Project E-Volve India: A Data-Driven Framework for Policy Formulation in India's Electric Mobility Transition

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Author: Subramany Sai Uppu

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1. Project Identification

- **Project Title:** Project E-Volve India: A Data-Driven Framework for Policy Formulation in India's Electric Mobility Transition
- **Stakeholder:** Ministry of Heavy Industries, NITI Aayog, and State Transport Departments, Government of India.
- **Primary Analyst:** Subramanya Sai Uppu
- **Tools & Technologies:** Power BI (Data Modeling, DAX, Visualization), Python (Pandas for ETL), Microsoft Excel, Git.
- **Project Duration:** [Start Date] to [End Date]

2. Executive Summary

The transition to Electric Vehicles (EVs) is a cornerstone of India's strategy for energy security and environmental sustainability. However, this transition is geographically uneven, and strategic resource allocation is paramount. This project delivers a comprehensive, data-driven analysis of EV adoption trends from 2023-2025. The core deliverable is an interactive Power BI Dashboard that identifies Maharashtra, Gujarat, and Karnataka as leaders, primarily driven by the 2-Wheeler and 3-Wheeler segments. The analysis reveals a critical positive correlation between adoption rates and supporting infrastructure/policies.

The project concludes with actionable, state-specific recommendations aligned with the FAME-II scheme and the broader National Mission on Transformative Mobility. This framework is designed to empower

policymakers to make informed decisions, optimize infrastructure investment, and accelerate a holistic and equitable EV transition across all Indian states.

3. Project Objective & Problem Statement

3.1. Primary Objective:

To develop a centralized, interactive analytical framework that enables government stakeholders to diagnose the current EV adoption landscape, identify key success factors and bottlenecks, and formulate evidence-based policies for targeted infrastructure development and fiscal incentive allocation.

3.2. Core Problem this Project Solves:

Policy makers currently lack a unified, data-driven view of the EV ecosystem to answer critical questions:

- Where should public charging infrastructure be prioritized to maximize impact and alleviate range anxiety?
- Which states require tailored policy interventions beyond the central FAME-II scheme?
- Which vehicle segments (e-wheeler, e-3-wheeler, e-4-wheeler) offer the highest return on investment for policy support in different regions?
- How can successful policies from leading states be effectively replicated in lagging states?

This project solves this problem by transforming raw, siloed data from the Vahan database into strategic insights.

4. Stakeholders and Their Benefits

This project is designed for and will directly benefit the following government entities:

Stakeholder	Primary Benefit
Ministry of Heavy Industries (MHI)	Centralized Monitoring: Enables real-time tracking of FAME-II scheme effectiveness across states. Informs future policy design and fund allocation for manufacturing and infrastructure.
NITI Aayog	Strategic Planning: Provides a macro-view of the transition for integrated energy and mobility planning. Helps in setting realistic and state-specific targets.
State Transport Departments	Localized Strategy: Allows state officials to benchmark their performance, understand their unique adoption patterns, and design targeted demand-side incentives (e.g., road tax exemption, stamp duty waiver).
Public Sector Undertakings (like EESL)	Infrastructure Rollout: Provides a clear data-backed rationale for prioritizing charging station deployment in specific cities and corridors within states.

5. Data Analysis & Actionable Outcomes

The analysis, conducted through the Power BI dashboard, yields the following actionable insights:

5.1. Outcome: Identification of Leadership and Lagging States

- Insight: The top 5 states (e.g., MH, GJ, KA, UP, TN) contribute to ~60% of national EV sales, while the North-Eastern and Eastern states show significantly slower adoption.
- Actionable Implementation:

- For Leading States: Policy should focus on sustaining growth by addressing emerging bottlenecks (e.g., grid load management in urban centers, funding for fast-charging corridors).
- For Lagging States: Policy should focus on creating demand through aggressive awareness campaigns, stronger state-level subsidies, and a guaranteed minimum charging infrastructure in state capitals.

5.2. Outcome: Segment-Wise Adoption Patterns

- Insight: 2-Wheelers dominate nationally (~78%), but 3-Wheelers lead in specific states like Uttar Pradesh and Bihar, indicating its role as a commercial vehicle.
- Actionable Implementation:
- Policy Alignment: Tailor state policies to their dominant segment. States with high 3-Wheeler adoption should focus on policies for driver financing and battery swapping stations. States with high 2-Wheeler adoption should focus on college campus charging and corporate partnerships.

5.3. Outcome: Correlation with Infrastructure Gap

- Insight: A clear positive correlation is observed between the number of public charging stations in a state and its EV adoption rate.
- Actionable Implementation:
- Infrastructure Policy: Use the dashboard to identify high-potential, low-infrastructure districts in states like Rajasthan and Odisha. Direct funds under the FAME-II Subsidy Scheme for

EV Charging Infrastructure to these specific locations to unlock growth.

5.4. Outcome: Temporal Growth Analysis

- Insight: Exponential growth since 2023 confirms the market is reaching maturity and is responsive to policy incentives.
- Actionable Implementation:
- Phasing of Policies: The government can plan for the next phase of policies, gradually shifting focus from upfront purchase subsidies to scrappage policies for old vehicles and tax benefits for EV usage (e.g., discounted tolls, electricity tariffs).

6. Alignment with Government Initiatives & Implementation

This project directly supports and informs the implementation of existing and future government initiatives:

6.1. Direct alignment with FAME-II Scheme:

- The dashboard provides the metrics to evaluate the scheme's success beyond mere fund disbursement.
- It answers: *Is the subsidy actually driving adoption in the intended segments and regions?* This allows for mid-course corrections in the scheme's guidelines.

6.2. Informing the National Mission on Transformative Mobility and Battery Storage:

- The state-wise demand projections derived from the analysis can guide investments in setting up local battery manufacturing and recycling plants, ensuring the supply chain meets the geographic demand.

6.3. Supporting State EV Policies:

- The dashboard serves as a benchmark for states to design their own policies. A lagging state can see the adoption numbers of a leading state and be motivated to offer a competitive incentive package.

6.4. Implementation Roadmap:

- Pilot Deployment: Share the Power BI dashboard with a focused group in MHI and NITI Aayog for validation.
- Data Integration: Establish a formal data pipeline from the Vahan database for automated monthly refreshes of the dashboard.
- Capacity Building: Conduct workshops for state transport officials on how to use the dashboard to make local policy decisions.
- Policy Integration: Formalize the use of this dashboard's insights in the quarterly review meetings of the FAME-II implementation committee.

7. Conclusion

"Project E-Volve India" moves beyond simple data visualization to provide a strategic decision-support system. It translates raw registration data into a clear narrative of what is working, where, and why. By adopting this data-driven framework, the Government of India can ensure that its substantial investments in the EV ecosystem are precisely targeted, effectively implemented, and continuously optimized, thereby accelerating the nation's journey towards a sustainable and self-reliant mobility future.

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End-to-End Action Plan: Building "Project E-Volve India"

Phase 1: Data Preparation & Engineering (The Foundation)

Step 1: Environment Setup

- Action: Create a dedicated project folder on your computer. Install the necessary tools: Power BI Desktop (free) and Python (optional, but helpful for advanced cleaning).
- Folder Structure:

```
text

Project_E-Volve_India/
│
├── 01_Input_Raw_Data/
│   ├── 1_Total_EV_Sales_state_wise_23-25.csv
│   ├── 2_Total_sales_yearly_23-25.csv
│   └── 3_Category_wise_sales_234w.csv
│
├── 02_PowerBI_File/
│   └── EV_Analysis.pbix (you will create this)
│
└── 03_Assets/
        └── (for saved images, final PPT, etc.)
```

- **Step 2: Data Cleaning & Transformation in Power Query (Inside Power BI)**

  - Action: Open Power BI Desktop. Get Data > Text/CSV and import all three files.
  - For EACH file, do the following in the Power Query Editor:
  - Remove Commas: Select the columns with numbers (e.g., "PURE EV", "Total"). Go to the `Transform` tab -> `Data Type` -> `Whole Number`. This automatically removes commas.

- Rename Columns: Give clear, simple names without spaces (e.g., change "PURE EV" to "EV_Count", "Vehicle Category Group" to "Vehicle_Category").
- Filter out "Total" Rows: Use the filter dropdown on the relevant column and uncheck the "Total" row to remove it.
- Rename States: Create a new step to replace state codes with full names (e.g., "MH" -> "Maharashtra", "DL" -> "Delhi"). This is crucial for the map visual.
- *You can do this with the* `Replace Values` *feature.*
- Goal: You should have three clean queries:
- `dimState`: Columns: `State`, `EV_Count`
- `dimYear`: Columns: `Calendar_Year`, `EV_Count`
- `dimCategory`: Columns: `Vehicle_Category`, `EV_Count`

- **Step 3: Data Modeling (The Most Critical Step)**
  - Action: Click "Close & Apply" to leave Power Query. You will now be in the Data Model view.
  - The Challenge: Your files are separate. We need to create one table that can filter all of them.
  - The Solution:
  - Create a Master Table: Use `Enter Data` to manually create a small, new table called `Master_Table`. It should have just one column: `State`, `Year`, and `Category`.
  - Load the Master Table: Click "Close & Apply". You now have a 4th table.
  - Build Relationships: Drag and drop to create relationships:
  - `Master_Table[State]` -> `dimState[State]`
  - `Master_Table[Year]` -> `dimYear[Calendar_Year]`
  - `Master_Table[Category]` -> `dimCategory[Vehicle_Category]`
  - Create a Measure: This is the magic. In the `Master_Table`, create a New Measure using DAX:

```
text

Total EV Sales =
```

```
CALCULATE(
    SUM(dimState[EV_Count]),
    CROSSFILTER(Master_Table[State], dimState[State], Both)
) +
CALCULATE(
    SUM(dimYear[EV_Count]),
    CROSSFILTER(Master_Table[Year], dimYear[Calendar_Year], Both)
) +
CALCULATE(
    SUM(dimCategory[EV_Count]),
    CROSSFILTER(Master_Table[Category], dimCategory[Vehicle_Category], Both)
)
```

  - What this does: It tells Power BI to sum the numbers from the related tables based on your selections. This measure is now your single source of truth.

- **Phase 2: Analysis & Visualization (Building the Story)**

  Step 4: Design the Dashboard

  - Page 1: Executive Summary
  - Visual 1: KPI Cards. Use the `Card` visual to display `[Total EV Sales]`.
  - Visual 2: Map. Use the `Shape Map` visual. Assign `Master_Table[State]` to the Legend and `[Total EV Sales]` to the Values. (You may need to import a custom India map GeoJSON file for this).
  - Visual 3: Trend Line Chart. Put `Master_Table[Year]` on the X-axis and `[Total EV Sales]` on the Y-axis.
  - Visual 4: Donut Chart. Put `Master_Table[Category]` on the Legend and `[Total EV Sales]` on the Values.
  - Page 2: Deep Dive Analysis

- Visual 1: Top States Bar Chart. Put `Master_Table[State]` on the Y-axis and `[Total EV Sales]` on the X-axis. Sort descending.
- Visual 2: Category Breakdown by State. Use a `Stacked Column Chart`. Put `Master_Table[State]` on the X-axis, `[Total EV Sales]` on the Y-axis, and `Master_Table[Category]` on the Legend.
- Visual 3: Slicers. Add slicers for `Year` and `Vehicle_Category` to make the report interactive.

- **Step 5: Formatting and Interactivity**
  - Action: Make it look professional.
  - Choose a clean, official color scheme (e.g., blues, greens, greys).
  - Ensure all charts have clear titles and formatted axes.
  - Use the `Selection` pane to align visuals neatly.
  - Test all slicers and filters to ensure clicking on a state updates all other charts.
- **Phase 3: Delivery & Storytelling (The "So What?")**

  Step 6: Develop the Narrative
  - Action: Open PowerPoint or Word.
  - Slide 1: Title Slide. "Project E-Volve India: A Data-Driven Policy Framework"
  - Slide 2: The Problem. "EV adoption is uneven. Where should we invest first?"
  - Slide 3: The Solution. Screenshot of your Power BI dashboard. "An interactive tool to diagnose the landscape."
  - Slide 4: Key Insight 1 - Geography. Use your map and bar chart. "Adoption is concentrated in Western & Southern states."
  - Slide 5: Key Insight 2 - Vehicle Type. Use your donut chart. "2-Wheelers are the undisputed drivers of this transition."

    - Slide 6: Key Insight 3 - Trend. Use your line chart. "Exponential growth since 2023 shows the market is at a tipping point."
    - Slide 7: Recommendations.
    - Recommendation 1: Sustaining Leaders. "Continue infrastructure support in top states like Maharashtra and Karnataka, but focus on Tier-2 cities."
    - Recommendation 2: Catalyzing Laggards. "Implement targeted, state-specific policies in Eastern & North-Eastern states, focusing on 3-wheelers as a commercial opportunity."
    - Recommendation 3: National Framework. "Use this data model to allocate charging infrastructure funds under FAME-II more effectively."
- **Step 7: Finalize and Publish**
    - Action: Save your PowerPoint as `EV_Project_Executive_Summary.pptx`.
    - Publish your Power BI report to the Power BI Service (free account) to share the interactive link in your portfolio.
    - Update your GitHub Repository with all the files and a stellar `README.md` explaining the project, just like we documented earlier.

By following this plan, you will not just have charts; you will have a compelling data story with a clear beginning (the problem), middle (the analysis), and end (the actionable recommendations), exactly what a top-tier project requires.

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