

EV MARKET ANALYSIS

1. Conclusion

The analysis of EV charging stations revealed that:

- The dataset clusters into **4 distinct operational groups** based on features like region, charger type, and power capacity.
 - **Spatial distribution** of chargers is uneven, with some regions showing higher clustering and potentially better infrastructure.
 - Charger types (e.g., DC-001) and services (e.g., Self Service) are largely standardized, but **power output varies**, indicating possible capacity planning gaps.
 - **Boxplots** showed variation in charger availability and power across regions, hinting at **state-wise investment disparities**.
 - The **trend analysis** suggests certain regions (or states, if applicable) are leading in sales/installation volume and are poised for growth.
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2. Process (Models, Frameworks, and Libraries Used)

Preprocessing & Feature Engineering

- Columns were cleaned using `pandas` by stripping and standardizing column names.
- **Power values** were extracted and converted to numeric kW values.

Encoding & Scaling

- `OneHotEncoder` from `sklearn` was used to encode categorical features like `region` and `type`.
- `StandardScaler` was used to normalize the dataset before clustering.

Clustering

- `KMeans` from `sklearn.cluster` helped identify 4 meaningful clusters.
- The **Elbow Method** was applied to select the optimal number of clusters.

Visualization

- `matplotlib.pyplot` and `seaborn` were used for creating plots like:
 - **Box plots**
 - **Scatter plots**

- **Cluster comparisons**
 - **Bar plots**
 - `statsmodels` was used for **Exponential Smoothing** to forecast sales trends.
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3. Graphs & Visualizations Explained

- **Elbow Plot:** Helped determine the ideal number of clusters ($k=4$), by visualizing inertia values.
 - **Scatter Plot by Cluster:** Showed how different regions fall into operational clusters based on charger type and power.
 - **Box Plots:** Highlighted the spread of charger power and frequency across regions and places, showing outliers and regional bias.
 - **Exponential Smoothing Plot:** Forecasted future EV charging station growth trends based on current regional deployment data.
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4. Recommendation to the Company

Based on the clustering and trend analysis, the following recommendations are proposed:

- **Standardize Charger Power Across Regions:** Some locations with low power capacity may hinder charging speed and user experience.
- **Target Under-Clustered Regions:** Expand infrastructure in regions showing low charger density but high future growth potential.
- **Scale Self-Service Models:** Given their popularity and cost-effectiveness, they should be prioritized in expansion.
- **Monitor Cluster Behavior Over Time:** Re-evaluate clusters every 6–12 months using updated data to detect shifts in usage or demand.
- **Use Forecasts for Strategic Investment:** Invest proactively in states or regions with rising sales/installation trends to stay ahead of demand.