

# Global Electric Vehicle Trend Analysis Report

## 1. Dataset Description

### 1.1 Source:

The dataset is sourced from **Kaggle – Electric Vehicle Population Data**.

- Records: ~130,000 vehicle entries.
- Time span: Covers EV registrations across multiple years up to 2023.

### 1.2 Columns:

1. **VIN (Vehicle Identification Number):** Unique identifier for each vehicle.
2. **County / City:** Geographic location of the vehicle registration.
3. **State:** U.S. state of registration.
4. **Model Year:** Manufacturing year of the vehicle (1997–2023).
5. **Make:** Manufacturer brand (e.g., Tesla, Nissan, Chevrolet, BMW).
6. **Model:** Specific vehicle model (e.g., Leaf, Model S, Bolt).
7. **Electric Vehicle Type:** BEV or PHEV.
8. **CAFV Eligibility:** Eligibility for Clean Alternative Fuel Vehicle incentives.
9. **Electric Range:** Vehicle range in miles.
10. **Base MSRP:** Manufacturer's Suggested Retail Price.
11. **Legislative District / Census Tract:** Geographic identifiers.
12. **DOL Vehicle ID:** Registry identifier.

### 1.3 Data Quality:

- **Schema inspection:** Confirmed categorical (Make, Model, EV Type) and numerical (Model Year, Electric Range, MSRP) fields.
- **Missing values:** Found in fields such as MSRP and CAFV eligibility. Geographic fields also have occasional blanks.
- **Uniqueness check:** VINs are unique identifiers. However, analysis is performed on non-sensitive fields (Make, Model, Year, Range).
- **Statistical summary:**
  - Model Years range from 1997–2023, with a sharp increase after 2015.
  - Electric Ranges vary widely: from <20 miles (early PHEVs) to >350 miles (modern BEVs).
  - Tesla dominates high-range EV registrations.

## 2. Operations Performed

The analysis workflow included the following steps:

- **Data Loading & Cleaning:** Imported CSV, checked schema, and removed null/invalid records.
- **Exploratory Data Analysis (EDA):**
  - Distribution plots for Electric Range.
  - Count plots for EVs by Manufacturer, Model Year, and Type.
  - Geographic distribution analysis (registrations by county/state).

- **Feature Engineering:**
  - Grouped models by manufacturer for trend analysis.
  - Categorized Electric Range into Low (<100 miles), Medium (100–250 miles), and High (>250 miles).
    - **Visualization:**
      - Histograms for Electric Range distribution.
      - Bar charts showing most popular EV manufacturers.
      - Time-series trend of EV adoption by Model Year.
      - Maps illustrating EV concentration across states/counties.
  - **Trend Analysis:** Compared BEV vs PHEV adoption over time.

### 3. Key Insights

1. **Rapid Growth Post-2015:**

The number of EVs, particularly BEVs, has grown sharply after 2015, aligning with Tesla Model S/3 launches and expansion of charging infrastructure.
2. **Manufacturer Dominance:**
  - Tesla leads the market in BEVs, particularly in long-range vehicles (>250 miles).
  - Nissan Leaf and Chevrolet Bolt are prominent among mid-range EVs.
  - Toyota and Ford dominate the PHEV category.
3. **Geographic Concentration:**

EV registrations are heavily concentrated in states like California, Washington, and New York, reflecting supportive state policies and infrastructure.
4. **Range Evolution:**
  - Early EVs (pre-2013) often had ranges under 100 miles.
  - Recent BEVs (2020–2023) frequently exceed 300 miles, addressing consumer range anxiety.
5. **Policy & Incentives Impact:**

Vehicles marked as “CAFV Eligible” show higher registration rates, suggesting government policies significantly influence adoption.

### 4. Recommendations

- i. **Infrastructure Expansion:**

Continue investment in charging infrastructure, especially in states/regions with low EV penetration.
- ii. **Support for Affordable EVs:**

While Tesla dominates, lower-cost EVs (e.g., Nissan Leaf, Chevy Bolt) play a crucial role in broader adoption. Incentives should target affordable, mid-range EVs.
- iii. **Policy Continuation:**

Maintain and expand Clean Vehicle Incentive Programs (CAFV eligibility shows clear correlation with adoption).
- iv. **Focus on Range & Battery Tech:**

Encourage R&D into higher-capacity batteries to push standard EV range beyond 300 miles, making EVs more competitive with ICE vehicles.
- v. **Diverse Manufacturer Engagement:**

Support new entrants and legacy automakers to balance Tesla’s dominance and diversify the EV ecosystem.

## **Conclusion**

The analysis confirms that global EV adoption is accelerating, led by BEVs with longer ranges and dominated by Tesla. However, continued growth depends on affordable models, charging infrastructure, and supportive policies. The dataset provides strong evidence that consumer adoption is shaped by range, price, and government incentives, all of which remain critical levers for the next decade of EV expansion.