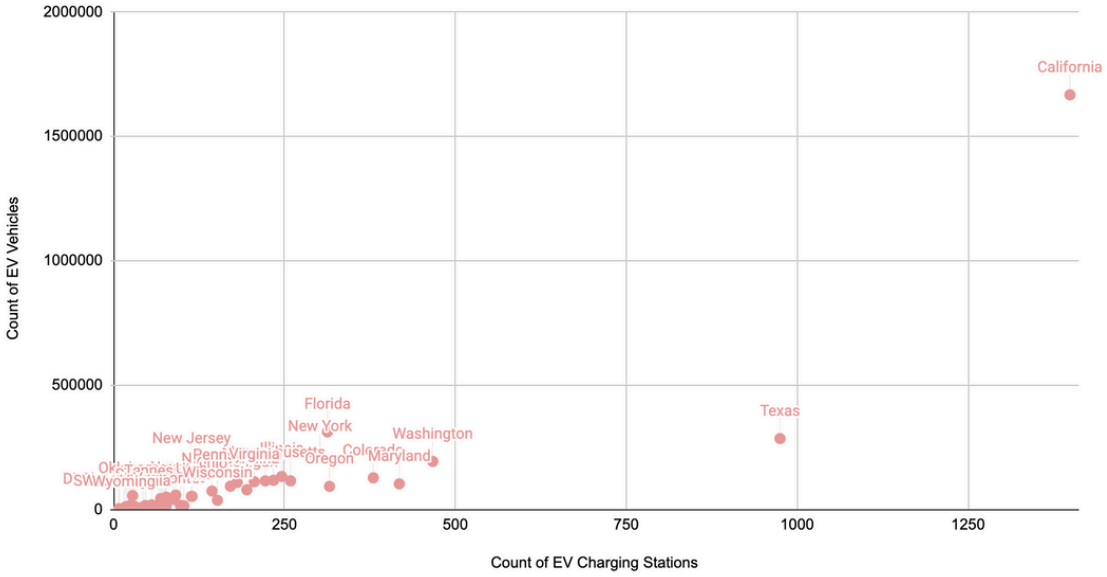
4.2 - Ratio of EV vehicles against charging stations in each state

The chart shows the EV-to-charging-station ratio across U.S. states, with most states displaying consistency but some spikes indicating underinvestment in infrastructure. These variations highlight areas needing additional charging stations to meet EV demand.

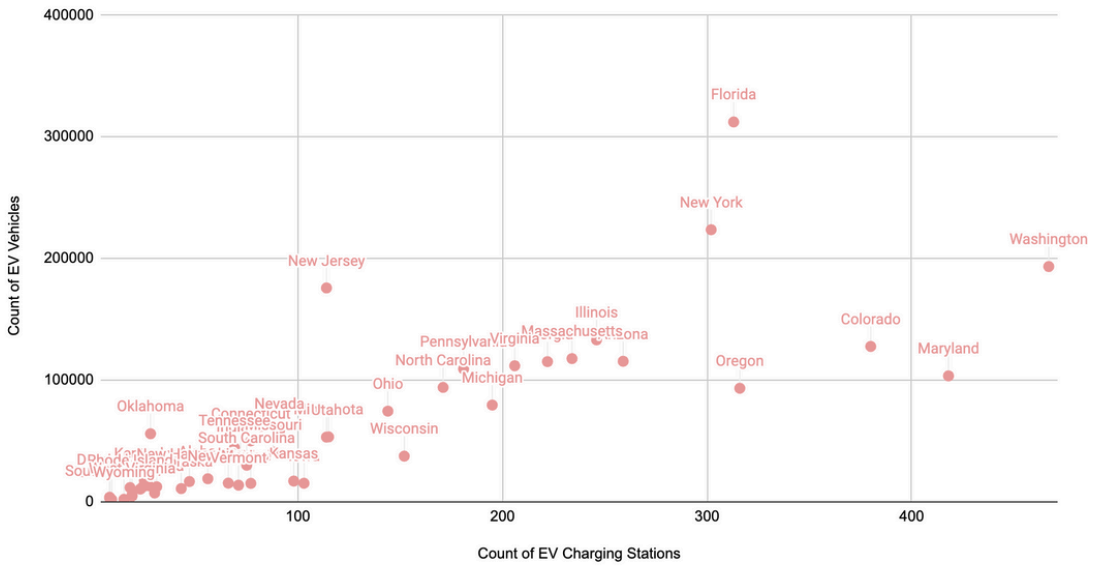


4.3 - Distribution of EV vehicles against charging stations

The scatter plot shows the distribution of EVs and charging stations across states, with most clustered at lower values and outliers like California and Texas leading in infrastructure. California dominates in both EV adoption and stations, while Texas has high station counts but fewer EVs. These disparities emphasize the need for strategic investments in other regions.



The scatter plot, excluding outliers like California and Texas, reveals a positive correlation between EVs and charging stations across states. Florida, New York, and Washington show higher counts of both, indicating well-developed infrastructure and alignment between EV adoption and development.



4.4 - Key Insights

The analysis reveals disparities in EV infrastructure across the U.S., with California and Texas leading while most states show limited but uniform distribution. A positive EV adoption-to-infrastructure correlation exists, though high EV-to-station ratios in some states suggest underinvestment. Targeted investments are needed in underserved regions to ensure equitable access and support EV growth.

5 - Conclusion

The analysis underscores the critical role of robust and evenly distributed EV charging infrastructure in supporting the widespread adoption of electric vehicles across the United States. Key insights reveal that while states like California and Texas lead in EV infrastructure, a linear demand-supply trend is observed in most other states. This study highlights the need for strategic investments in underserved regions to ensure equitable access and support future EV growth. These findings provide actionable guidance for policymakers and stakeholders to drive sustainable energy transitions.