

“Electric Vehicles Sales in India”

A virtual Internship Project Report on EDA (Exploratory Data Analysis) of EV Sales in India.



Submitted to:



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Batch: - 01/04 - 01/08/2025

Introduction

This project explores the state-wise electric vehicle (EV) sales trends across India, offering a data-driven insight into the adoption of EVs over time. The analysis is built on a meticulously cleaned dataset sourced from the Clean Mobility Shift initiative, capturing critical attributes such as vehicle type, category, class, sales quantity, and time across all Indian states and Union Territories from 2014 to 2023. It is versatile and ideal for geographic market segmentation, trend analysis, and predictive modelling. By offering insights into regional EV sales patterns, the dataset supports strategic decision-making in market planning and infrastructure investment.

Key Insights from Dataset

- Coverage of all Indian states and UTs, including top performers like Maharashtra, Karnataka, and UP.
- Vehicle types span from 2-wheelers, 3-wheelers, 4-wheelers to buses and goods carriers.
- EV sales have shown rapid growth since 2019, peaking in 2023.
- The data is clean (no missing/duplicate entries) and ready for analysis.

Objective : The primary aim is to:

- Analyse sales patterns and growth trends of EVs.
- Identify geographical and category-wise sales performance.
- Build a predictive model to forecast EV sales.
- Support policy making, investment strategy, and infrastructure planning in the electric mobility sector.

Tools & Technologies Used

- Python (Pandas, Matplotlib, Seaborn, Numpy)

Dataset Details

- File Name: EV_Dataset.csv
- File Path :
https://drive.google.com/file/d/14_cAtKqyS_nlzAhdhftC7NDlnBx_4YBS/view?pli=1

Analytical Approach

- Data Cleaning & Preprocessing – Handling nulls, datatype conversions.
- Exploratory Data Analysis (EDA) – Identifying trends by year, state, category.
- Feature Engineering – Extracting time-based and categorical features.
- Visual dashboards showing sales trends by year, state, vehicle type/class.

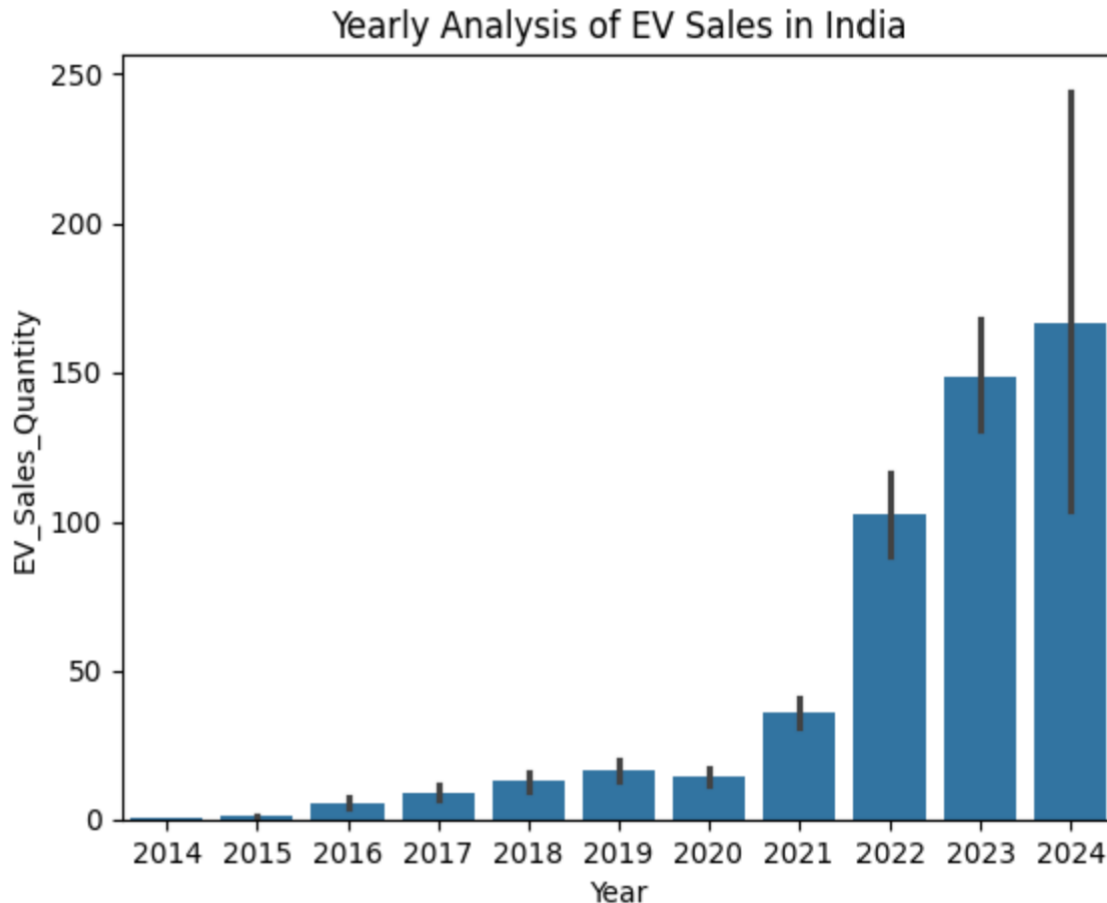
Implementation & Analysis

- **Yearly Analysis of EV Sales in India**

By analysing the patterns from 2014 to 2024 hereby we can conclude that, there shown a

```
In [36]: sns.barplot( x = 'Year' , y = 'EV_Sales_Quantity' , data = df ,)
plt.title('Yearly Analysis of EV Sales in India')
```

```
Out[36]: Text(0.5, 1.0, 'Yearly Analysis of EV Sales in India')
```

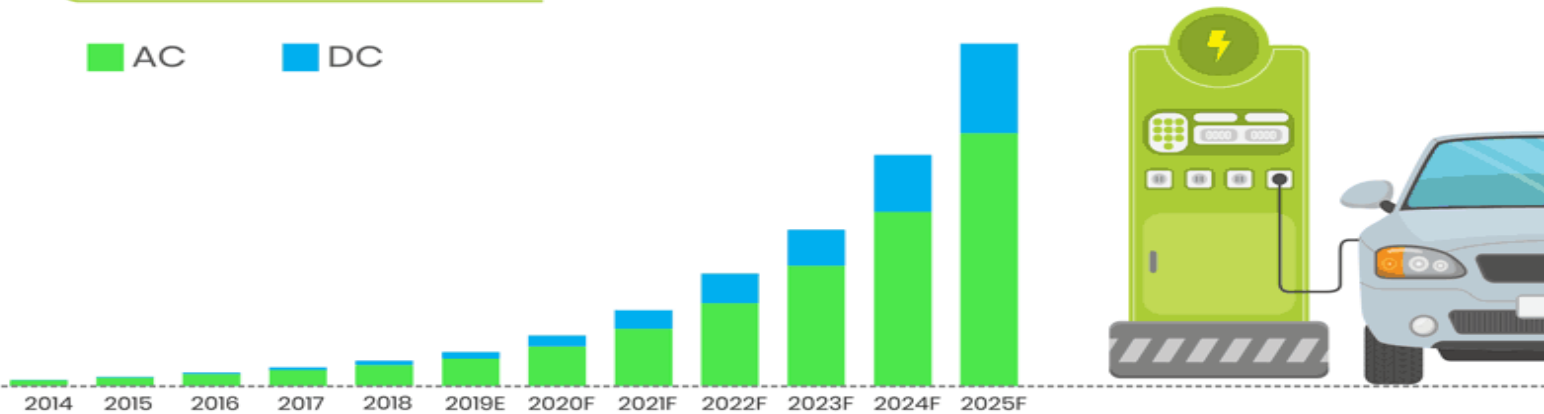


great rise in EV Sales from 2021-2024. Also it was claimed that during 2014 EV Market holds less than 0.01% Market shares but, till 2024 it gains a pretty good rise about 2.5%-3.6%, with some popular brands like – TATA Motors, MG-Motors, Mahindra, Ola, Bajaj, etc. And from latest updates during 2025, about 138606 EV Models has been sold.

INDIA ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) MARKET

AC

DC



The government's target for the deployment of DC fast chargers at various corridors and highway is expected to boost the market of this category during the forecast period

2019
Market Size
\$1,027.9
thousand

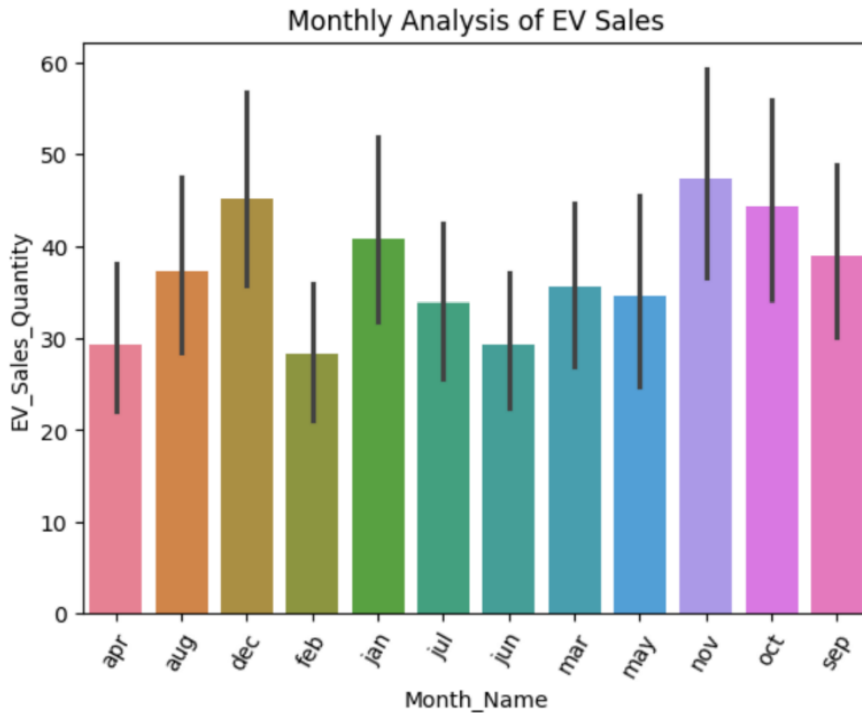
2025
Market Size
\$13,833.0
thousand

Market
Growth Rate
(2019-2025)
54.2%

"The data indicates a gradual growth of the electric vehicle market in India. Although we're still in the early stages with modest results, the accelerating pace suggests that EVs will likely occupy a substantial share of the Indian vehicle market in the future."

- **Monthly Analysis of EV Sales**

```
In [51]: plt.title('Monthly Analysis of EV Sales')
sns.barplot(x='Month_Name', y='EV_Sales_Quantity', data=df , hue= 'Month_Name' )
plt.xticks(rotation=60);
```



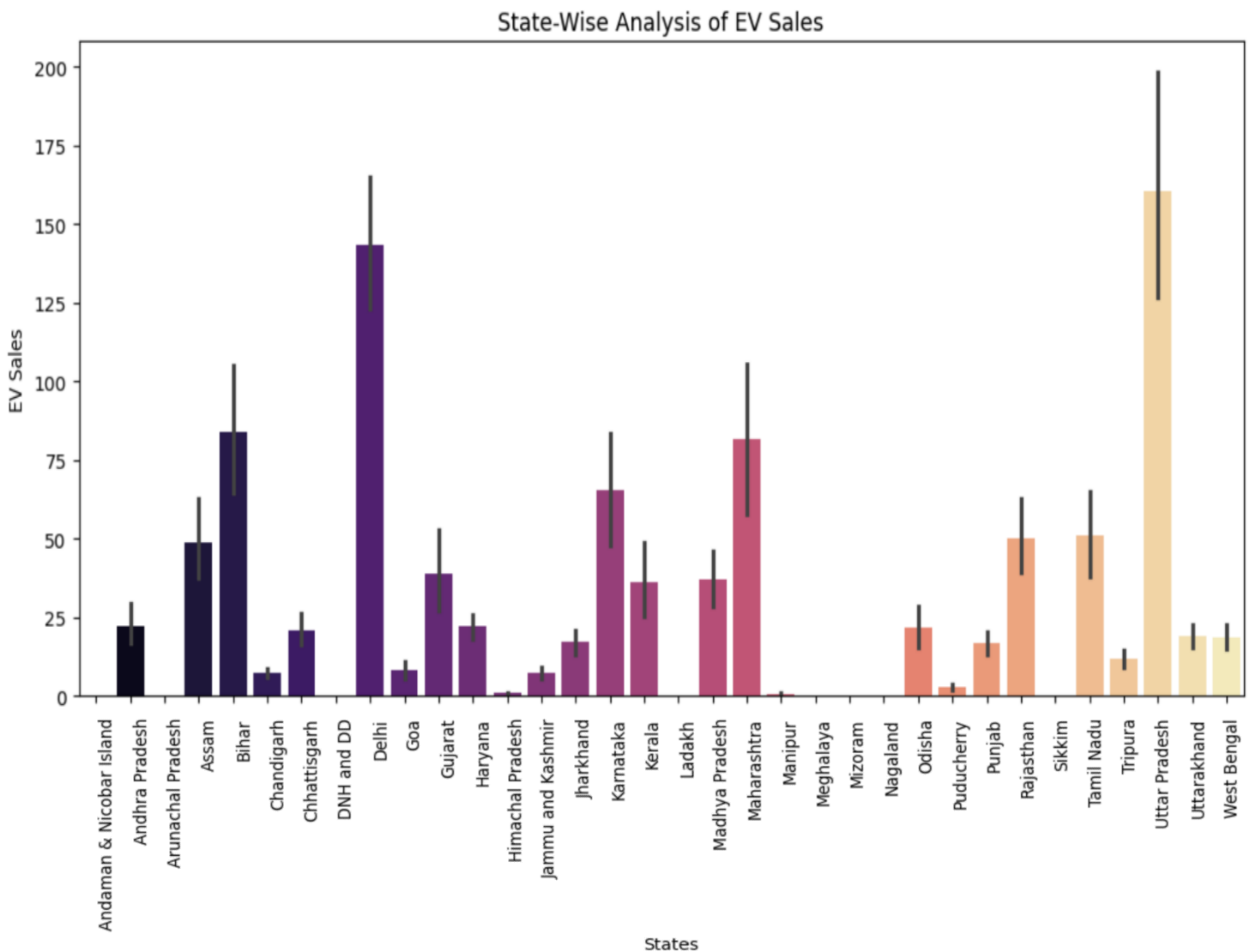
Illustrating seasonal EV Sales in India can be as followed:

- **Dec/Jan/Feb:** - the beginning of winter brings a strong sales momentum in these months likely driven by year-end targets and last minute purchases. Occasions like New Year also tends to show a boost in EV sales.
- **Mar/Apr/May:** - April is the weakest month of EV sales, showing a significant dip whereas March and May are moderate. It could reflect a wait-and-watch approach, post-financial-year end, and before the onset of peak summer heat.
- **Jun/Jul/Aug:** - it shows mixed performance. Jun and Jul are moderate, but August shows a significant rebound in sales August often leads to the start of pre-festive buzz, like Ganesh chatuthi, in some regions, potentially driving purchases.
- **Sep/Oct/Nov:** - monsoon and post-monsoon seasons are the peak sales period specially November show the robust sales. It directly correlates with the major Indian festive seasons (Navratri, Durga Pooja, and Diwali) which typically runs from September to November, driving consumer spending on big-ticket items.

Financial Idea: - optimize inventory and marketing efforts around the festive seasons for maximum profit and impact, and considered special promotions during spring months.

- **State-Wise Analysis of EV Sales Analysis.**

```
In [49]: plt.figure(figsize=(12,6))
plt.title('State-Wise Analysis of EV Sales')
sns.barplot(x='State', y='EV_Sales_Quantity', data=df,
hue='State', palette='magma')
plt.ylabel('EV Sales')
plt.xlabel('States')
plt.xticks(rotation = 90);
```



It represents strong geographical disparities in EV adoption, potentially driven by state-level policies, infrastructure, and urbanization.

1. Top Performance States In EV Sales:

- **Uttar Pradesh-**
 - Highest EV sales among all regions.

- Suggests strong adoption possibly due to population size, rural e-mobility programs, and local government incentives.
- **Delhi-**
 - A leading EV hub indicates high EV penetration in urban areas with dense charging infrastructure.
 - Supported by aggressive EV policies and subsidies.
- **Maharashtra, Karnataka, Bihar, Tamil Nadu:**
 - Each shows moderately high EV sales
 - Maharashtra and Tamil Nadu are automotive manufacturing hubs, likely benefiting from local supply chains and incentives.

2. Moderate Performing States:

- Gujarat, Rajasthan, Punjab, Madhya Pradesh, Assam and Kerala.
- These regions may have emerging EV ecosystems, but still lagging behind leaders due to infrastructure, awareness, or policy support gaps.

3. Low Performing States:

- Ladakh, Mizoram, Meghalaya, Nagaland, DNH & DD and several North-eastern states have negligible to no EV sales.
- Reasons:
 - a) Lack of infrastructure (charging stations).
 - b) Limited urbanization.
 - c) Lower income levels and smaller populations.
 - d) Geographic terrain not ideal for EV performance.

Financial idea: -

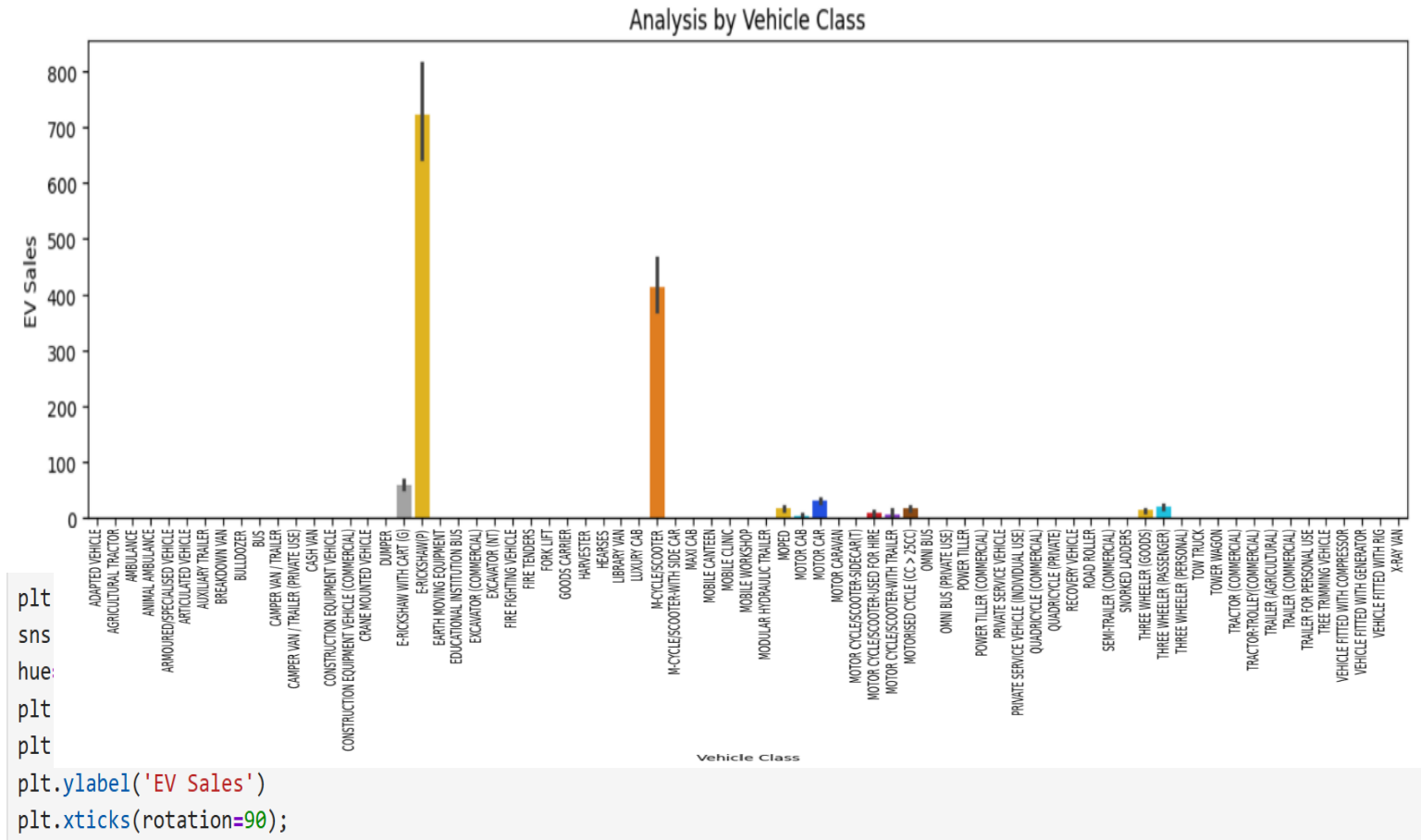
1. Focus Market Strategy: - Companies can prioritize Uttar Pradesh, Delhi, Maharashtra, and Tamil Nadu for market penetration and charging infrastructure investment.

2. Policy Support & Partnerships: - States with moderate EV sales can be approached for public-private partnerships to boost adoption. Encourage state-specific EV-friendly loan schemes and battery-swapping policies.

3. Consumer Awareness Campaigns: - In low-sales regions, initiate EV awareness and education drives, especially in tier-2 and tier-3 cities.

4. Infrastructure Investment: - EV charging infrastructure must be expanded in low-performance states to support future demand.

- **Analysis by vehicle class.**



The bar graph titled "Analysis by Vehicle Class" illustrates the quantity of Electric Vehicle (EV) sales across various vehicle classes.

- **Top Class Vehicles**

- E Rickshaw (P):- This class has the highest EV sales. This suggests that consumers are highly inclined towards electric E-Rickshaw (p).
 - Interpretation: This suggests strong demand for affordable public or semi-public transport in urban and semi-urban areas, particularly in tier-2 and tier-3 cities.
 - Market Insight: A clear focus area for manufacturers and policymakers. High adoption may be driven by government subsidies and urban last-mile connectivity needs.

- b) M-Cycle/Scooter: - This class has the second-highest EV sales. This indicates a strong demand for electric cars.

1. Interpretation: Two-wheelers continue to be a dominant mode of transport in India. Their electrification represents a major shift, likely due to cost savings and ease of urban commuting.

- **Middle Class Vehicles**

- a) E-Rickshaw with Cart (G):-The E-Rickshaw with Cart (G) class has moderate EV sales. This suggests a growing interest in electric pickup trucks.
- b) Motor Car: The Motor Car class also has moderate EV sales. This indicates a strongest demand for Motor Car.
- c) These segments show promise and could be expanded with improved charging infrastructure and policy support.
- d) Luxury Cars' presence in this bracket indicates growing interest in premium EVs, possibly fueled by early adopters.

- **Low Class Vehicles**

- a) Moped: - The Moped class has low EV sales. This could be due to limited demand or high production costs.
- b) Motor Cab: - The Motor Cab class also has low EV sales. This suggests limited demand or a lack of market appeal.
- c) Most commercial vehicles, construction equipment, and trailers have zero or negligible EV sales.
- d) Interpretation: These classes face infrastructure, cost, and technological barriers (e.g., battery capacity, payload needs).
- e) Targeted R&D and pilot programs are needed to bring electrification to heavier and industrial segments.

Financial ideas:

1. Policy Intervention: Accelerate subsidy schemes and financing options, especially for mid-tier goods and passenger vehicles.
2. Infrastructure Development: Urban and rural EV charging infrastructure is critical to boost adoption beyond E-Rickshaws and scooters.
3. Private Sector Focus: Start-ups and OEMs should prioritize R&D for electric commercial goods transport (mini trucks, utility vehicles).

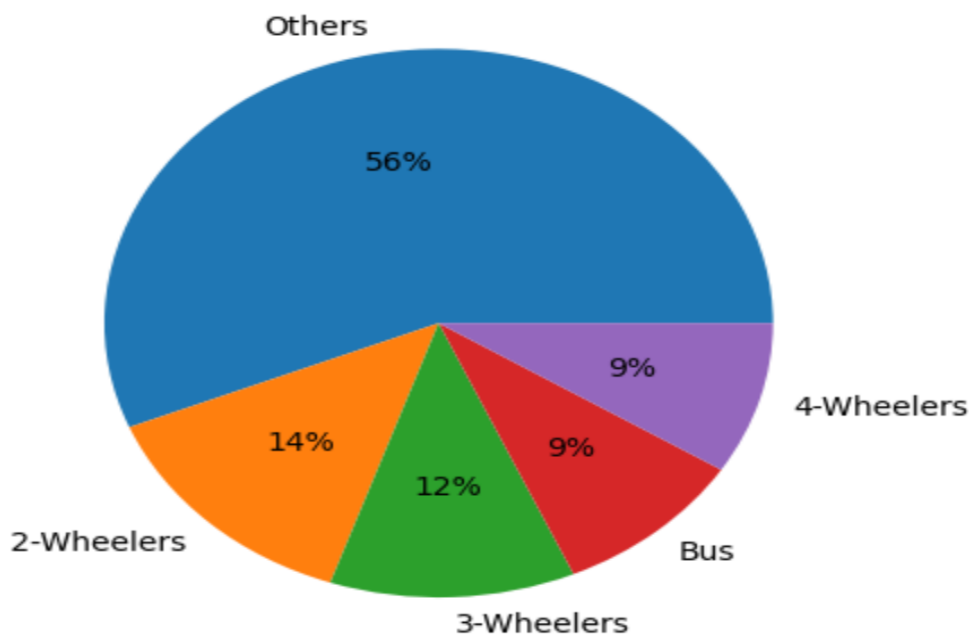
4. Untapped Segments: Luxury EV market and public transportation (electric buses) need targeted marketing and incentives.

5. Tier-2 and Tier-3 Markets: These cities are driving EV growth. Marketing, servicing, and charging infra here can unlock massive demand.

- Target markets: Focus on developing electric vehicles for specific industries, such as construction or logistics, where there is a growing demand for eco-friendly solutions.
- Invest in research and development: Continuously invest in R&D to improve the range, efficiency, and features of electric vehicles, making them more appealing to a wider audience.

- **Analysis By Vehicle Category**

```
sales = [54423, 13121, 11491, 9119, 8691]
Vehicle_category = ['Others', '2-Wheelers', '3-Wheelers', 'Bus', '4-Wheelers']
plt.pie(sales, labels=Vehicle_category, autopct='%1.1f%%')
plt.show()
```



The pie chart illustrates the percentage share of different vehicle categories in total EV sales. The segments include:

- **2-Wheelers (14%):**- A strong performer in the EV market.

Reasons:

Low acquisition cost
Cost-efficient for daily commuting
Quick adoption in urban and semi-urban areas
Market Impact: Indicates mass adoption in personal mobility. Many startups and legacy players are entering this space (e.g., Ola Electric, Ather, TVS iQube).

- **3-Wheelers (12%):-** Significant chunk, mostly used for public and goods transport.

Reasons:

Popular in Tier-2/3 cities for last-mile delivery and shared rides
Benefiting from subsidies and low running costs

Market Impact: Strong potential for employment generation and green logistics. Financing and battery swapping infra will boost adoption.

- **Buses (9%):-** Still a minor share but growing.

Reasons:

High upfront cost
Policy-driven adoption (State transport units, Smart City missions)

Market Impact: Key for decarbonizing public transport. Growth likely in next 5 years with support from government schemes like FAME II.

- **4-Wheelers (9%):-** Despite growth in consumer awareness, penetration is still limited.

Reasons:

Range anxiety, high price, and limited charging infra
Strong luxury EV growth (e.g., Tata Nexon EV, Hyundai Kona, BYD, MG)

Market Impact: The segment is evolving. Tapping into mass-market EVs will drive this share higher in coming years.

- **Others (56%):-** Majority of the pie, includes niche and specialized vehicles. Like E-Rickshaws, Loaders, Utility vehicles, Construction vehicles, Power

Tillers

Reason:

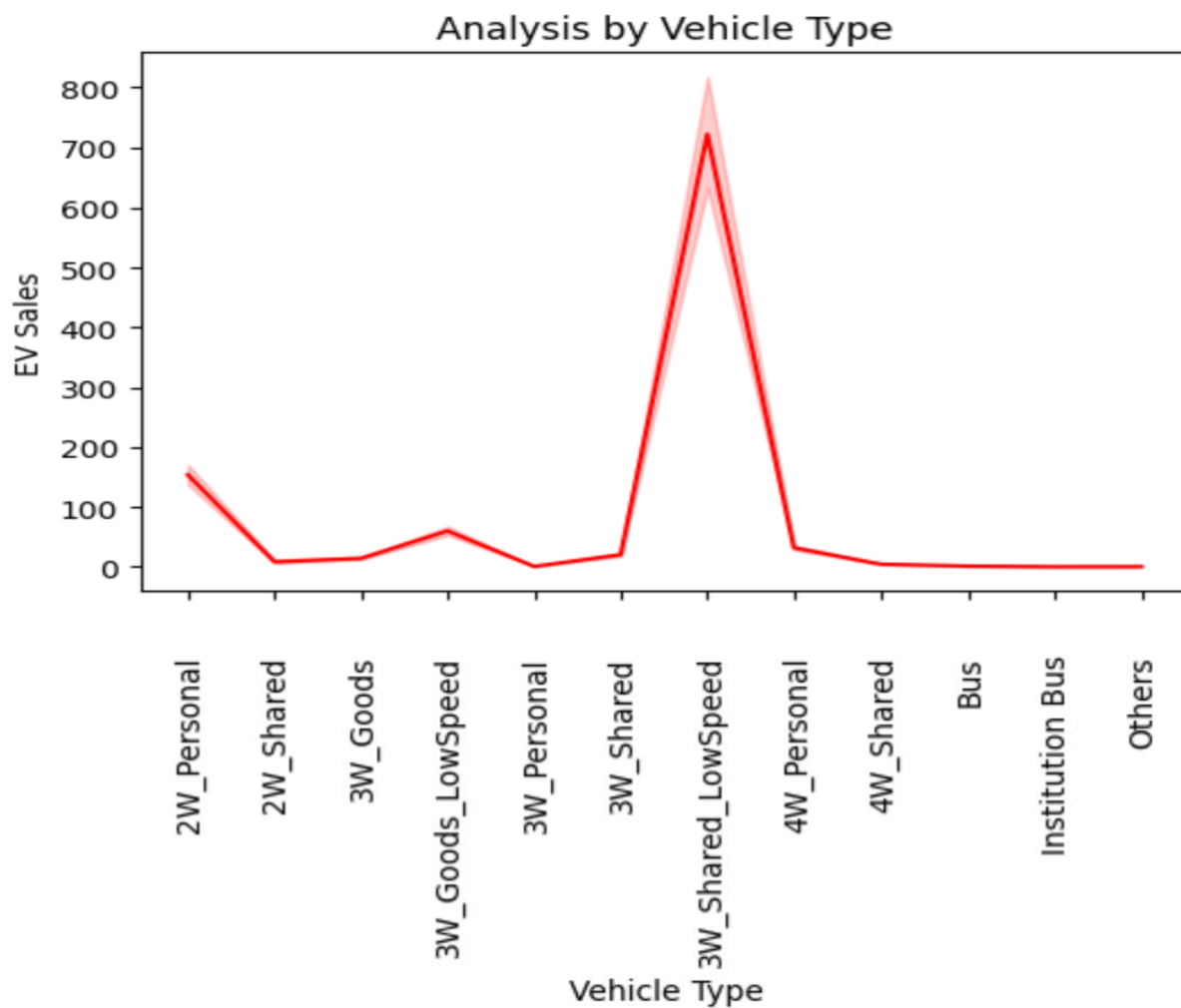
E-Rickshaws alone dominate India's EV market due to low cost and utility in intra-city movement

Market Impact & Future Outlook:

- **Short-Term (1-2 Years):**
 - a) 2W and 3W will continue to dominate due to affordability.
 - b) EV start-ups will grow rapidly in last-mile mobility and urban freight.
- **Mid-Term (3-5 Years):**
 - a) Significant adoption in bus and 4W segments as infra and policy mature.
 - b) Private vehicle users will start shifting faster as costs come down.

- **Long-Term (5+ Years):**
 - a) EVs will become mainstream across categories.
 - b) Market will move from policy-push to demand-pull scenario.
- **Analysis By Vehicle Type**

```
plt.figure(figsize=(6,4))
sns.lineplot(x='Vehicle_Type', y='EV_Sales_Quantity',data=df, color= 'red')
plt.title('Analysis by Vehicle Type')
plt.xlabel('Vehicle Type')
plt.ylabel('EV Sales')
plt.xticks(rotation=90);
```



Market Segmentation & Performance Overview:

- **Dominant Performers (High Volume):**

3W Shared Low Speed: This segment is the undisputed powerhouse. It represents ~72% of total EV sales shown in the graph. This is the highest-volume EV segment in India by a significant margin.

2W Personal: A strong second, accounting for ~14% of total EV sales. This signifies robust individual consumer adoption.

- **Nascent Performers (Low Volume):**

3W Goods Low Speed: - it indicating a nascent market for electric last-mile logistics.

3W Personal: - suggesting limited individual adoption outside of shared/goods use.

- **Underperforming / Negligible Sales (High Barriers):**

2W Shared, 3W Goods, 3W Shared: Extremely low sales, suggesting these specific sub-segments of 2W and 3W are yet to find significant traction.

4W Personal & 4W Shared: Both categories show very low. This highlights the challenges in scaling the electric car market.

- **Bus & Institution Bus:** Near-zero sales, critically indicating significant hurdles for public and private fleet electrification.

Key Drivers & Reasons

- a) **2W & 3W** is highly compelling. Lower running costs (electricity vs. petrol/diesel), coupled with lower maintenance, quickly offset the initial EV premium. For high-utilization commercial vehicles like e-rickshaws, these savings directly translate to higher daily earnings and faster ROI.
- b) **4W & Buses** Higher upfront vehicle costs (due to larger batteries), need for more sophisticated/expensive charging infrastructure, and longer routes/payload requirements mean or requires significant capital outlay and longer payback periods.
- c) **2W & 3W** benefit from flexible charging or efficient battery swapping networks mitigating range anxiety and charging downtime.
- d) **Critical Gap for 4W & Commercial:** The lack of widespread, reliable, fast-charging public infrastructure for cars, and specialized, high-power depot charging for buses/trucks, remains a significant deterrent.
- e) The dominant **2W** and **3W** segments perfectly cater to urban commuting, last-mile delivery, and shared short-distance transport, where the limited range of early EVs is less of a concern.

Financial Implications:-

- a) **Untapped Potential:** The **4W** and commercial vehicle segments represent enormous long-term growth potential, driven by urbanization, environmental mandates, and

eventual cost parity. However, they demand patient capital, significant R&D investment, and a higher risk tolerance due to current low adoption.

- b) **Infrastructure Investment:** The massive deficit in charging infrastructure for 4W and commercial vehicles presents a substantial investment opportunity for charging station developers, grid solution providers, and renewable energy companies.
- c) **Policy Risk & Catalyst:** The EV market's trajectory remains highly sensitive to government policies and subsidies. Any shifts (e.g., changes to FAME scheme successors, new state-level incentives, or mandates for fleet electrification) will significantly impact market dynamics and valuations.
- d) **Competitive Landscape:** The success of 2W/3W has likely attracted intense competition, potentially leading to margin pressures for manufacturers in these segments. Differentiation through technology, quality, and service will be crucial.

Investing in electric vehicles (EVs) is a smart move due to several key factors:

Modern Technology: EVs are packed with cutting-edge tech. This includes advanced battery systems for longer range and faster charging, AI-powered features for safety (ADAS) and personalized driving, and software updates that improve the car over time. They offer a quiet, smooth, and technologically superior driving experience compared to traditional cars.

"If We Buy More, It Will Grow More": The positive feedback loop of market growth. As more people buy EVs, production scales up, driving down manufacturing costs. This affordability, in turn, encourages more buyers. Increased demand also spurs vital investments in charging infrastructure and further R&D, making EVs even more convenient and appealing. It's a self-reinforcing cycle of growth and improvement.

Future Domination: EVs are not just a trend; they represent the future of transportation. Global and Indian government policies are strongly pushing for EV adoption to combat climate change and reduce reliance on fossil fuels. Technological advancements are rapidly overcoming current limitations, making EVs increasingly practical and superior. This shift will make EVs the primary mode of transport, offering long-term sustainability and economic benefits.

Advantages & Disadvantages of Electric Vehicles



ADVANTAGES



No carbon emissions so ecofriendly



Reduces reliance on fossil fuels



EVs have impressive torque & performance



EVs operate silently so reduces noise pollution

DISADVANTAGES



Charging time of EV is quite high.



Limited number of EV models



Electric vehicles have high initial cost



Limited number of EV charging stations

❖ Advantages

- Environmental Friendly: Zero tailpipe emissions mean cleaner air and reduced carbon footprint.
- High Mobility in Tier-2, Tier-3 Cities: Ideal for commutes and increasingly popular due to affordability and improving infrastructure.
- Less Running Cost: Significantly cheaper to "refuel" (charge) and require minimal maintenance, saving money.
- Evaporate Silently, Reduce Noise Pollution: Quiet operation leads to less noise in urban areas, enhancing peace and quiet.
- EVs conserve finite fossil fuels by running on electricity, often from renewable sources. They're also more energy-efficient.

❖ Disadvantages

- Electric vehicles often have a high upfront cost, and they don't seem to fetch a good price in the second-hand market either."
- Limited Charging Infrastructure: The availability of public charging stations, especially fast chargers, is still insufficient across India. This creates "range anxiety" and inconvenience for EV owners, making long-distance travel challenging compared to the widespread network of petrol pumps.
- Reliability in Rural Areas (Tier 1): Beyond charging, the overall ecosystem for EVs in rural and semi-urban areas is underdeveloped. This includes a scarcity of skilled technicians for EV maintenance and repair, limited availability of spare parts, and inconsistent grid electricity supply.
- Inefficiency for Heavy Goods Transport: Current EV technology, particularly battery density and charging speed, makes electric vehicles less efficient and practical for transporting heavy goods over long distances.
- Market Share: Despite government incentives and growing awareness, the market share of EVs in India remains relatively low compared to internal combustion engine (ICE) vehicles.