Electric Vehicle Analysis in Power BI

Introduction:-

This document serves as a comprehensive metadata guide for the electric vehicle (EV) sales datasets utilized in this project. The data has been sourced primarily from Kaggle and is structured to support detailed analysis and forecasting related to EV adoption trends across India.

The datasets include multiple CSV files that capture electric vehicle sales segmented by **state** and **manufacturer**, along with a **date dimension table** that facilitates time-series analysis. In addition to the raw data, derived tables have been created to enrich the dataset with **month**, **quarter**, and **year** fields. These enhancements help structure the chronological order of events and support more accurate **predictive modeling and trend analysis** over time.

This metadata document provides detailed descriptions of each column in the datasets, explaining the purpose, data type, and any transformation logic applied. It aims to assist users in understanding the structure and utility of the data for analysis, visualization, and forecasting.

Datasets:-

Primary Data Sources for Modeling and Analysis-

The following datasets form the core foundation for electric vehicle (EV) sales analysis and forecasting. They have been structured and curated to support robust data modeling in Power BI and other analytical environments. These files collectively provide a multidimensional view of EV sales across time, geography, and manufacturer, enabling both historical insight and predictive analysis.

1. electric_vehicle_sales_by_state.csv

This dataset captures monthly electric vehicle sales data across different Indian states and is essential for regional and temporal trend analysis.

- date: The reporting date for the sales data, recorded monthly. Format: DD-MMM-YY.

- state: The Indian state where the vehicle sales were recorded, allowing for geographic segmentation.

- vehicle_category: Classification of the vehicle type — either 2-Wheeler or 4-Wheeler.

- electric_vehicles_sold: Total number of electric vehicles sold in the specified state and category on the given date.

- total_vehicles_sold: Total number of vehicles (including both electric and non-electric) sold in the specified state and category on the given date. This allows comparison of EV adoption relative to overall sales.

date	state	vehicle_category	electric_vehicles_sold	total_vehicles_sold	Total_Price_vehicle_state	Total_Price_EV_state	Financial_year	Years
01 April 2021	Sikkim	2-Wheelers	0	398	33830000	0	2022	2021
01 April 2021	Sikkim	4-Wheelers	0	361	541500000	0	2022	2021
01 May 2021	Sikkim	2-Wheelers	0	113	9605000	0	2022	2021
01 May 2021	Sikkim	4-Wheelers	0	98	147000000	0	2022	2021
01 June 2021	Sikkim	2-Wheelers	0	229	19465000	0	2022	2021
01 June 2021	Sikkim	4-Wheelers	0	244	366000000	0	2022	2021
01 July 2021	Sikkim	2-Wheelers	0	458	38930000	0	2022	2021
01 July 2021	Sikkim	4-Wheelers	0	452	678000000	0	2022	2021
01 August 2021	Sikkim	2-Wheelers	0	489	41565000	0	2022	2021
01 August 2021	Sikkim	4-Wheelers	0	408	612000000	0	2022	2021
01 September 2021	Sikkim	2-Wheelers	0	540	45900000	0	2022	2021
01 September 2021	Sikkim	4-Wheelers	0	355	532500000	0	2022	2021
01 October 2021	Sikkim	2-Wheelers	0	455	38675000	0	2022	2021
01 October 2021	Sikkim	4-Wheelers	0	345	517500000	0	2022	2021
01 November 2021	Sikkim	2-Wheelers	0	478	40630000	0	2022	2021
01 November 2021	Sikkim	4-Wheelers	0	351	526500000	0	2022	2021
01 December 2021	Sikkim	2-Wheelers	0	454	38590000	0	2022	2021
01 December 2021	Sikkim	4-Wheelers	0	394	591000000	0	2022	2021
01 January 2022	Sikkim	2-Wheelers	0	400	34000000	0	2022	2022
01 January 2022	Sikkim	4-Wheelers	0	270	405000000	0	2022	2022
01 February 2022	Sikkim	2-Wheelers	0	384	32640000	0	2022	2022
01 February 2022	Sikkim	4-Wheelers	0	371	556500000	0	2022	2022
01 March 2022	Sikkim	2-Wheelers	0	460	39100000	0	2022	2022
01 March 2022	Sikkim	4-Wheelers	0	390	585000000	0	2022	2022
01 April 2022	Sikkim	2-Wheelers	0	455	38675000	0	2022	2022
01 April 2022	Sikkim	4-Wheelers	0	380	570000000	0	2022	2022
01 May 2022	Sikkim	2-Wheelers	0	461	39185000	0	2022	2022
01 May 2022	Sikkim	4-Wheelers	0	421	631500000	0	2022	2022
01 June 2022	Sikkim	2-Wheelers	0	429	36465000	0	2022	2022

electric_vehicle_sales_by_state (2,445 rows)

2. electric_vehicle_sales_by_makers.csv

This dataset provides insights into the performance of different manufacturers, allowing for brand-level comparison and analysis.

- date: The monthly timestamp for the recorded sales data. Format: DD-MMM-YY.
- vehicle_category: Indicates the vehicle type sold (2-Wheeler or 4-Wheeler).
- maker: Name of the electric vehicle manufacturer or brand.
- electric_vehicles_sold: Number of electric vehicles sold by each maker within the specified category and date.

date	vehicle_category	maker	electric_vehicles_sold	year
01 April 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 April 2022	2-Wheelers	OKAYA EV	0	2022
01 May 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 June 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 July 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 August 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 September 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 October 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 November 2021	2-Wheelers	OLA ELECTRIC	0	2021
01 April 2021	4-Wheelers	BYD India	0	2021
01 April 2021	4-Wheelers	PCA Automobiles	0	2021
01 April 2021	4-Wheelers	BMW India	0	2021
01 April 2021	4-Wheelers	Volvo Auto India	0	2021
01 April 2021	4-Wheelers	KIA Motors	0	2021
01 April 2022	4-Wheelers	PCA Automobiles	0	2022
01 April 2022	4-Wheelers	Volvo Auto India	0	2022
01 April 2022	4-Wheelers	KIA Motors	0	2022
01 May 2021	4-Wheelers	BYD India	0	2021
01 May 2021	4-Wheelers	PCA Automobiles	0	2021
01 May 2021	4-Wheelers	BMW India	0	2021
01 May 2021	4-Wheelers	Mercedes -Benz AG	0	2021
01 May 2021	4-Wheelers	Volvo Auto India	0	2021
01 May 2021	4-Wheelers	KIA Motors	0	2021
01 May 2022	4-Wheelers	PCA Automobiles	0	2022
01 May 2022	4-Wheelers	Volvo Auto India	0	2022
01 May 2022	4-Wheelers	KIA Motors	0	2022
01 June 2021	4-Wheelers	BYD India	0	2021
01 June 2021	4-Wheelers	PCA Automobiles	0	2021
01 June 2021	4-Wheelers	BMW India	0	2021

lectric_vehicle_sales_by_makers (816 rows)

3. dim_date.csv

This dimension table is a crucial component for time-series modeling. It enables fiscal and calendar-based time slicing, aggregations, and trend analysis.

- date: A continuous monthly date reference aligned with the sales data. Format: DD-MMM-YY.

- fiscal_year: Fiscal year designation used for financial reporting and business analysis.

- quarter: Corresponding fiscal quarter (e.g., Q1, Q2, Q3, Q4), enabling quarter-over-quarter analysis.

date	fiscal_year	quarter	Year	Month	Month-Year	Quater-Year	Actual_date	Financial_Yea	Quarter_Order_	Year_Order_Rank	Month_Order_R
01 April 2021	2022	Q1	2021	Apr	Apr-21	Q1-22	01-04-2021	0	1	1	1
01 May 2021	2022	Q1	2021	May	May-21	Q1-22	01-05-2021	0	1	1	1
01 June 2021	2022	Q1	2021	Jun	Jun-21	Q1-22	01-06-2021	0	1	1	1
01 July 2021	2022	Q2	2021	Jul	Jul-21	Q2-22	01-07-2021	0	2	1	2
01 August 2021	2022	Q2	2021	Aug	Aug-21	Q2-22	01-08-2021	0	2	1	2
01 September 2021	2022	Q2	2021	Sep	Sep-21	Q2-22	01-09-2021	0	2	1	2
01 October 2021	2022	Q3	2021	Oct	Oct-21	Q3-22	01-10-2021	0	3	1	3
01 November 2021	2022	Q3	2021	Nov	Nov-21	Q3-22	01-11-2021	0	3	1	3
01 December 2021	2022	Q3	2021	Dec	Dec-21	Q3-22	01-12-2021	0	3	1	3
01 January 2022	2022	Q4	2022	Jan	Jan-22	Q4-22	01-01-2022	0	4	2	4
01 February 2022	2022	Q4	2022	Feb	Feb-22	Q4-22	01-02-2022	0	4	2	4
01 March 2022	2022	Q4	2022	Mar	Mar-22	Q4-22	01-03-2022	0	4	2	4
01 April 2022	2023	Q1	2022	Apr	Apr-22	Q1-23	01-04-2022	0	5	2	5
01 May 2022	2023	Q1	2022	May	May-22	Q1-23	01-05-2022	0	5	2	5
01 June 2022	2023	Q1	2022	Jun	Jun-22	Q1-23	01-06-2022	0	5	2	5
01 July 2022	2023	Q2	2022	Jul	Jul-22	Q2-23	01-07-2022	0	6	2	6
01 August 2022	2023	Q2	2022	Aug	Aug-22	Q2-23	01-08-2022	0	6	2	6
01 September 2022	2023	Q2	2022	Sep	Sep-22	Q2-23	01-09-2022	0	6	2	6
01 October 2022	2023	Q3	2022	Oct	Oct-22	Q3-23	01-10-2022	0	7	2	7
01 November 2022	2023	Q3	2022	Nov	Nov-22	Q3-23	01-11-2022	0	7	2	7
01 December 2022	2023	Q3	2022	Dec	Dec-22	Q3-23	01-12-2022	0	7	2	7
01 January 2023	2023	Q4	2023	Jan	Jan-23	Q4-23	01-01-2023	0	8	3	8
01 February 2023	2023	Q4	2023	Feb	Feb-23	Q4-23	01-02-2023	0	8	3	8
01 March 2023	2023	Q4	2023	Mar	Mar-23	Q4-23	01-03-2023	0	8	3	8
01 April 2023	2024	Q1	2023	Apr	Apr-23	Q1-24	01-04-2023	0	9	3	9
01 May 2023	2024	Q1	2023	May	May-23	Q1-24	01-05-2023	0	9	3	9
01 June 2023	2024	Q1	2023	Jun	Jun-23	Q1-24	01-06-2023	0	9	3	9
01 July 2023	2024	Q2	2023	Jul	Jul-23	Q2-24	01-07-2023	0	10	3	10
01 August 2023	2024	Q2	2023	Aug	Aug-23	Q2-24	01-08-2023	0	10	3	10

Derived Tables Based on the Date Dimension-

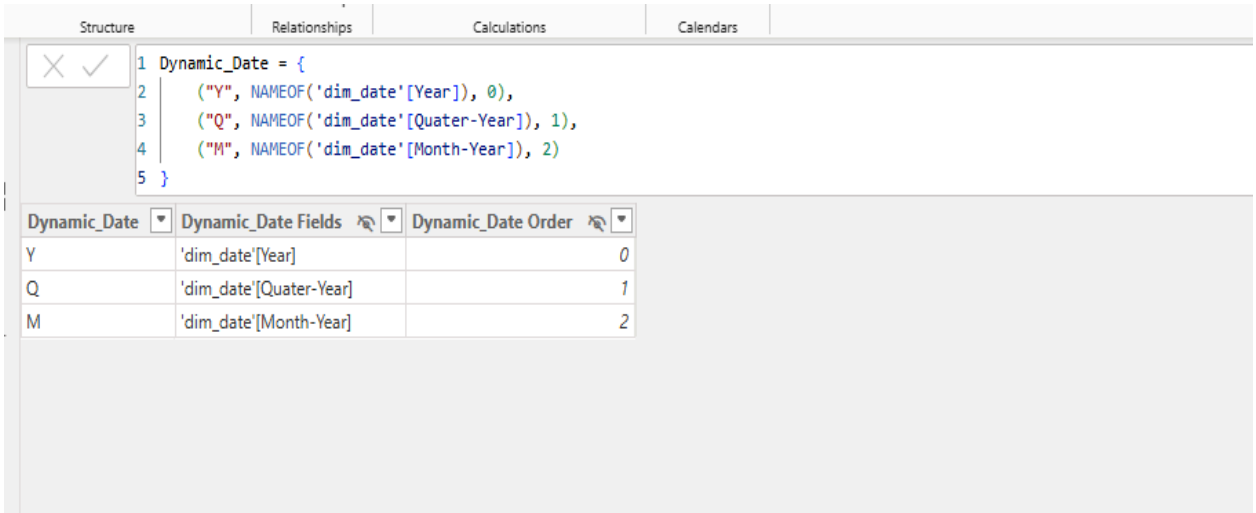
In addition to the core datasets, several supporting tables have been created using data from the dim_date table. These derived tables are designed to organize and enhance the chronological structure of the model by incorporating **month**, **quarter**, and **fiscal year** breakdowns. This setup ensures that all time-based analyses are aligned with the appropriate **fiscal calendar**, which is particularly important for business reporting and forecasting.

These tables help:

- Maintain correct **month and quarter ordering** (e.g., Apr–May–Jun as Q1, if following Indian fiscal year),
- Enable flexible grouping for **monthly, quarterly, and yearly analysis**,
- Support **fiscal year-based performance tracking**, such as fiscal year-to-date (FYTD) comparisons,
- Provide a robust foundation for **trend analysis and time intelligence** in Power BI.

By aligning the entire time model with the fiscal year, these derived tables ensure consistency across reports and dashboards, especially when evaluating growth, seasonality, or cumulative metrics over business cycles.

4) Dynamic_Date Table

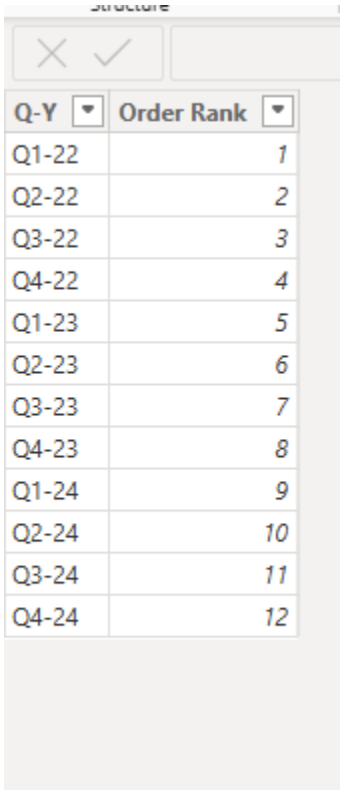


5) M_Y Order Table

Month-Year	Order_Rank
Apr-21	1
May-21	2
Jun-21	3
Jul-21	4
Aug-21	5
Sep-21	6
Oct-21	7
Nov-21	8
Dec-21	9
Jan-22	10
Feb-22	11
Mar-22	12
Apr-22	13
May-22	14
Jun-22	15
Jul-22	16
Aug-22	17
Sep-22	18
Oct-22	19
Nov-22	20
Dec-22	21
Jan-23	22
Feb-23	23
Mar-23	24
Apr-23	25
May-23	26
Jun-23	27
Jul-23	28
Aug-23	29

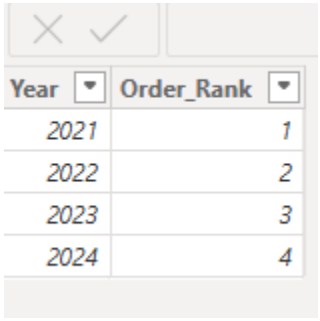
1_Y Order Table (36 rows)

6) Q_Y Order Table



Q-Y	Order Rank
Q1-22	1
Q2-22	2
Q3-22	3
Q4-22	4
Q1-23	5
Q2-23	6
Q3-23	7
Q4-23	8
Q1-24	9
Q2-24	10
Q3-24	11
Q4-24	12

7) Y Order Table

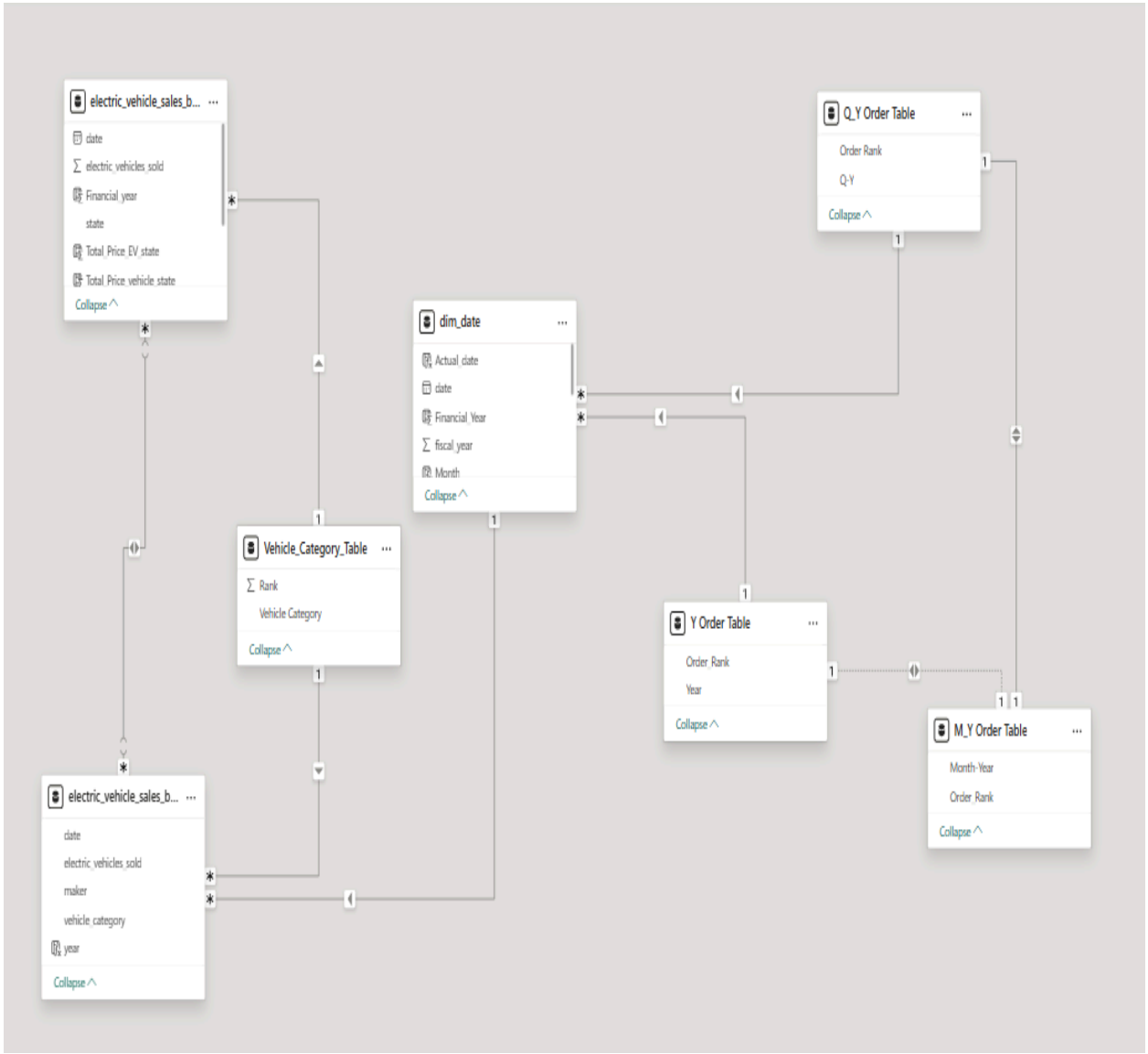


Year	Order_Rank
2021	1
2022	2
2023	3
2024	4

8) Vehicle Category Table

Vehicle Category	Rank
2-Wheelers	1
4-Wheelers	2

Model View:-



DAX Expressions:-

Few Key Points:

1. Fiscal Year: The fiscal year is a one-year period used for financial reporting and budgeting, starting on April 1st and ending on March 31st of the following year in India.

2. Penetration Rate: This metric represents the percentage of total vehicles that are electric within a specific region or category. It is calculated as:

Penetration Rate = (Electric Vehicles Sold / Total Vehicles Sold) * 100

This indicates the adoption level of electric vehicles.

3. Compound Annual Growth Rate (CAGR): CAGR measures the mean annual growth rate over a specified period longer than one year. It is calculated as:

CAGR = [(Ending Value / Beginning Value) ** 1/n] -1

Measure Table:

1) 2_EV Revenue_2022 = CALCULATE(CALCULATE (SUM ('electric_vehicle_sales_by_makers'[electric_vehicles_sold]), 'dim_date'[fiscal_year]="2022"), 'electric_vehicle_sales_by_makers'[vehicle_category] = "2-Wheelers")

2) Total_Vehicles_Sold = SUM(electric_vehicle_sales_by_makers[electric_vehicles_sold])

3) Beginner CAGR = CALCULATE(SUM(electric_vehicle_sales_by_state[electric_vehicles_sold]), dim_date[Financial_Year] = MIN(dim_date[Financial_Year]))

4) CAGR STATE_2223 = CALCULATE(

```
            IFERROR(([SecondEndingvaluestateEV] / [Beginner CAGR])^ (1/1)-1,0),
ALL(dim_date)
            )
```

5) CAGR_MAKER_EV_% =

```
VAR FS_MK =
CALCULATE(SUM(electric_vehicle_sales_by_makers[electric_vehicles_sold]),
dim_date[fiscal_year] = MIN(dim_date[fiscal_year]))
VAR lS_MK =
CALCULATE(SUM(electric_vehicle_sales_by_makers[electric_vehicles_sold]),
dim_date[fiscal_year] = MAX(dim_date[fiscal_year]))
VAR NO_YEAR =
CALCULATE(DISTINCTCOUNT(dim_date[fiscal_year])-1,ALL(dim_date))

RETURN

CALCULATE(
   IFERROR(((lS_MK/FS_MK)^(1/NO_YEAR)-1)*100,0),ALL(dim_date)
)
```

6) CAGR_State_Ev =

```
VAR initial_date =
CALCULATE(SUM(electric_vehicle_sales_by_state[electric_vehicles_sold]),
dim_date[fiscal_year] = MIN(dim_date[fiscal_year]))
var final_date_sales =
CALCULATE(SUM(electric_vehicle_sales_by_state[electric_vehicles_sold]),
dim_date[fiscal_year] = MAX(dim_date[fiscal_year]))
VAR noofyear =
CALCULATE(DISTINCTCOUNT(dim_date[fiscal_year])-1,ALL(dim_date))

RETURN

CALCULATE(
   IFERROR((final_date_sales/initial_date)^(1/noofyear)-1,0), ALL(dim_date)
   )
```

7) ENDING CAGR =
CALCULATE(
SUM(electric_vehicle_sales_by_state[electric_vehicles_sold]),
dim_date[Financial_Year] = MAX(dim_date[Financial_Year])
)

8) Penetration Rate =
DIVIDE([Total EV Sale_State],[Total_Vehicle_sales_State],0)

9) ProjectedEVSales2024 =
[SecondEndingvaluestateEV] * POWER(1 + [CAGR STATE_2223], 1)

10) ProjectedEVSales2030 = [ENDING CAGR] * POWER(1+[CAGR_Stae_Ev],6)

11) second_max_year =

```
VAR toptwoyeras =
  TOPN(2,
  VALUES(dim_date[Financial_Year]),
  dim_date[Financial_Year],
  DESC
  )

RETURN

MINX(toptwoyeras, dim_date[Financial_Year])
```

12) SecondEndingvaluestateEV =

```
VAR secondmaxyear = [second_max_year]
RETURN

CALCULATE(
  SUM(electric_vehicle_sales_by_state[electric_vehicles_sold]), FILTER(dim_date ,
dim_date[Financial_Year] = [second_max_year])
)
```

13) Total EV Sale_State =
SUM(electric_vehicle_sales_by_state[electric_vehicles_sold])

14) Total_EV_Sales_Maker =
SUM(electric_vehicle_sales_by_makers[electric_vehicles_sold])

15) Total_Vehicle_sales_State =
SUM(electric_vehicle_sales_by_state[total_vehicles_sold])

16) Change_Sales_EV_22vs24 = [EV_Sales_2024] - [EV_Sales_2022]

17) Change_Sales_Total_Vehicle_22vs24 =
[Total_vehicle_Sales_2024]-[Total_Vehicle_Sales_2022]

18) EV_Sales_2022 = CALCULATE([Total EV
Sale_State],electric_vehicle_sales_by_state[Years] = "2022")

19) EV_Sales_2024 =
CALCULATE([Total_Vehicle_sales_State],electric_vehicle_sales_by_state[Years]
= "2024")

20) Panetration_Rate_22vs24 =
DIVIDE([Change_Sales_EV_22vs24],[Change_Sales_Total_Vehicle_22vs24],0)

21) Penetration Rate = ([Total EV Sale_State]/[Total_Vehicle_sales_State])

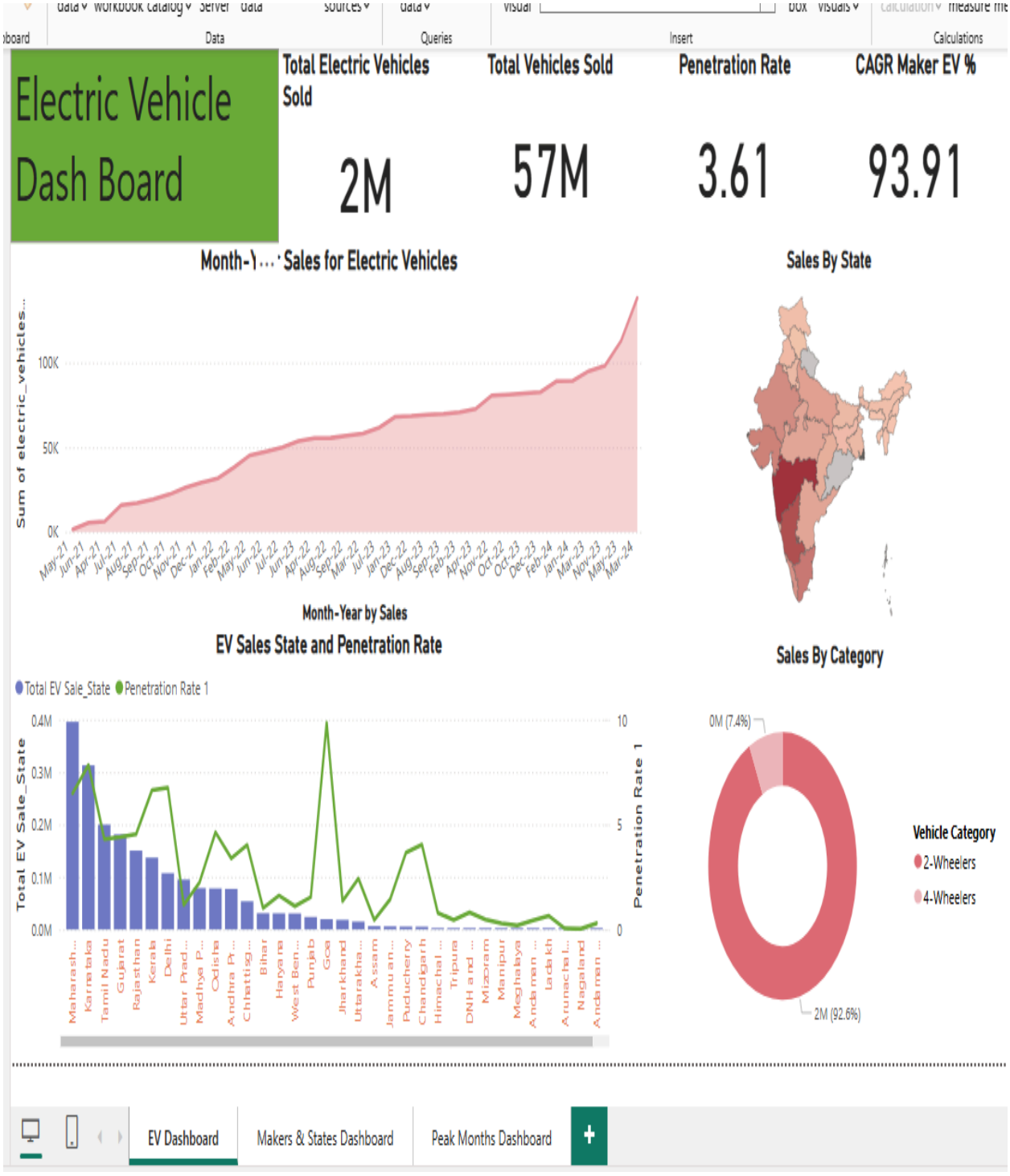
22) Penetration Rate 1 = ([Total EV Sale_State]/[Total_Vehicle_sales_State]) * 100

23) Total_Vehicle_Sales_2022 = CALCULATE([Total_Vehicle_sales_State],
electric_vehicle_sales_by_state[Years]="2022")

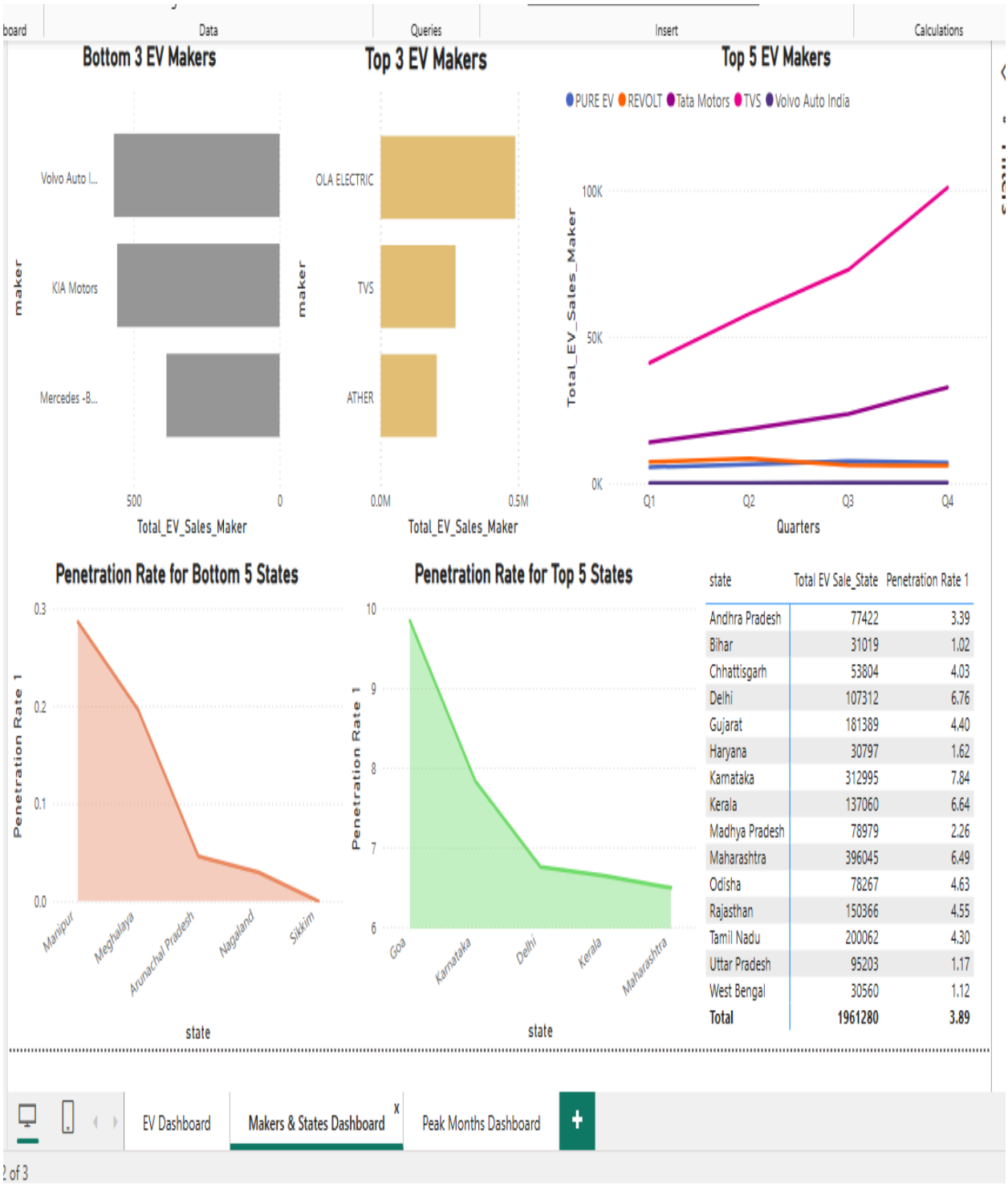
24) Total_vehicle_Sales_2024 = CALCULATE([Total_Vehicle_sales_State],
electric_vehicle_sales_by_state[Years] = "2024")

Power BI DashBoards:-

1) EV Dashboard

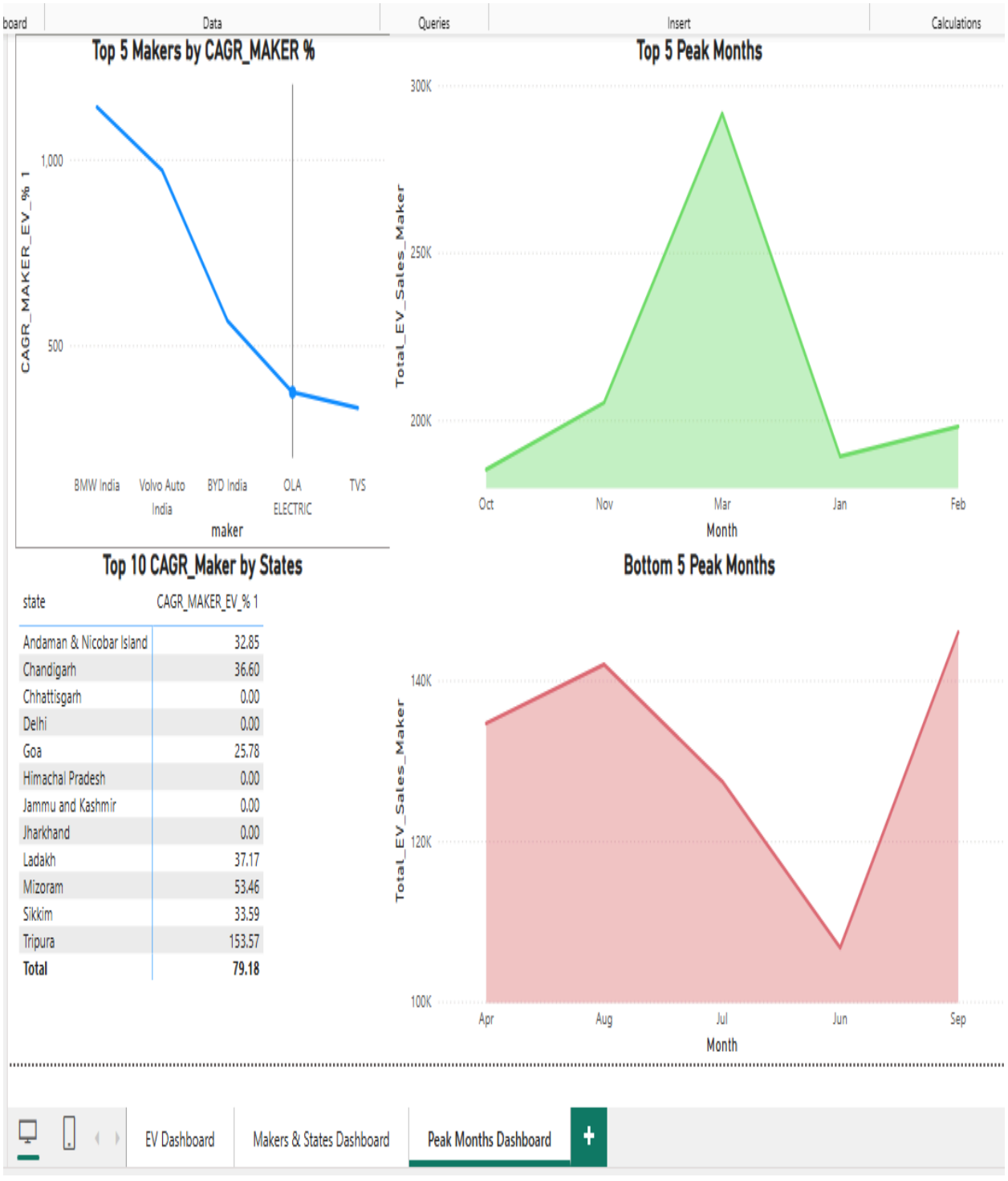


2) Makers & States Dashboard



state	Total EV Sale_State	Penetration Rate 1
Andhra Pradesh	77422	3.39
Bihar	31019	1.02
Chhattisgarh	53804	4.03
Delhi	107312	6.76
Gujarat	181389	4.40
Haryana	30797	1.62
Karnataka	312995	7.84
Kerala	137060	6.64
Madhya Pradesh	78979	2.26
Maharashtra	396045	6.49
Odisha	78267	4.63
Rajasthan	150366	4.55
Tamil Nadu	200062	4.30
Uttar Pradesh	95203	1.17
West Bengal	30560	1.12
Total	**1961280**	**3.89**

3) Peak Months Dashboard



Analysis:-

1) Cost Comparison: Electric Vehicles vs. Conventional Vehicles

For Cars: The annual running cost of an electric vehicle (EV) is ₹29,200, significantly lower than ₹120,906.25 for petrol vehicles and ₹112,953.13 for diesel vehicles. This translates to a cost per kilometre of ₹1.60 for EVs compared to ₹6.63 for petrol and ₹6.18 for diesel.

For Two-Wheelers: The annual running cost of an EV is ₹19,211.00, compared to ₹31,937.50 for petrol two-wheelers. This results in a cost per kilometre of ₹1.05 for EVs versus ₹1.75 for petrol.

2) Primary reasons for customers choosing 4-wheeler EVs in 2023 and 2024

a. Cost Savings: EVs offer lower running costs due to reduced fuel and maintenance expenses. The cost of electricity is generally lower than petrol or diesel, and EVs have fewer moving parts, reducing maintenance needs.

b. Environmental Concerns: Increasing awareness of climate change and air pollution drives customers to choose EVs, as they produce zero tailpipe emissions and contribute to reducing urban air pollution.

c. Government Incentives: Government schemes, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) II scheme, provide subsidies and incentives for EV purchases, making them more affordable and attractive.

3) Top 3 States that have provided substantial subsidies in India

Delhi: Offers significant incentives under the Delhi Electric Vehicle Policy, including subsidies and reduced registration fees.

Maharashtra: Provides substantial subsidies for both 2-wheelers and 4-wheelers under the Maharashtra Electric Vehicle Policy.

Tamil Nadu: Includes incentives as part of its Tamil Nadu Electric Vehicle Policy to promote EV adoption.

4) Top 5 States with the highest EV adoption rates

Delhi: A dense network of charging stations supports high EV sales.

Maharashtra: Investments in charging infrastructure have driven significant EV penetration.

Tamil Nadu: Expanded charging facilities correlate with rising EV adoption.

Karnataka: A growing number of charging stations contributes to increasing EV sales.

Gujarat: Strategic development of charging infrastructure has enhanced EV market penetration.

Conclusion:-

The comparative analysis clearly demonstrates that **electric vehicles (EVs)** offer substantial **cost advantages** over conventional petrol and diesel vehicles — both for cars and two-wheelers. With significantly lower annual running costs and cost-per-kilometre, EVs are becoming a financially smarter choice for consumers.

Beyond cost savings, the rapid growth in EV adoption during 2023 and 2024 is driven by increasing **environmental awareness**, a strong desire to reduce **urban pollution**, and attractive **government incentives** such as the FAME II scheme.

State-level initiatives have also played a critical role. **Delhi, Maharashtra, and Tamil Nadu** stand out for providing substantial subsidies, while **Delhi, Maharashtra, Tamil Nadu, Karnataka, and Gujarat** lead in EV adoption due to proactive investment in charging infrastructure.

Together, these factors are accelerating the shift toward cleaner, more sustainable mobility across India.