

Visualization Tool for Electric Vehicle Charge and Range Analysis



Visualization Tool for Electric Vehicle Charge and Range Analysis
Project Based Experiential Learning Program

1. INTRODUCTION

Project Overview

India has the third-largest road network in the world, making the transition to electric mobility a national priority. With rising concerns over urban air quality and global climate commitments, the shift from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) is gaining momentum. This transition is fueled by government policies, increasing EV model availability, and the urgent need for cleaner transportation.

Multiple stakeholders — including policymakers, technologists, energy authorities, and automotive industries — are now working to accelerate EV adoption by improving infrastructure, enabling data-driven decisions, and removing adoption barriers. This project contributes to that mission by creating a visual analytics tool that empowers users to explore, compare, and evaluate EV models and charging availability in India.

Purpose

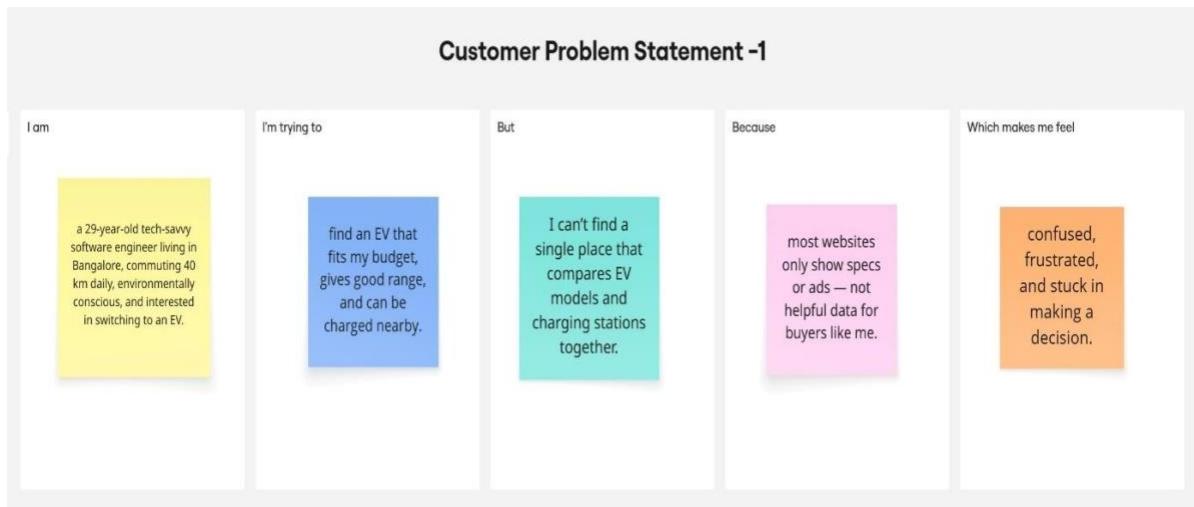
The increasing variety of electric vehicle (EV) models — including passenger cars, buses, vans, and even heavy goods vehicles — marks a major shift in the global transportation landscape. With over 40 highway-capable EV models already available and more set to launch soon, consumers now have more choices than ever before.

Recognizing the rapid growth and opportunities in this space, this project aims to support EV adoption by providing a comprehensive visualization tool. The dashboard helps users explore EV specifications, compare models, and analyze charging infrastructure across regions. By turning complex EV data into easy-to-understand visuals, the tool empowers individuals and stakeholders to make informed, future-ready transportation decisions.

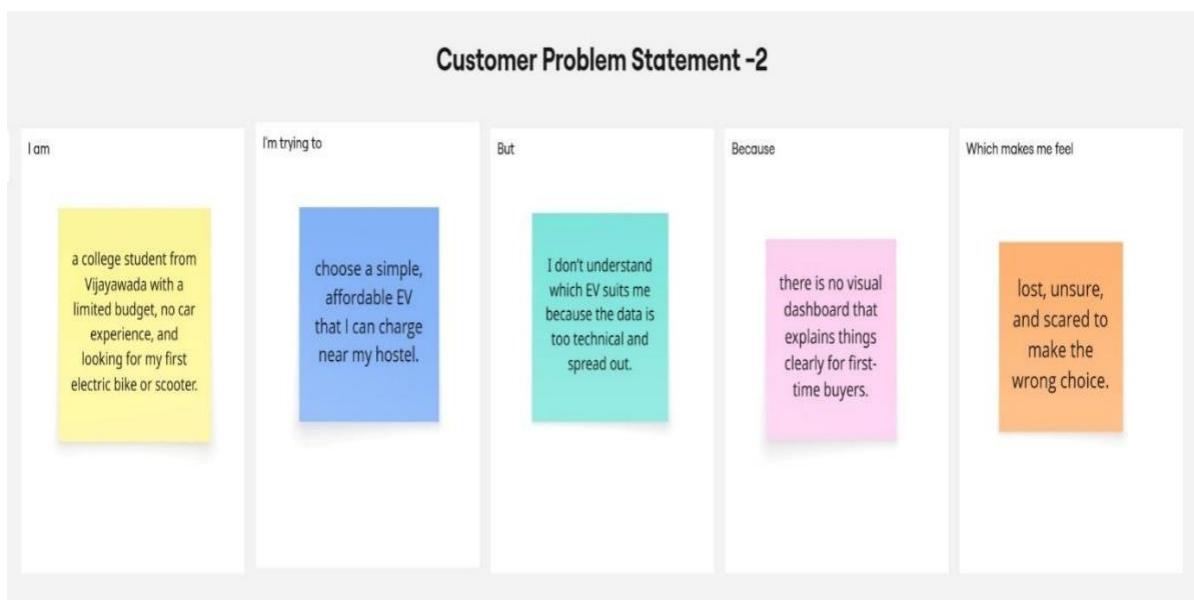
2. IDEATION PHASE

Problem Statement

Customer Problem Statement-1:



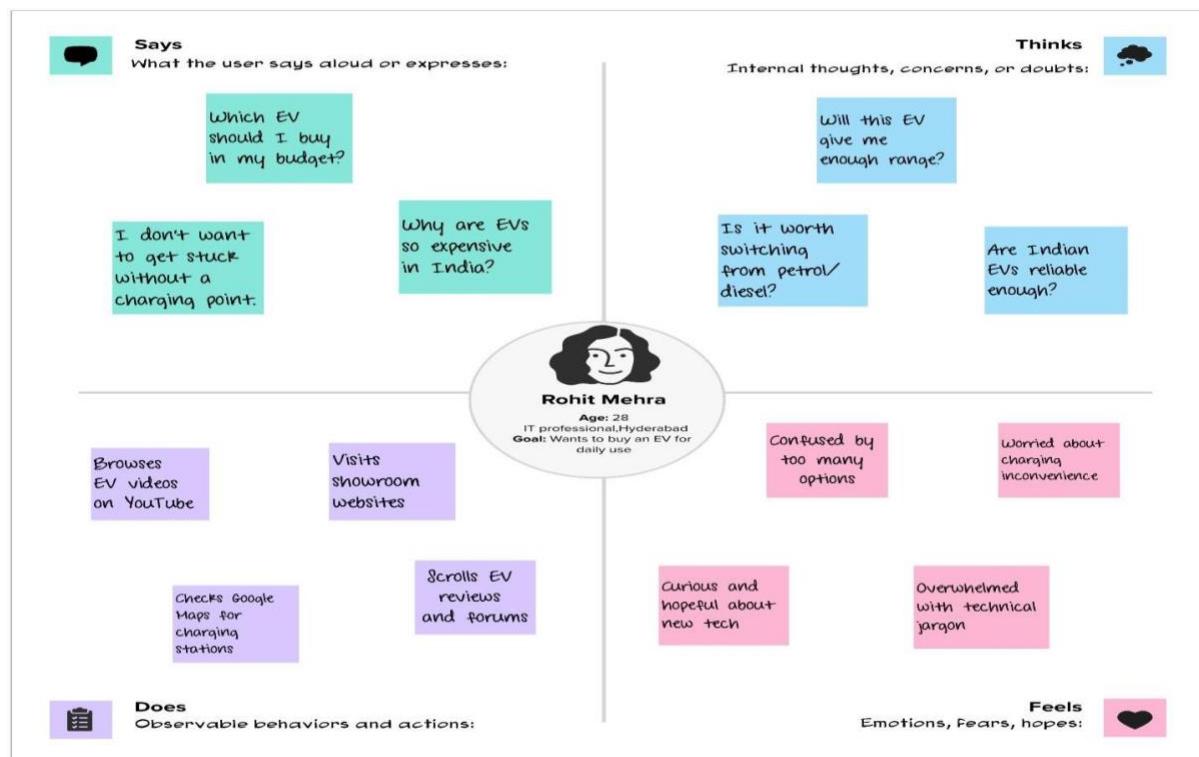
Customer Problem Statement-2:



Problem Statements:

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	a 29-year-old tech-savvy software engineer living in Bangalore, commuting 40 km daily, environmentally conscious, and interested in switching to an EV.	find an EV that fits my budget, gives good range, and can be charged nearby.	I can't find a single place that compares EV models and charging stations together.	most websites only show specs or ads — not helpful data for buyers like me.	confused, frustrated, and stuck in making a decision.
PS-2	a college student from Vijayawada with a limited budget, no car experience, and looking for my first electric bike or scooter.	choose a simple, affordable EV that I can charge near my hostel.	I don't understand which EV suits me because the data is too technical and spread out.	there is no visual dashboard that explains things clearly for first-time buyers.	lost, unsure, and scared to make the wrong choice.

Empathy Map Canvas



Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statement:

Before you collaborate
This session focuses on generating ideas for a visual solution that supports EV buyers in India. We've gathered relevant datasets and understood the needs of first-time EV buyers. Participants are familiar with basic Tableau and data handling.

Team gathering
Participants in this session have a good understanding of EV solution basics. They were invited to the Mural board and provided with an opportunity to contribute ideas for EV buyers' specifications and charging station locations.

Set the goal!
We will generate meaningful ideas that help EV buyers compare vehicle models, analyze performance, and find charging stations. Our ultimate goal is to create a user-friendly visual dashboard that supports smart decision making.

Define your problem statement
To guide our brainstorming, we rephrased our main problem as a "How Might We" question that encourages solution-focused thinking.

PROBLEM
How might we help EV buyers in India compare electric vehicle models and locate charging stations using an interactive dashboard?

Key rules of brainstorming
To have an smooth and productive session:
 - Stay on topic.
 - Encourage wild ideas.
 - Defer judgment.
 - Listen to others.
 - Go for volume.
 - If possible, be visual.

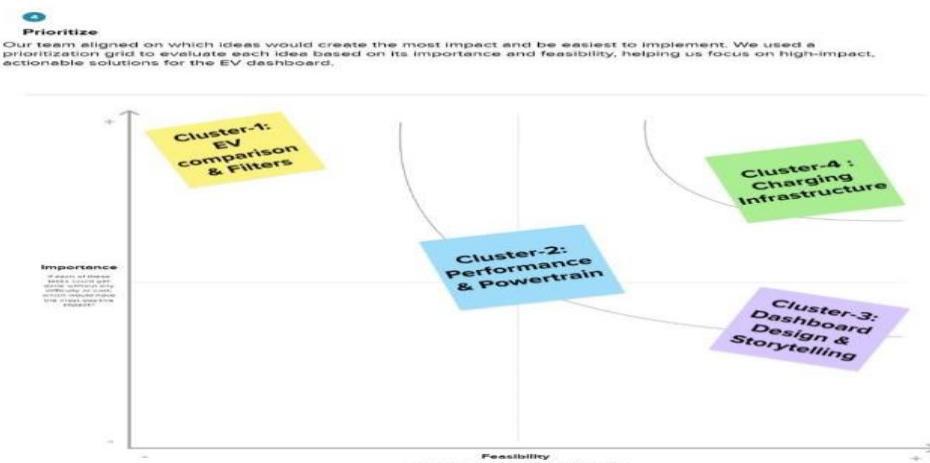
Step-2: Brainstorm, Idea Listing and Grouping:

Brainstorm
In our group of 4 members, each participant contributed individual ideas to address the EV dashboard problem statement. We used sticky notes to freely list possible solutions related to vehicle comparisons, user needs, charging infrastructure, and data visualization.

Group ideas
We took turns sharing our notes and grouped similar ideas into clusters. Each cluster was given a sentence-like label based on its theme:

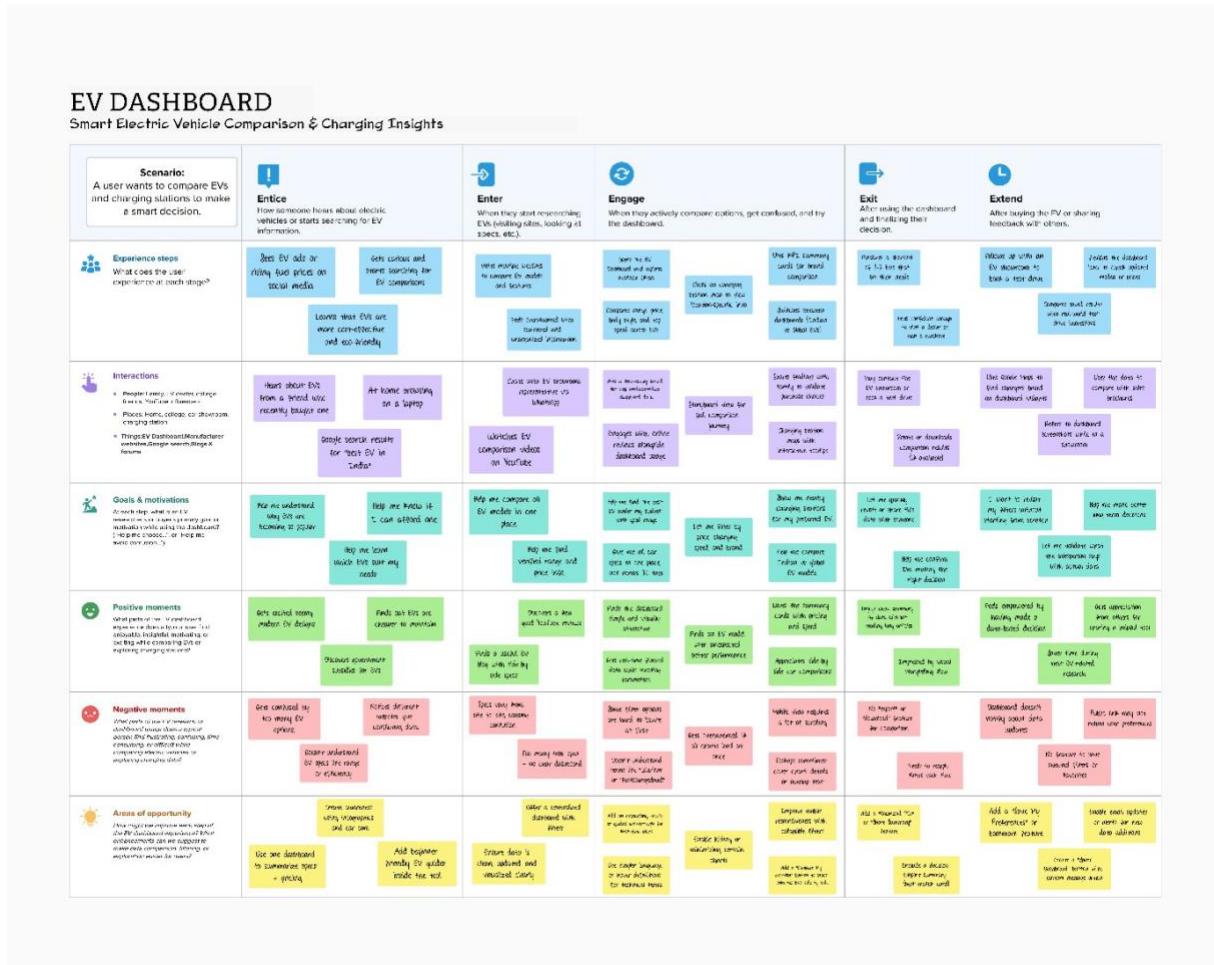
Cluster-1: EV Comparison & Filters	Cluster-2: Performance & Powertrain
Compare EVs by price and range Display average acceleration and top speed Show EV charging stations by region and type Build a Tableau story with 4-6 key charts Add filters for body style, segment, and brand Use a map to locate charger locations with filters Rank EVs by efficiency (Wh/km) Identity vehicles with fast charging support	Show top 20 EVs by efficiency Create filters to compare top speed across brands Add filters for body style, segment, and brand Display average acceleration and top speed Rank EVs by efficiency (Wh/km) Identity vehicles with fast charging support
Cluster-3: Dashboard Design & Storytelling	Cluster-4: Charging Infrastructure
Compare powertrain types (FWD, RWD, AWD) Create filters for powertrain, brand, and segment Create bar charts to compare top speed across brands Add summary cards for Indian and global EV stats Compare charger availability between states Add a KPI dashboard for top brands, pricing, and speed Create filters for powertrain, brand, and segment Build a Tableau story with 4-6 key charts Add summary cards for Indian and global EV stats Add a KPI dashboard for top brands, pricing, and speed	Show EV charging stations by region and type Use a map to display charger locations with filters Add charger power (kW) and service type info Compare charger availability between states

Step-3: Idea Prioritization:



3. REQUIREMENTANALYSIS

Customer Journey Map



SolutionRequirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement(Epic)	SubRequirement(Story/Sub-Task)
FR-1	Data Import and Preparation	Load four EV-related datasets (CSV format) into Tableau. Clean and prepare data for visualizations. Combine relevant fields for a unified view.
FR-2	Dashboard and Visualizations	Provide comparative charts (range, price, efficiency, etc.) of different EV models. Map EV charging stations by region and type. Enable filters (brand, powertrain, body style, segment).
FR-3	KPI Summary Cards	Display key insights such as average prices, top speeds, number of brands, etc. Include summary cards for India and global EV data.

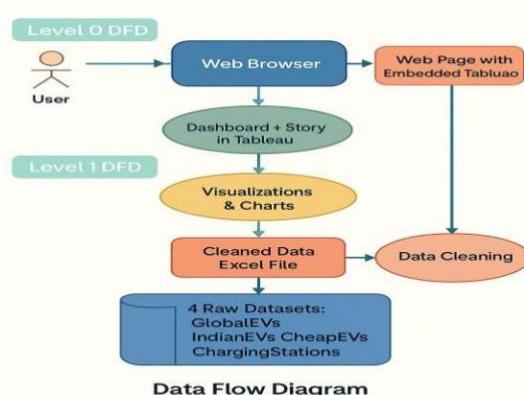
FR-4	Storyboarding	Construct a user-friendly story path highlighting dashboard findings. Present data in logical, decision-guiding order.
FR-5	User Interaction	Filters and parameters to explore different segments of EV data. Hover/tool tip features to display additional info.
FR-6	Publishing and Access:	Publish final dashboard and story to Tableau Public. Generate public share link.

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Dashboard must be user-friendly and intuitive for a non-technical audience.
NFR-2	Security	Published dashboards should not expose any sensitive or personal data.
NFR-3	Reliability	Dashboard should perform consistently without crashes or data loss.
NFR-4	Performance	Load times should be under 5 seconds for average datasets.
NFR-5	Availability	Dashboard should be accessible anytime via Tableau Public.
NFR-6	Scalability	Solution should handle increased data volume without major redesign.

Data Flow Diagram

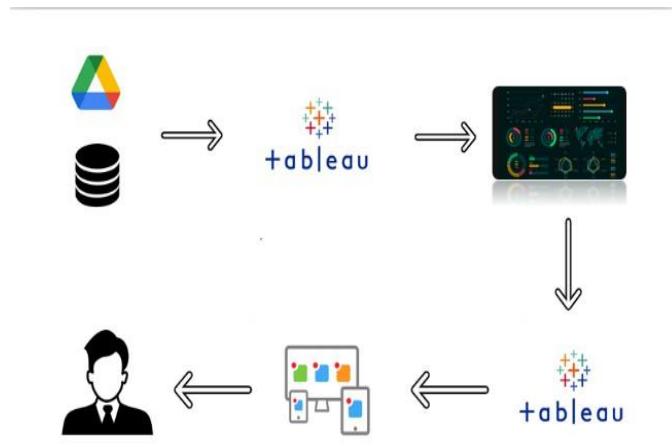


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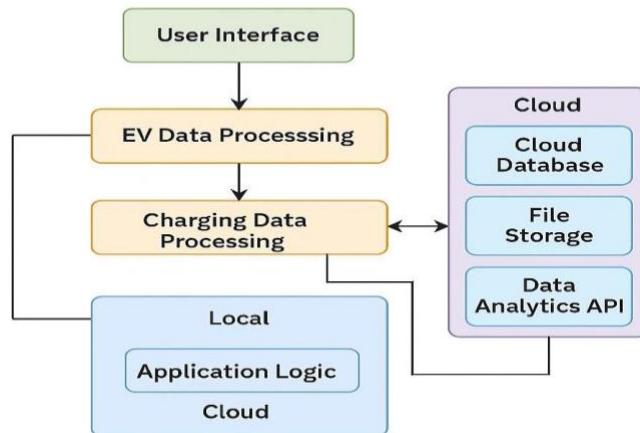
UserStories-EVVisualizationProject:

UserType	Functional Requirement (Epic)	User Story Number	UserStory/ Task	Acceptance Criteria	Priority	Release
Customer (Webuser)	Data Exploration	USN-1	As a user, I can view global and Indian EV data in one dashboard	I can compare price, range, and features easily	High	Sprint-1
	Charging Station Map	USN-2	As a user, I can view EV charging station locations on an interactive map	I can see location markers and zoom on city-wise regions	High	Sprint-1
	Filtering and Sorting	USN-3	As a user, I can filter EVs by price, range, and segment	Filters apply correctly and update all visuals	Medium	Sprint-2
	Story Dashboard	USN-4	As a user, I can view a visual story comparing Indian vs global EV trends	I can read narrative visual flow embedded into the web app	High	Sprint-2
	WebApp Access	USN-5	As a user, I can access the dashboard via a public webpage	I can open the webpage and see the Tableau visuals embedded without login	High	Sprint-1
Admin	Data Publishing	USN-6	As an admin, I can publish updated Tableau dashboards and link to the web app	Tableau links are live and reflect changes	High	Sprint-2
Developer	Web Integration	USN-7	As a developer, I can embed Tableau dashboards into a Bootstrap-based HTML page	Embedded dashboard works on different devices and loads fully	Medium	Sprint-2

Technology Stack



Technical Architecture



4. PROJECT DESIGN

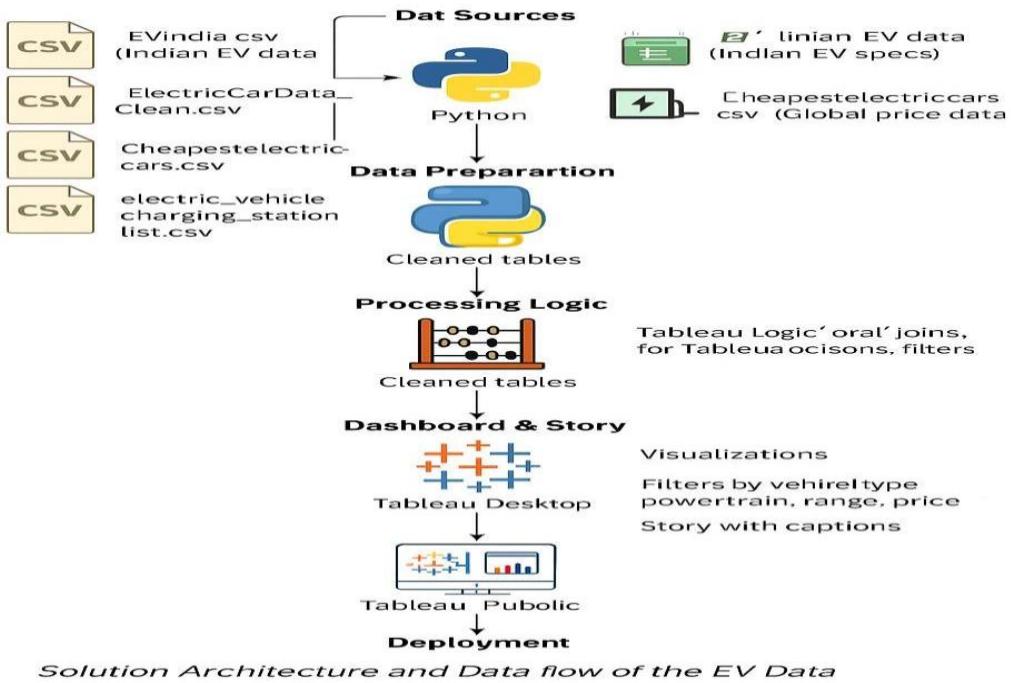
Problem Solution Fit

1. CUSTOMER SEGMENTS <small>CS</small>	2. CUSTOMER LIMITATIONS <small>CL</small>	5 AVAILABLES SOLUTIONS <small>AS</small>
<ul style="list-style-type: none"> EV buyers (India and globally) Government Manufacturers Analysts, journalists 	<ul style="list-style-type: none"> Difficulty in comparing EVs by range, price, power train Lack of a central source for Indian and global EV data Limited charging station knowledge Manual and slow data comparison 	<ul style="list-style-type: none"> Lack of technical knowledge Pear of buying their/more EV Budget constraints Range anxiety Time constraints
3. TRIGGERS TO ACT <small>TR</small>	7. PROBLEM ROOT / CAUSE <small>RC</small>	7. BEHAVIOR <small>BE</small>
<ul style="list-style-type: none"> Government EV subsidies, or tax rebates High fuel prices Pear recommendations 	<ul style="list-style-type: none"> Lack of a unified, interactive platform for EV comparison Lack of visual tools combining Indian and global EV data Fragmented datasets with no standard structure 	<ul style="list-style-type: none"> Ay unnned interactive platform for EV comparison Lack of visual tools combining Indian and global EV data Fragmented datasets
4. EMOTIONS <small>EM</small>	9. PROBLEM ROOT / CAUSE <small>RC</small>	7. BEHAVIOR <small>BE</small>
<ul style="list-style-type: none"> Confusion Unsure Overwhelmed 	<ul style="list-style-type: none"> Lack of a unified, interactive platform for EV comparison Lack of visual tools combining Indian and global EV data Fragmented datasets with no standard structure 	<ul style="list-style-type: none"> Searching online on "I want EV (want D) takhi" Watching comparison video to check EV infuse, range, price, top speed Visiting 2-4 brand websites before deciding Looking for charger availability near byern
10. YOUR SOLUTION <small>SL</small>	10. YOUR SOLUTION <small>SL</small>	8. CHANNELS of BEHAVIOR <small>CH</small>
	<ul style="list-style-type: none"> A tableau dashboard and story interface combining Indian and global data. Visualizing range, price, powertrain efficiency, top speed, and model count, showing interactive in dealership or government langente Helps buyers analysts, and policy makers make informed decisions 	<ul style="list-style-type: none"> Online Dealership visits

Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement	EV buyers and researchers struggle to access centralized, visual comparisons of EVs across price, range, efficiency, and availability.
2.	Idea / Solution description	A Tableau-based dashboard that integrates 4 EV datasets to visualize Indian and global EV data by brand, specs, and charging coverage. Includes filters, KPIs, and interactive stories
3.	Novelty / Uniqueness	Combines India + global EV data in one platform. Visualizes efficiency, range, and charging infrastructure interactively. Includes behavioral insight-based story slides.
4.	Social Impact / Customer Satisfaction	Helps buyers make informed decisions, promotes EV adoption, aids sustainability goals, and supports government/industry awareness.
5.	Business Model (Revenue Model)	Freemium insights. Advanced analytics and brand custom dashboards for manufacturers and state departments. Sponsorship, affiliate leads.
6.	Scalability of the Solution	Add more datasets (real-time charging API, battery health data), include predictive analytics, embed in dealership and government portals.

Solution Architecture



5. PROJECT PLANNING & SCHEDULING

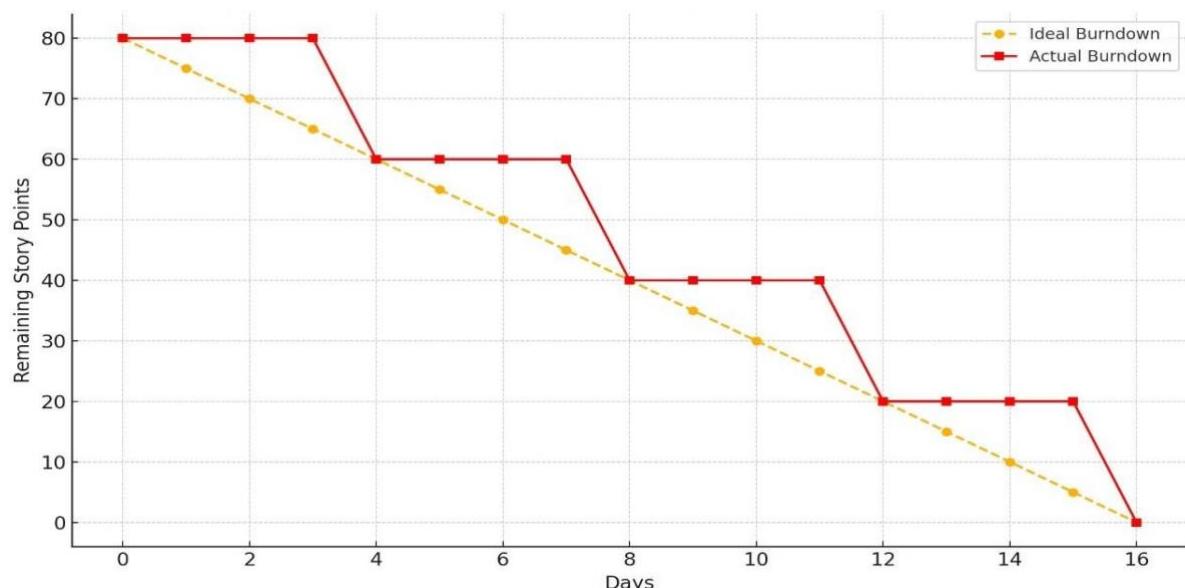
Project Planning

Product Backlog, Sprint Schedule, and Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Integration	USN-1	As a developer, I can load and integrate multiple EV-related datasets into Tableau	3	High	Inapakolla Sai Saranya
Sprint-1	Data Preprocessing	USN-2	As a developer, I can clean and format data fields (e.g., city names, range categories)	2	High	Anurag Gupta
Sprint-2	Visual Analysis	USN-3	As a user, I can view EV growth trends using line and area charts	3	Medium	Nadipalli Devakiran
Sprint-2	Visual Analysis	USN-4	As a user, I can compare EV brands by range and cost using bar, bubble, and pie charts	3	High	Adadi Mouli Sri Priya
Sprint-3	Interactive Dashboard	USN-5	As a user, I can log into the application by entering email & password	2	High	Nadipalli Devakiran
Sprint-3	KPI and Comparison Cards	USN-6	As a user, I can navigate story points to understand EV market insights	2	Medium	Inapakolla Sai Saranya
Sprint-4	Storytelling Dashboard	USN-7	As a user, I can navigate a story dashboard that presents insights on EV adoption.	3	High	Adadi Mouli Sri Priya
Sprint-4	Documentation & Testing	USN-8	As a team, we can prepare project documentation and test the performance of visuals.	2	Medium	Nadipalli Devakiran

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed	Sprint Release Date (Actual)
Sprint-1	20	4 Days	31Jan2026	03Feb2026	20	03Feb2026
Sprint-2	20	4 Days	04Feb2026	07Feb2026	20	07Feb2026
Sprint-3	20	4 Days	08Feb2026	11Feb2026	20	11Feb2026
Sprint-4	20	4 Days	12Feb2026	15Feb2026	20	15Feb2026



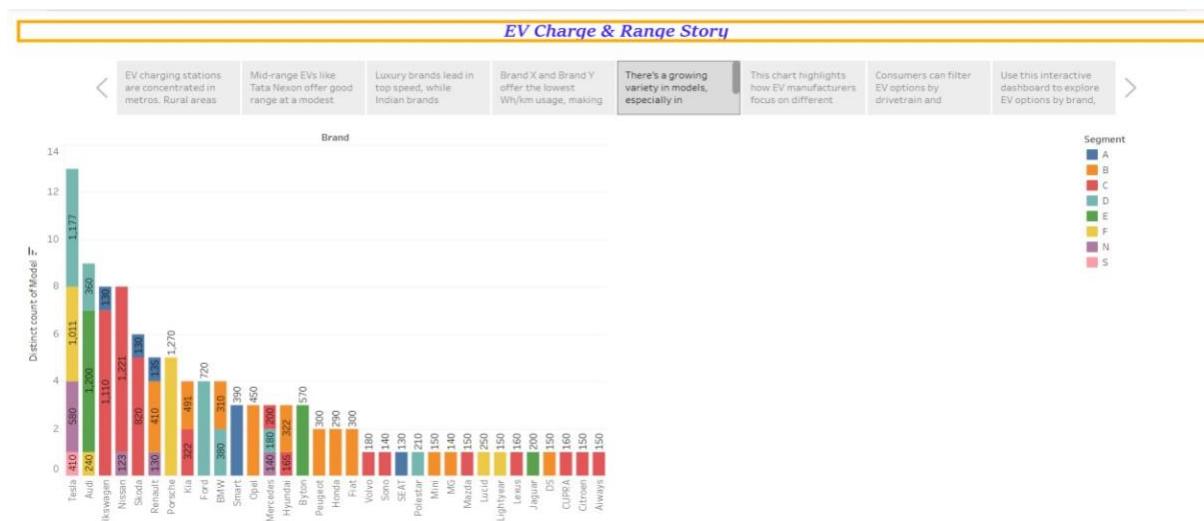
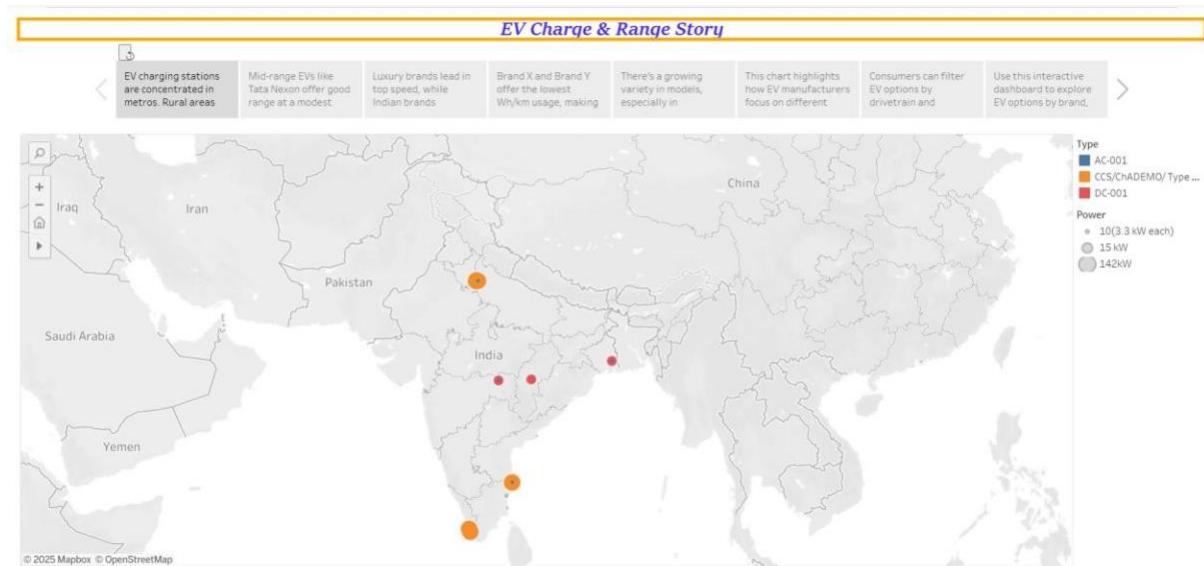
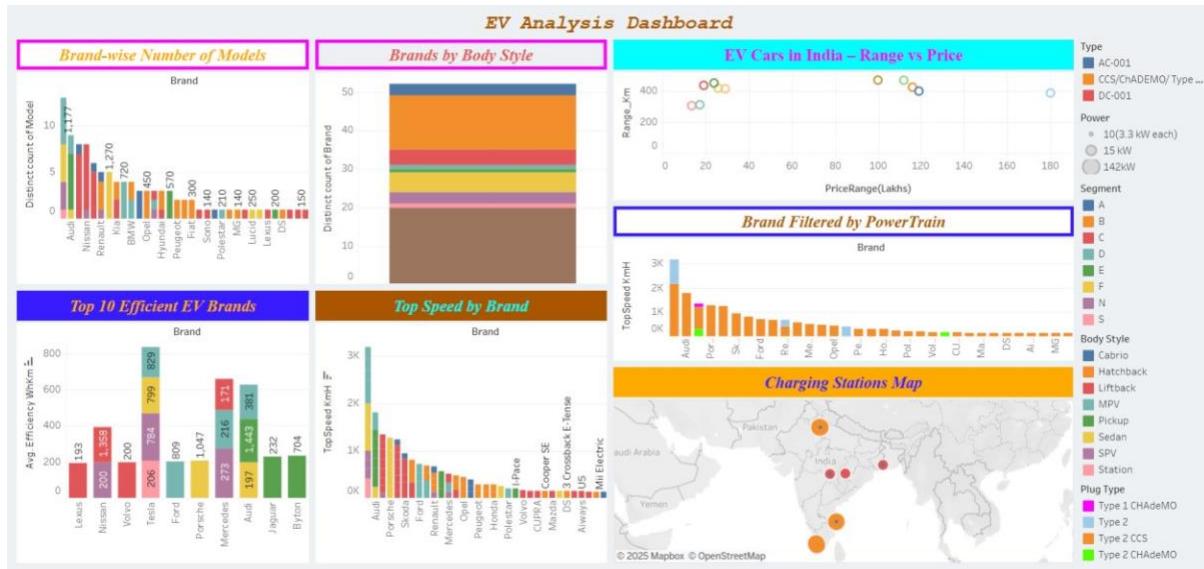
6. FUNCTIONAL AND PERFORMANCE TESTING

Performance Testing

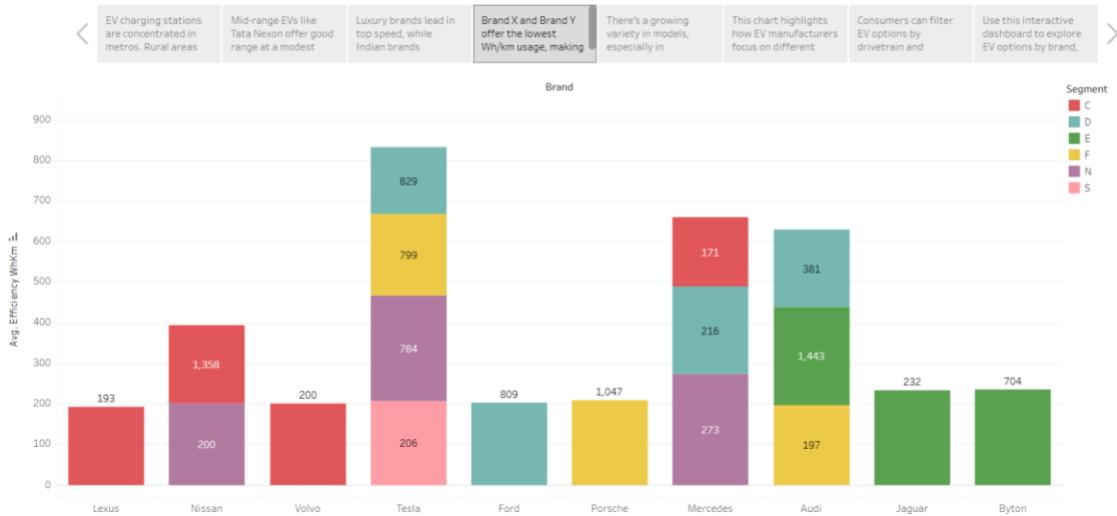
S.No.	Parameter	Screenshot/Values
1.	Data Rendered	<p>Data from 4 datasets:</p> <ul style="list-style-type: none"> EVIndia.csv Electric_vehicle_charging_station_list.csv ElectricCarData_Clean.csv Cheapestelectriccars-EVDatabase.csv
2.	Data Preprocessing	<ul style="list-style-type: none"> Removed null/missing values Cleaned inconsistent labels (e.g., station types, city names) Extracted fields like Year, Range Category, City-wise Count
3.	Utilization of Filters	<p>Applied Filters:</p> <ul style="list-style-type: none"> City Year Manufacturer Charging Type Range (km) Price Range
4.	Calculation fields Used	<ul style="list-style-type: none"> Total Stations per City Average Range by Manufacturer Cost per km Custom bins for Range and Price
5.	Dashboard design	<p>No of Visualizations/Graphs - 11</p> <ul style="list-style-type: none"> All major charts (Map, Line, Bar, Pie, Bubble, KPI cards, etc.) arranged with interactivity
6.	Story Design	<p>No of Visualizations/Graphs - 8</p> <ul style="list-style-type: none"> Full walkthrough from EV adoption to charging infrastructure cost & range analysis Story points with annotations for better interpretation

7. RESULTS

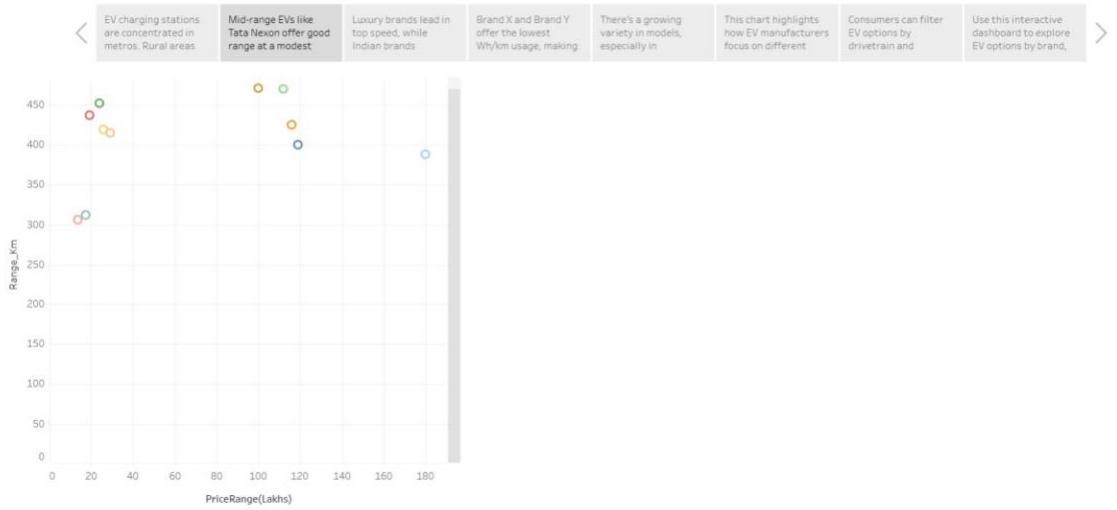
Output Screenshots



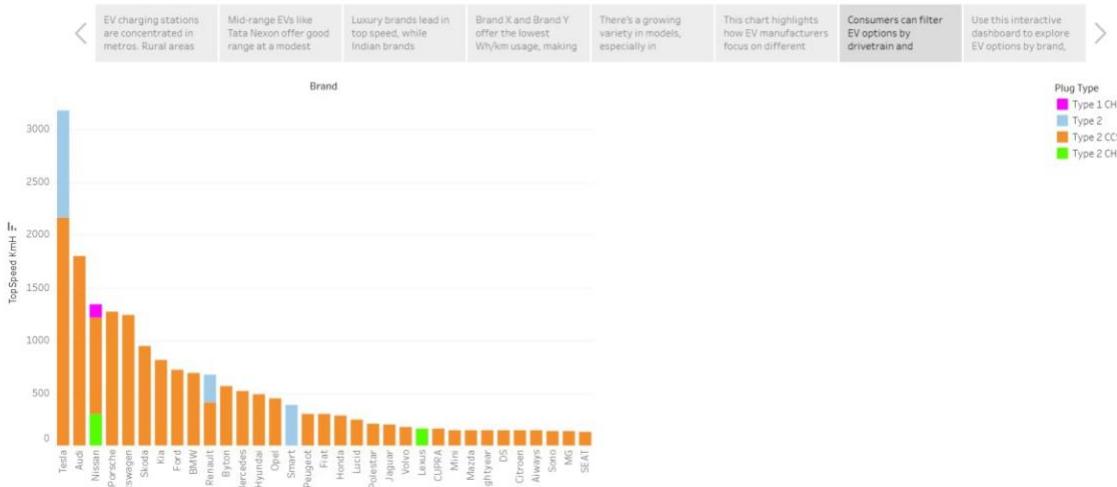
EV Charge & Range Story



EV Charge & Range Story



EV Charge & Range Story



8. ADVANTAGES & DISADVANTAGES

Advantages of Electric Vehicles

- **Eco-Friendly:** EVs do not burn fuel, so they emit no harmful gases. This helps reduce air pollution and contributes to a cleaner environment.
- **Renewable Energy Source:** Unlike conventional vehicles that rely on fossil fuels, EVs can run on renewable energy sources, helping preserve natural resources.
- **Less Noise and Smoother Motion:** EVs operate more quietly due to fewer moving parts, providing a smooth and noise-free driving experience.
- **Cost-Effective:** Electricity is cheaper than petrol or diesel, and if solar energy is used at home, charging becomes even more economical.
- **Low Maintenance:** With fewer moving components, EVs experience less wear and tear. Maintenance is simpler and more affordable than for ICE vehicles.
- **Government Support:** Many governments offer incentives, subsidies, and tax benefits to encourage the adoption of electric vehicles.

Disadvantages of Electric Vehicles

- **High Initial Cost:** EVs still have a relatively high purchase price, making them less accessible to some buyers.
- **Limited Charging Stations:** Charging infrastructure is still developing, especially for long-distance travel where stations may not be readily available.
- **Long Charging Time:** Unlike petrol refueling, charging an EV can take several hours depending on the charger type.
- **Limited Model Options:** Compared to ICE vehicles, fewer EV models are currently available with fewer choices for customization.
- **Shorter Driving Range:** Most EVs have a limited range per charge, which can be a drawback for long-distance travel.

Applications of Data Visualization in the Project

In today's data-driven world, data visualization plays a crucial role in simplifying complex data and delivering insights in an intuitive way. Visual elements like charts, maps, and graphs help users quickly understand trends, patterns, and anomalies in large datasets.

In this project, data visualization is used to help users explore and compare electric vehicles efficiently. For example:

- Visualizing top speed by brand enables customers to clearly understand performance differences.

- Interactive charts and filters allow users to evaluate EVs based on price, range, body style, and charging options.

These insights empower potential EV buyers with accurate, real-time data to make smarter and more informed purchase decisions.

9. CONCLUSION

Electric vehicles represent the future of sustainable transportation. With zero tailpipe emissions, they offer a cleaner alternative to conventional vehicles and play a key role in reducing environmental pollution.

While challenges such as limited range, slow charging, and lack of widespread charging infrastructure remain, the long-term economic and environmental benefits make EVs a viable solution. As fossil fuel prices rise and awareness around climate change grows, the shift toward electric mobility is accelerating.

Governments are providing incentives, and manufacturers are releasing advanced EV models to meet growing demand. Despite current limitations, electric vehicles are expected to dominate the automotive landscape by 2040, driving both innovation and sustainability forward.

10. FUTURESCOPE

Electric vehicles are poised to become a transformative innovation in the automotive industry. As they produce zero greenhouse gas emissions, EVs are an essential part of the shift toward sustainable transportation and environmental conservation.

Despite current limitations like limited driving range, charging delays, and insufficient infrastructure, the long-term potential of EVs remains strong. As fossil fuel costs continue to rise and environmental awareness increases, EV adoption is expected to accelerate significantly.

By 2040, most vehicles on the road are predicted to be electric. Continued government support, investment in charging networks, and advancements in battery technology will help overcome existing challenges. The ongoing efforts by manufacturers to introduce high-performance EVs further solidify the promising future of electric mobility.

11. APPENDIX

DatasetLink:

<https://drive.google.com/drive/folders/1hBagvhmu6zVWjnRqx-LEckq8JnrrYTGg?usp=sharing>

DashboardLink:

<https://public.tableau.com/app/profile/surisetty.vandana.leela/viz/EVVisualizationDashboard/>

StorycardLink:

https://public.tableau.com/app/profile/surisetty.vandana.leela/viz/Story_17719164957210

GitHubLink:

<https://github.com/Vandanaleela-Surisetty/Visualization-tool-for-Electric-Vehicle-Charge-and-Range-Analysis>

ProjectDemoLink:

<https://drive.google.com/drive/folders/1hBagvhmu6zVWjnRqxLEckq8JnrrYTGg?usp=sharing>