Prepared By: Deepali Malik

Title: Analysis of EV Charging Infrastructure and Its Impact on Electric Vehicle Adoption in India

1. Introduction

With the increasing adoption of electric vehicles (EVs) in India, the availability of charging stations has become a crucial factor influencing EV sales. This report analyzes the relationship between the number of EV charging stations and total EV sales across different states in India. The objective is to identify whether infrastructure development aligns with EV adoption trends and to recommend potential solutions for addressing infrastructure gaps.

2. Data Overview

2.1 Datasets Used

1. **EV Sales Data**: Contains EV sales information categorized by state, year, and vehicle type (2W, 3W, 4W).
2. **EV Charging Stations in India Dataset**: Provides details on the number of charging stations available in various Indian states.

2.2 Data Cleaning & Processing

- Standardized column names and removed inconsistencies in state names.
- Aggregated total EV sales by state.
- Merged the EV sales dataset with the EV charging stations dataset for comparative analysis.

3. Analysis & Findings

3.1 EV Sales vs Charging Station Availability

After merging the two datasets, the analysis revealed a **moderate positive correlation** between the number of charging stations and EV sales. Key findings include:

- **States with High EV Sales and Adequate Charging Infrastructure**:
    - Maharashtra: **155,045 EV sales, 3,079 charging stations** (strong infrastructure support).
    - Karnataka: **87,447 EV sales, 1,016 charging stations**.
- **States with High EV Sales but Limited Charging Infrastructure**:
    - Bihar: **213,076 EV sales, only 124 charging stations**.

    - Uttar Pradesh: **414,978 EV sales, only 406 charging stations**.
- **States with Low EV Sales and Few Charging Stations**:
    - Arunachal Pradesh: **40 EV sales, 9 charging stations**.
    - Mizoram: **354 EV sales, 2 charging stations**.

3.2 Visualization Insights

3.2.1 EV Sales vs Charging Stations

A scatter plot was generated to visualize the relationship between EV sales and the number of charging stations across states.

- The trend shows that states with a higher number of charging stations tend to have higher EV sales, confirming the importance of infrastructure in EV adoption.
- Some states, such as **Uttar Pradesh and Bihar**, exhibit high EV sales despite having fewer charging stations, suggesting alternative charging solutions or unmet infrastructure demand.

3.2.2 Top 5 States by EV Sales and Charging Stations

A bar chart comparing the top five states with the highest EV sales and their respective charging station count was plotted.

- **Maharashtra and Karnataka** lead in both EV sales and charging station availability.
- **Bihar and Uttar Pradesh**, despite their high sales, lack adequate charging infrastructure.
- This reinforces the need for targeted expansion in states with growing EV adoption.

3.2.3 Correlation Between EV Sales and Charging Stations

A heatmap was used to illustrate the correlation between the two variables.

- The analysis revealed a moderate **positive correlation (~0.65)**, indicating that while charging station availability influences EV adoption, other factors such as government incentives and consumer preferences also play a role.

4. Conclusion & Recommendations

4.1 Key Conclusion

- While a **moderate positive correlation** exists between charging stations and EV sales, infrastructure gaps persist in certain high-adoption states.
- A few states with high EV sales lack sufficient public charging stations, potentially slowing further adoption.
- The **EV ecosystem needs balanced infrastructure growth** to support nationwide adoption.

4.2 Proposed Solutions for Companies & Policymakers

1. **Targeted Expansion**: Focus on states like **Bihar, Uttar Pradesh, and Rajasthan**, which have high EV adoption but insufficient charging stations.
2. **Encourage Private Investment**: Public-private partnerships can accelerate charging station installations in underserved regions.
3. **Fast-Charging Infrastructure**: Deploy more **fast-charging stations** in urban areas to cater to high-density EV users.
4. **Rural Expansion**: Since two-wheelers and three-wheelers are widely used in semi-urban and rural areas, localized charging stations can boost EV sales.

5. Final Thoughts

This study provides valuable insights into the current state of EV infrastructure in India and highlights areas needing urgent improvement. Bridging the charging station gap will be critical in **ensuring sustained EV growth** and supporting India's transition to a greener transportation system.

Links:

1. https://colab.research.google.com/drive/1QfVfHLviMT3MrmtRlb8d0z-BPBzliVMl?usp=sharing
2. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2003003&utm_source=chatgpt.com
3. https://www.kaggle.com/datasets/nezukokamaado/e-v-charging-stations?utm_source=chatgpt.com
4. https://github.com/deepali971/EV