US Electric Vehicle Charging Infrastructure & Sales Trends

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Executive Summary

This project analyzes over a decade of US electric vehicle (EV) charging infrastructure growth alongside EV sales trends. Using aggregated yearly data from the US Department of Energy's Alternative Fuels Data Center, the work combines public and private charging station records with per-model annual sales statistics from the US market.

The report highlights:

- The strong year-on-year growth in both **public and private charging ports and locations** from 2014 to 2022.

- Correlation between **rising EV sales** and the expansion of charging networks.

- Clear leadership of public charging in total ports, but rapid private sector growth in recent years.

Findings support strategic planning for EV infrastructure rollout, marketing, and policy development.

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Introduction

Background

The rapid adoption of electric vehicles in the United States has made **charging infrastructure** a key factor determining consumer uptake and satisfaction.

This analysis combines EV charging infrastructure data (public and private) with multi-model EV sales data to understand:

- Infrastructure expansion patterns

- Sales growth trends

- Relationships between supply (charging) and demand (vehicle sales)

Objective

- Quantify growth rates of public and private charging ports and locations.

- Analyze US EV sales trends across major OEMs and models.

- Provide actionable insights for infrastructure providers, policymakers, and OEMs.

Data Overview

Charging Infrastructure Data:

- **private_ev_charging.csv**:

  o `year`, `private_ports`, `private_station_locations`

- **public_ev_charging.csv**:

  o `year`, `public_ports`, `public_station_locations`

EV Sales Data:

- **ev_sales.csv**:

  o `Vehicle`, `year`, `sales` (number of vehicles sold per model/year)

Coverage:

- Infrastructure: 2014–2022 (both public and private have complete overlap from 2014 onwards)

- Sales: Model-level data from 2011 to 2019

Methodology

1. **Data Loading & Cleaning**

   o Imported CSVs for public/private charging and EV sales.

   o Performed an inner join on `year` for charging datasets to ensure complete annual records.

   o Checked for missing sales values (`NA`)—retained actual counts where available.

2. **Data Integration**

   o Created a unified infrastructure dataset with yearly total counts of public/private ports and station locations.

   o Added aggregated yearly EV sales totals by summing across all models for each year.

3. **Analysis Approach**

   o Tabular comparison of growth over time.

   o Visualization of trends for ports, locations, and sales.

   o Qualitative interpretation of infrastructure versus adoption dynamics.

Results & Visualizations

Infrastructure Growth (2014 → 2022):

Year	Private Ports	Private Locations	Public Ports	Public Locations
2014	3,695	1,825	22,470	9,207
2018	6,812	2,489	56,842	19,893
2022	19,993	4,435	136,513	53,764

- **Public Ports** grew by over **6×** from 2014 to 2022.

- **Private Ports** grew by more than **5×** in the same period, with acceleration after 2020.

EV Sales Trends (selected total years):

Year	Total EV Sales
2014	~118,882
2016	~159,616
2018	~361,315
2019	~... (slight dip or plateau)

- Clear growth surge 2016–2018 aligned with introduction of popular long-range models (Tesla Model 3, Chevy Bolt).

(In your notebook, you can include line charts here to visualize these trends.)

Discussion

- **Infrastructure vs. Sales:**
  The expansion of charging ports—especially public—appears to follow EV sales growth trends with a slight lag, suggesting responsiveness in infrastructure deployment.

- **Public vs. Private Role:**
  Public infrastructure still dominates in total port count, but private growth is catching up rapidly, particularly from 2020 through 2022, possibly due to retail and workplace charging installations.

- **Market Implications:**

  o   Urban areas may see continued flooding of public ports.

  o   Private operators could target underserved suburban/corridor locations.

  o   OEMs benefit from co-marketing with infrastructure expansions.

Conclusion & Recommendations

Conclusion:

US EV adoption from 2014–2019 was supported by large-scale public charging expansion. Since 2020, private sector growth has accelerated, diversifying charging availability.

Recommendations:

1. **Infrastructure Providers:** Continue proactive planning in high-sales growth states; collaborate with fleet operators.

2. **Automakers:** Align product launches with charging expansion to address range anxiety.

3. **Policy Makers:** Sustain incentives for both public and private charging investments, focusing on filling geographic gaps.

Appendix

- **Full Data:** See `notebook.ipynb` for complete loading, joins, aggregation, and plotting code.

- **Source:** US DOE Alternative Fuels Data Center, aggregated December counts.

- **Visual Enhancements:** Add:

  o Dual-axis line chart (total ports vs. total EV sales by year)

  o Stacked bar chart (public vs. private port share over time)

  o Top 5 model sales trends over years for context