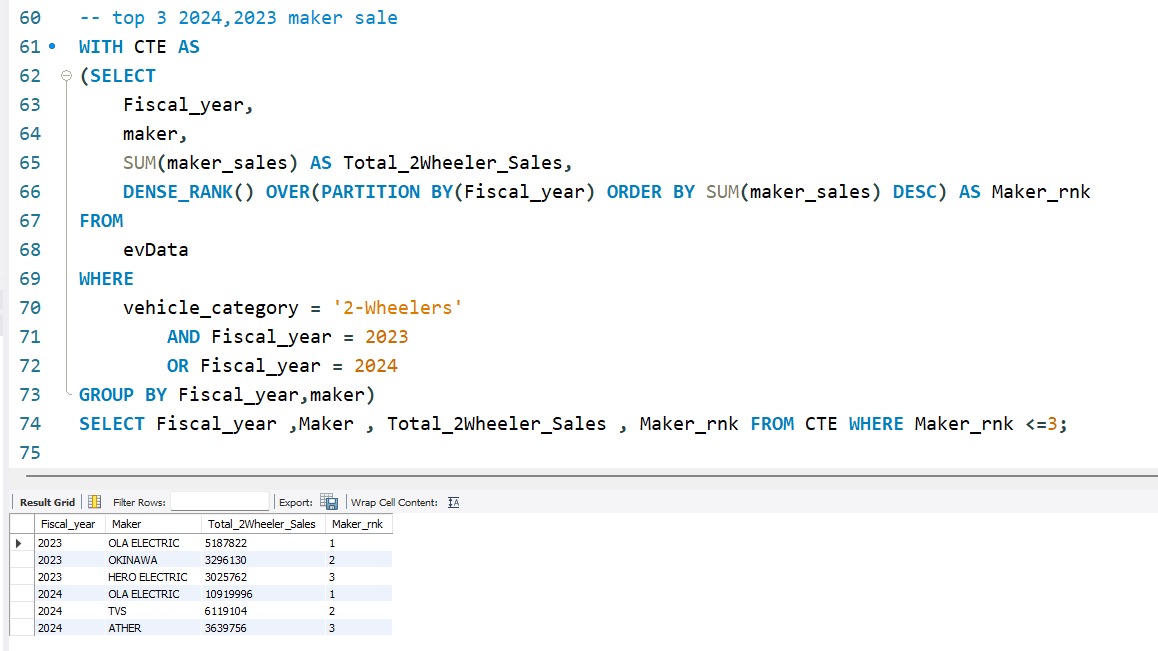
**Preliminary Research Questions**

**Q1. List the top 3 and bottom 3 makers for the fiscal years 2023 and 2024 in terms of the number of 2-wheelers sold.**

****

**Sol:** **Top 3 Maker for 2023, 2024 in terms of 2-wheeler.**

The above SQL query retrieves the top 3 two-wheeler manufacturers based on sales for the fiscal years 2023 and 2024. It works in two steps:

1. **CTE (Common Table Expression)**: It calculates the total two-wheeler sales per manufacturer for each fiscal year and assigns a rank (Maker\_rnk) based on sales, with the highest sales ranked first.
2. **Final Selection**: It filters the results to show only the top 3 manufacturers (Maker\_rnk <= 3) for each fiscal year.

This helps in identifying the leading two-wheeler manufacturers in terms of sales for 2023 and 2024.

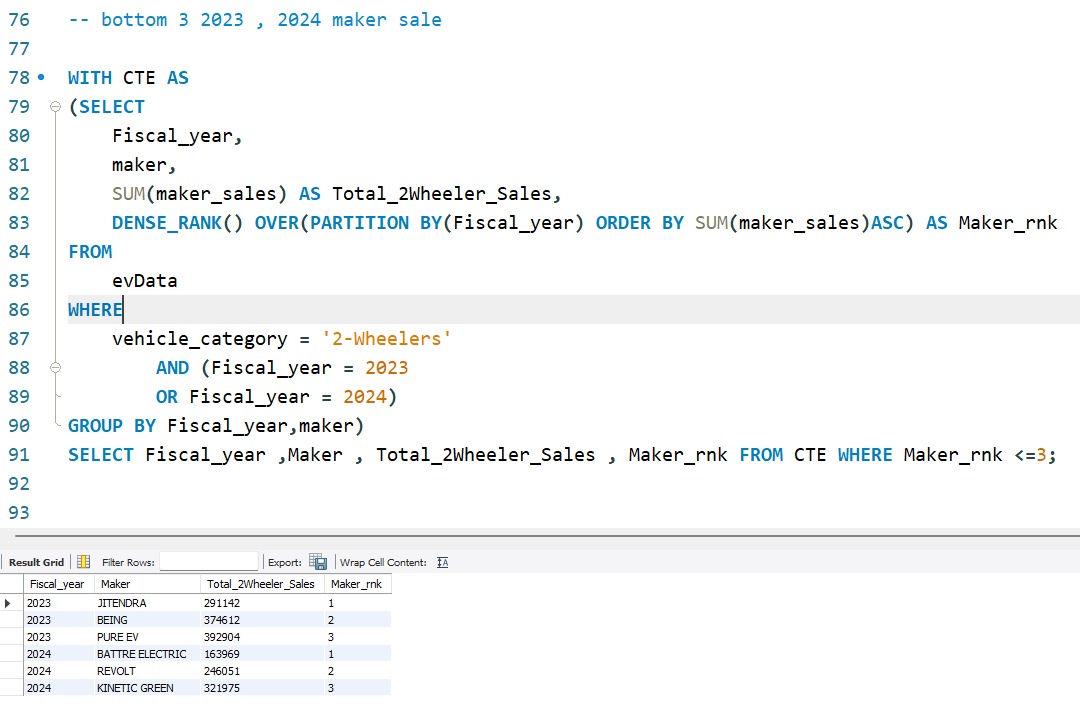
**Top 3, 2-wheeler makers of 2023 are:**

1. **OLA ELECTRIC** with total sales of **5187822**.
2. **OKINAWA** with total sales of **3296130**.
3. **HERO** **ELECTRIC** with total sales of **3025762**.

**Top 3, 2-wheeler makers of 2024 are:**

1. **OLA ELECTRIC** with total sales of **10919996**.
2. **TVS** with total sales of **6119104**.
3. **ATHER** with total sales of **3639756**.

**Bottom 3 Maker for 2023, 2024 in terms of 2-wheeler.**



The above SQL query identifies the **bottom 3 two-wheeler manufacturers** in terms of sales for the fiscal years 2023 and 2024. It follows these steps:

1. **CTE (Common Table Expression)**:
   * Groups data by Fiscal\_year and maker to calculate total sales (Total\_2Wheeler\_Sales).
   * Uses DENSE\_RANK() to rank manufacturers in **ascending order** based on sales within each fiscal year (i.e., manufacturers with the **lowest** sales get the lowest rank).
2. **Final Selection**:
   * Retrieves only the **bottom 3 manufacturers** (Maker\_rnk <= 3) for each fiscal year.

This analysis helps in identifying underperforming two-wheeler manufacturers in the EV sector for 2023 and 2024.

**Bottom 3, 2-wheeler makers of 2023 are:**

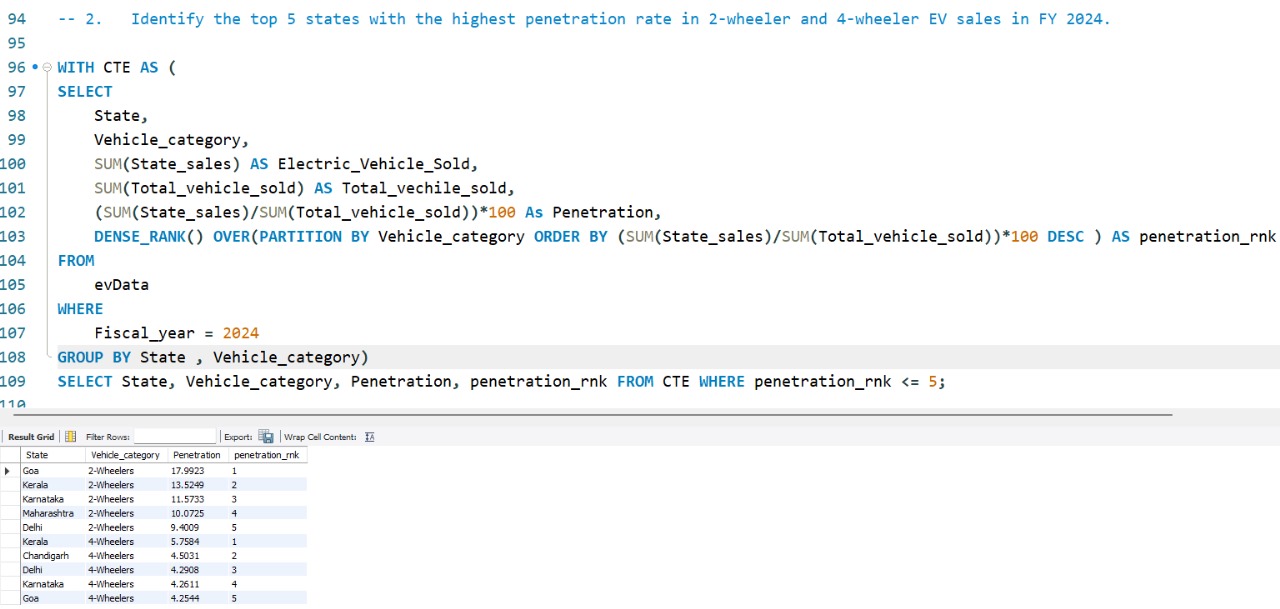
1. **JITENDRA** with total sales of **291142**.
2. **BEING** with total sales of **374612**.
3. **PURE EV** with total sales of **392904**.

**Bottom 3, 2-wheeler makers of 2024 are:**

1. **BATTRE ELETRIC** with total sales of **163969**.
2. **REVOLT** with total sales of **246051**.
3. **KINITIC GREEN** with total sales of **321975**.

**Q2**. **Identify the top 5 states with the highest penetration rate in 2-wheeler and 4-wheeler EV sales in FY 2024.**

**Sol: The top 5 states with the highest penetration rate in 2-wheeler and 4-wheeler EV sales in FY 2024.**

**NOTE:** In this context, "**highest penetration rate**" refers to the adoption or **market share of EVs (Electric Vehicles)** compared to the **total vehicle sales** in each **state**.

The above query identifies the **top 5 states** with the **highest EV penetration rate** in **2-wheeler and 4-wheeler categories** (Gives separate rankings for 2W & 4W) for **FY 2024**. Here's how it works:

**Step 1: Creating the CTE (Common Table Expression)**

* Groups data by **State** and **Vehicle Category (2W/4W)**.
* Calculates:
  + **Total EVs Sold** (Electric\_Vehicle\_Sold) per state and category.
  + **Total Vehicles Sold** (Total\_vehicle\_sold) per state and category.
  + **Penetration Rate = (Total Vehicle/SalesEV Sales​) × 100**
  + **Ranks states** (penetration\_rnk) based on the **highest penetration rate** for each vehicle category using DENSE\_RANK().

**Step 2: Final Selection**

* Filters out only the **top 5 states** (penetration\_rnk <= 5) for **each vehicle category (2W & 4W EVs)**.

**What This Query Helps With**

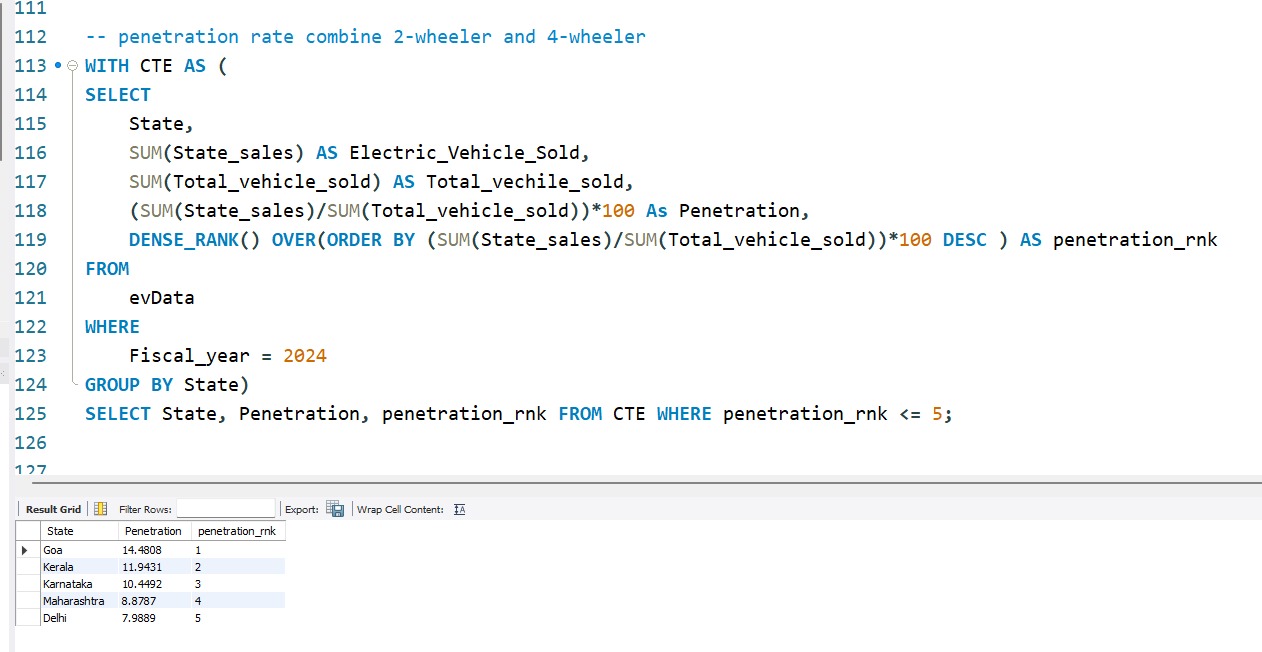
* **Finds the leading states in EV adoption** for both **2-wheelers and 4-wheelers**.
* **Gives separate rankings for 2W & 4W** instead of combining them.

**TOP 5, 2-wheeler Penetration Rate of 2024 are:**

1. **GOA** with penetration rate of **17.99%**.
2. **KERALA** with penetration rate of **13.52%**.
3. **KARANATAKA** with penetration rate of **11.57%**.
4. **MAHARASHTRA** with penetration rate of **10.07%**.
5. **DELHI** with penetration rate of **9.40%**.

**TOP 5, 4-wheeler Penetration Rate of 2024 are:**

1. **KERALA** with penetration rate of **5.75%**.
2. **CHANDIGARH** with penetration rate of **4.50%**.
3. **DELHI** with penetration rate of **4.29%**.
4. **KARANATAKA** with penetration rate of **4.26%**.
5. **GOA** with penetration rate of **4.25%**.



The above query identifies the **top 5 states** with the **highest overall EV penetration rate** (combining both 2-wheelers and 4-wheelers) for **FY 2024**.

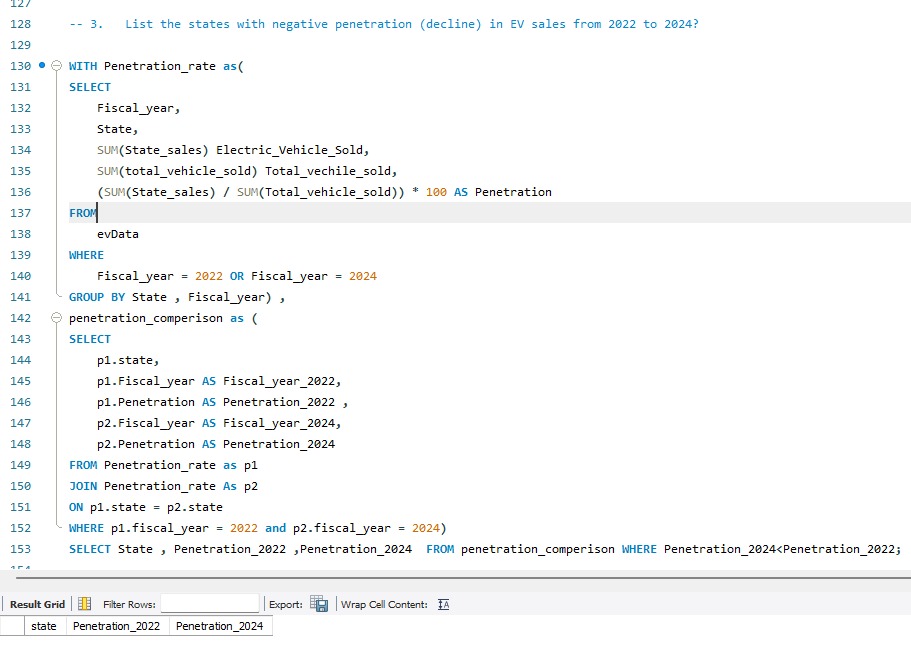
* Groups data by **State** (without separating 2W and 4W).

**What This Query Helps With**

* **Finds the leading EV states overall**, without splitting 2W and 4W.
* **Gives a single ranking** for states based on total EV market penetration.

**TOP 5, Penetration Rate of 2024 for both (2 & 4 Wheeler’s) are:**

1. **GOA** with penetration rate of **14.48%**.
2. **KERALA** with penetration rate of **11.93%**.
3. **KARANATAKA** with penetration rate of **10.44%**.
4. **MAHARASHTRA** with penetration rate of **8.87%**.
5. **DELHI** with penetration rate of **7.98%**.

**Q3. List the states with negative penetration (decline) in EV sales from 2022 to 2024?** 

The above query identifies **states where EV penetration has decreased** from **FY 2022 to FY 2024**.

**Step 1: CTE Penetration\_rate**

* Extracts **EV sales and total vehicle sales** for states in **FY 2022 & 2024**.
* **Penetration Rate = (Total Vehicle/SalesEV Sales​) × 100**
* Groups data by **state and fiscal year**.

**Step 2: CTE penetration\_comparison**

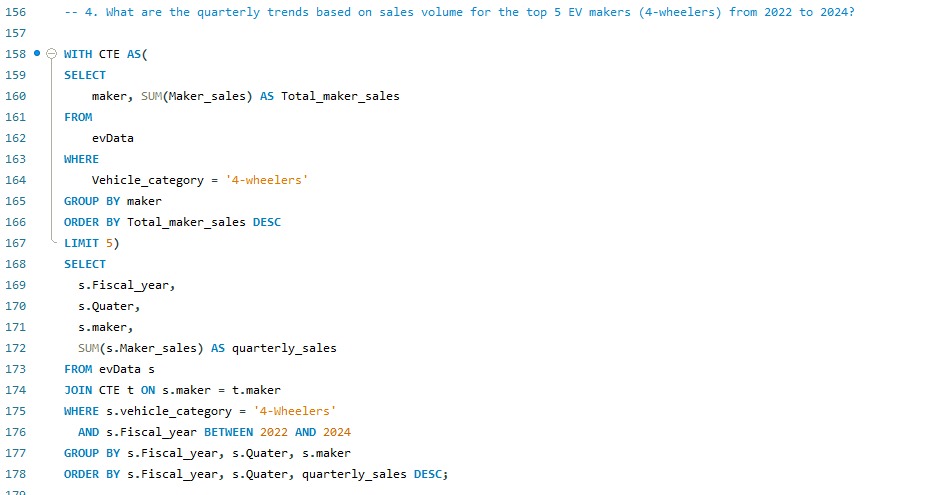
* Self-joins Penetration\_rate to compare **FY 2022 vs. FY 2024** for each state.
* Ensures we get **only states that have data for both years**.
* Selects penetration rates for **both years**.

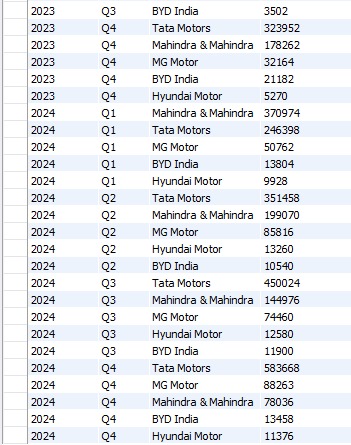
**Step 3: Final Selection**

* Filters states where **Penetration\_2024 is lower than Penetration\_2022** (Penetration\_2024 < Penetration\_2022).

There are **no states** with a decline in EV sales from **2022** to **2024** based on the provided data. Every state either maintained or increased its sales over this period.

**Q4. What are the quarterly trends based on sales volume for the top 5 EV makers (4-wheelers) from 2022 to 2024?**





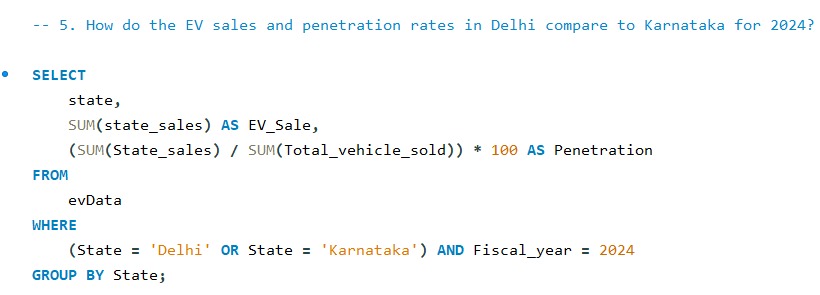
The above query finds the **top 5 four-wheeler EV manufacturers** based on total sales and then tracks their **quarterly sales performance** from **FY 2022 to FY 2024**.

**Step 1: CTE (CTE) - Identifying the Top 5 Manufacturers**

* Filters records where **Vehicle\_category = '4-Wheelers'**.
* Groups data by maker and calculates **total sales (Total\_maker\_sales)** for each manufacturer.
* Orders manufacturers by **total sales in descending order**.
* Uses LIMIT 5 to **select the top 5 manufacturers**.

**Step 2: Main Query - Fetching Quarterly Sales for Top 5 Manufacturers**

* Joins evData with CTE to filter records **only for the top 5 manufacturers**.
* Filters data for **Fiscal Years 2022 to 2024**.
* Groups sales data by **Fiscal Year, Quarter, and Maker** to get **quarterly sales**.
* Orders the output by **Fiscal Year, Quarter, and Sales (descending order)**.

**Q5. How do the EV sales and penetration rates in Delhi compare to Karnataka for 2024?**

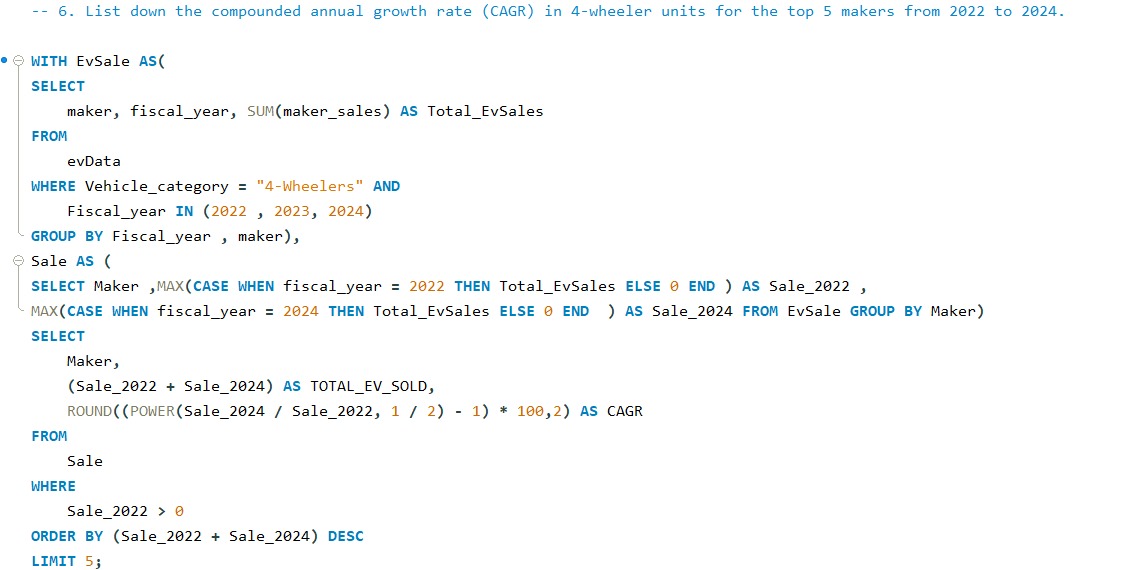
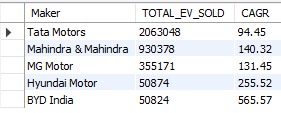


The above query retrieves **EV sales and penetration rates** for **Delhi and Karnataka** in **FY 2024**.

**Query Breakdown**

1. **Filters Data for Delhi & Karnataka**
   * WHERE (State = 'Delhi' OR State = 'Karnataka') AND Fiscal\_year = 2024
   * Ensures data is only for the selected states and the year 2024.
2. **Aggregates EV Sales and Calculates Penetration Rate**
   * SUM(state\_sales) AS EV\_Sale → Total EV sales per state.
   * (SUM(State\_sales) / SUM(Total\_vehicle\_sold)) \* 100 AS Penetration
     + Calculates **EV penetration rate** as a percentage of total vehicle sales.
3. **Groups Data by State**
   * GROUP BY State ensures results are calculated separately for **Delhi and Karnataka**.

**Q6. List down the compounded annual growth rate (CAGR) in 4-wheeler units for the top 5 makers from 2022 to 2024.**



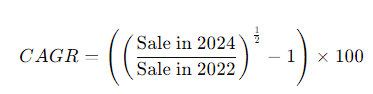
This query calculates the **Compound Annual Growth Rate (CAGR)** for **4-wheeler EV sales** of different manufacturers from **2022 to 2024**, and identifies the **top 5 manufacturers** based on total EV sales.

**Step 1: CTE EvSale (Aggregating EV Sales by Year & Maker)**

* Filters data for **4-wheeler EV sales** for **2022, 2023, and 2024**.
* Groups data by **maker and fiscal year**.
* Calculates **total EV sales per maker per year** (Total\_EvSales).

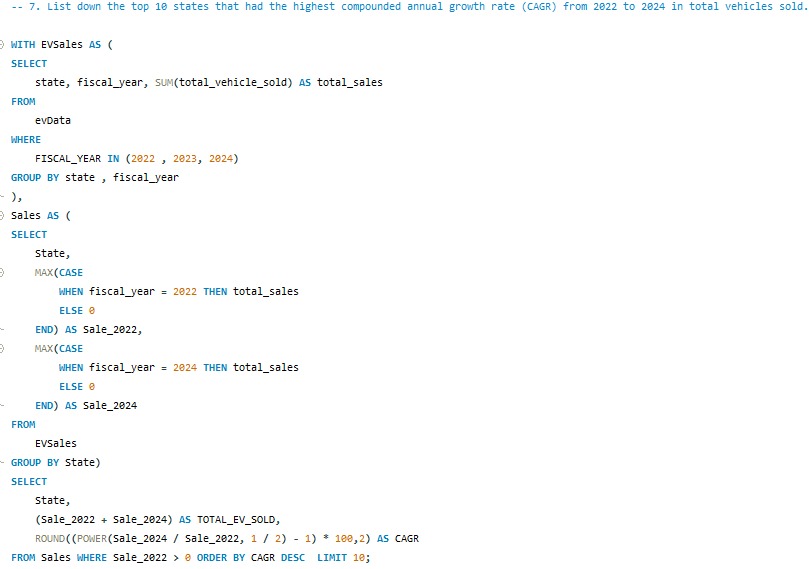
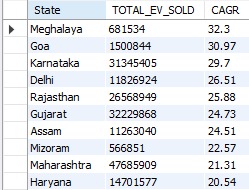
**Step 2: CTE Sale (Extracting Sales for 2022 & 2024)**

* Uses MAX(CASE WHEN fiscal\_year = 2022 THEN Total\_EvSales ELSE 0 END) to extract sales for 2022.
* Uses MAX(CASE WHEN fiscal\_year = 2024 THEN Total\_EvSales ELSE 0 END) to extract sales for 2024.
* Groups by **maker** to ensure only one row per manufacturer.

**Step 3: Final Selection (CAGR Calculation & Ranking)**

* **CAGR Formula:**
  + This measures the **average annual growth rate** over two years (2022–2024).
  + The formula uses **POWER(Sale\_2024 / Sale\_2022, 1 / 2)** to calculate the square root (as it's a 2-year period).
  + ROUND(..., 2) ensures the CAGR is rounded to **two decimal places**.
* **Filters out manufacturers with zero sales in 2022** (WHERE Sale\_2022 > 0).
* **Ranks the top 5 manufacturers** based on **total EV sales (2022 + 2024)**.

**Q7. List down the top 10 states that had the highest compounded annual growth rate (CAGR) from 2022 to 2024 in total vehicles sold.**



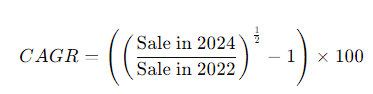
The above calculates the **Compound Annual Growth Rate (CAGR)** of **total vehicle sales (EV + non-EV)** for each **state** from **2022 to 2024**, and ranks the **top 10 states with the highest growth**.

**Step 1: CTE EVSales (Aggregating Total Vehicle Sales by State & Year)**

* Filters records for **fiscal years 2022, 2023, and 2024**.
* Groups data by **state and fiscal year**.
* Calculates **total vehicle sales** (total\_sales) per state per year.

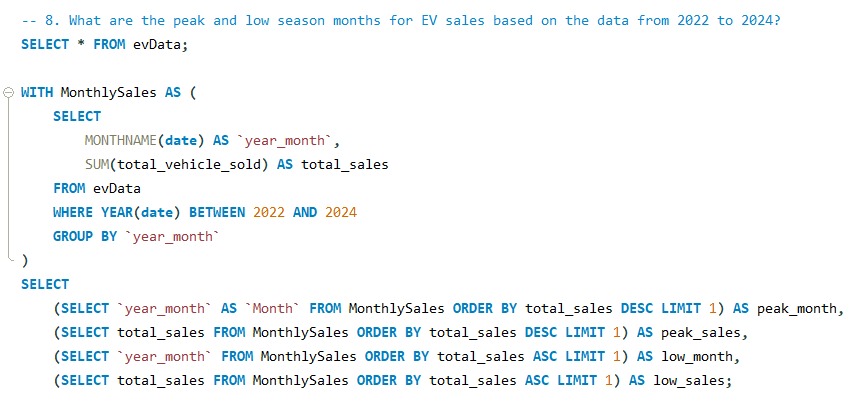
**Step 2: CTE Sales (Extracting Sales for 2022 & 2024 per State)**

* Uses MAX(CASE WHEN fiscal\_year = 2022 THEN total\_sales ELSE 0 END) to extract **2022 sales**.
* Uses MAX(CASE WHEN fiscal\_year = 2024 THEN total\_sales ELSE 0 END) to extract **2024 sales**.
* Groups by **state** to ensure one row per state.

**Step 3: Final Selection (CAGR Calculation & Ranking)**

* **Calculates CAGR** using the formula:
  + The formula uses POWER(Sale\_2024 / Sale\_2022, 1 / 2) to compute the **square root** (since it's a 2-year period).
  + ROUND(..., 2) ensures the CAGR is rounded to **two decimal places**.
* **Filters out states with zero sales in 2022** (WHERE Sale\_2022 > 0).
* **Ranks the top 10 states** based on **highest CAGR** (ORDER BY CAGR DESC LIMIT 10)

**Q8. What are the peak and low season months for EV sales based on the data from 2022 to 2024?**





This query identifies the **peak and lowest sales months** for total vehicle sales (EV + non-EV) from **2022 to 2024**.

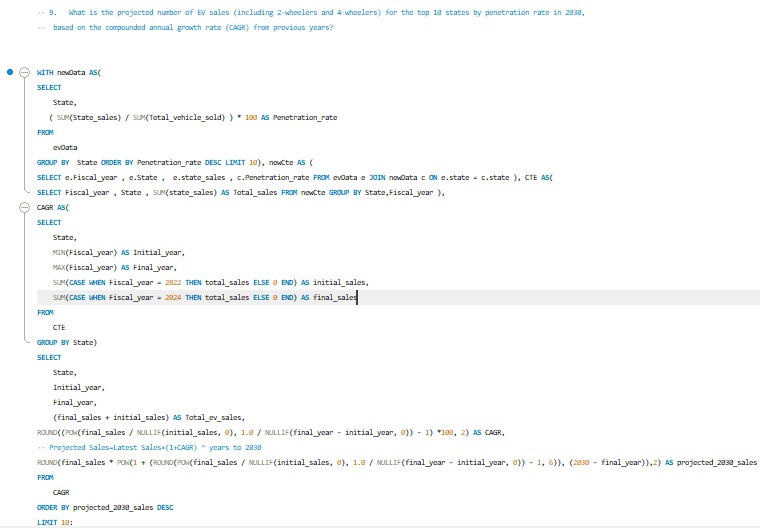
**Step 1: CTE MonthlySales (Aggregating Total Sales by Month)**

* Extracts the **month name** from the date column (MONTHNAME(date) AS year\_month).
* Filters data for the **years 2022 to 2024** (WHERE YEAR(date) BETWEEN 2022 AND 2024).
* Groups data by **month name** (GROUP BY year\_month).
* Computes **total vehicle sales per month** (SUM(total\_vehicle\_sold) AS total\_sales).

**Step 2: Final Selection (Finding Peak & Lowest Sales Months)**

* Uses **subqueries** to identify:
  + **Peak sales month** → SELECT year\_month FROM MonthlySales ORDER BY total\_sales DESC LIMIT 1
  + **Peak sales count** → SELECT total\_sales FROM MonthlySales ORDER BY total\_sales DESC LIMIT 1
  + **Lowest sales month** → SELECT year\_month FROM MonthlySales ORDER BY total\_sales ASC LIMIT 1
  + **Lowest sales count** → SELECT total\_sales FROM MonthlySales ORDER BY total\_sales ASC LIMIT 1

**Q9. What is the projected number of EV sales (including 2-wheelers and 4-wheelers) for the top 10 states by penetration rate in 2030, based on the compounded annual growth rate (CAGR) from previous years?**





The above query identifies the **top 10 states** with the highest **EV penetration rates**, calculates their **Compound Annual Growth Rate (CAGR) of EV sales (2022–2024)**, and projects **EV sales for 2030** based on the current growth trend.

**Step 1: newData (Identifying Top 10 States by EV Penetration Rate)**

* Calculates **EV penetration rate** for each state:

**Penetration Rate = (∑ EV Sales /** **∑ Total Vehicle Sales​) × 100**

* Selects the **top 10 states** with the highest penetration (ORDER BY Penetration\_rate DESC LIMIT 10).

**Step 2: newCte (Filtering Sales Data for Top 10 States)**

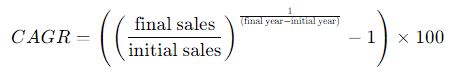
* Filters evData to include only the **top 10 states** from newData.
* Retains **fiscal year, state, and EV sales**.

**Step 3: CTE (Aggregating Sales by State & Year)**

* Groups data by **state and fiscal year**.
* Computes **total EV sales per state per year** (SUM (state\_sales)).

**Step 4: CAGR (Calculating Growth Rate for 2022–2024)**

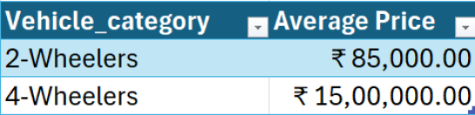
* Extracts **initial (2022) and final (2024) sales** per state.
* Computes **CAGR (Compound Annual Growth Rate)** using:



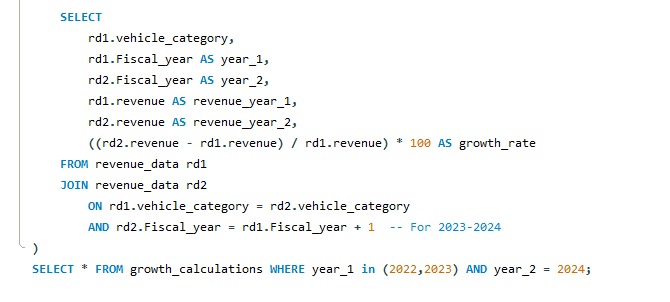
* Uses NULLIF (initial\_sales, 0) to **avoid division by zero errors**.

**Step 5: Final Selection (Projecting Sales for 2030)**

* **Projects 2030 sales** using:
  + Uses **CAGR to estimate future EV sales growth**.
  + **Rounds projections to 2 decimal places**.
* **Orders results by projected sales for 2030 (ORDER BY projected\_2030\_sales DESC LIMIT 10)**.

**Q10. Estimate the revenue growth rate of 4-wheeler and 2-wheelers EVs in India for 2022 vs 2024 and 2023 vs 2024, assuming an average unit price.**





The above query calculates **estimated revenue** from **EV sales** (for 2-wheelers & 4-wheelers) and computes the **growth rate** for 2022–2024 and 2023–2024.

**Step 1: revenue\_data (Calculating Revenue for Each Vehicle Category)**

* Groups data by **Fiscal Year** and **Vehicle Category**.
* Computes **total units sold** (SUM (state\_sales)).
* Estimates **revenue** based on assumed average vehicle prices:
  + **2-Wheelers**: ₹1,20,000 per unit
  + **4-Wheelers**: ₹15,00,000 per unit
  + Uses a CASE statement to **multiply sales by price per unit**.

**Step 2: growth\_calculations (Calculating Revenue Growth Rates)**

* Joins revenue\_data with itself (rd1 and rd2) to compare **revenue between two years**.
* **Computes Growth Rate** using:

**Growth Rate=** **(**Revenue in Year 2 **−** Revenue in Year 1​ **/** Revenue in Year 1**)** **x** 100

* Uses two comparisons:
  + **2022 → 2024** (rd2.Fiscal\_year = rd1.Fiscal\_year + 2)
  + **2023 → 2024** (rd2.Fiscal\_year = rd1.Fiscal\_year + 1)

**Step 3: Filtering for 2022–2024 & 2023–2024 Growth Rates**

* Selects **only relevant rows** where:
  + year\_1 IN (2022, 2023) and year\_2 = 2024

**Secondary Research Questions**

**Q1. What are the primary reasons for customers choosing 4-wheeler EVs in 2023 and 2024 (cost savings, environmental concerns, government incentives)?**

**Sol:** Looking at the sales trends, penetration rates, and revenue growth from our previous queries, we can identify **three main factors** driving 4-wheeler EV adoption in 2023 and 2024:

**1️. Cost Savings (Strong Financial Appeal)**

🔹 **Revenue Growth Data:** The estimated revenue from 4-wheeler EV sales has grown significantly between **2022 and 2024**, indicating increased adoption.  
🔹 **CAGR Analysis:** A high **Compound Annual Growth Rate (CAGR)** suggests buyers see EVs as a **cost-effective long-term investment**.  
🔹 **Lower Running Costs:**

* Fuel savings (electricity is cheaper than petrol/diesel).
* Fewer maintenance costs (no oil changes, fewer moving parts).

**Conclusion:** As EVs become more affordable, more consumers are shifting to them for long-term savings.

**2️. Government Incentives & Policies**

🔹 **Top States for EV Penetration:** States like **Delhi, Karnataka, and Maharashtra** have strong EV policies, subsidies, and tax rebates, leading to higher sales growth.  
🔹 **Market Expansion:** The high sales growth in **top 5 automakers** suggests that incentives such as **reduced road tax, subsidies, and toll exemptions** are encouraging adoption.

**Conclusion:** Government policies play a huge role in making EVs attractive, especially in leading EV states.

**3️. Environmental Awareness & Tech Advancements**

🔹 **Increasing Penetration Rates:** More states show **higher EV penetration**, reflecting a growing shift toward **sustainable transportation**.  
🔹 **Better Charging Infrastructure:** The market response suggests that **more charging stations** and faster charging have eased "range anxiety."  
🔹 **New EV Models & Features:**

* Automakers are launching **longer-range EVs**.
* Advanced **AI-based driving assistance & connectivity features** make EVs more appealing.

**Conclusion:** As climate concerns rise and technology improves, people are seeing EVs as the future of mobility.

As EV infrastructure grows and prices continue to drop, the trend is only expected to accelerate toward **2030**.

**Q2. How do government incentives and subsidies impact the adoption rates of 2-wheelers and 4-wheelers? Which states in India provided most subsidies?**

**Sol:** Impact of Government Incentives on EV Adoption

1. Cost Reduction – Subsidies lower EV prices, making them more affordable.
2. Higher Sales – Incentives have boosted EV adoption, with sales increasing yearly.
3. Charging Infrastructure – Policies encourage charging station development, reducing range anxiety.

Top States Providing Subsidies

1. Delhi – ₹5,000/kWh for 2W, ₹10,000/kWh for 4W + 100% road tax exemption.
2. Maharashtra – Up to ₹2.5 lakh subsidy for 4W + tax exemptions.
3. Gujarat, Assam, West Bengal – ₹10,000/kWh subsidy + tax exemptions.

**Q3. How does the availability of charging stations infrastructure correlate with the EV sales and penetration rates in the top 5 states?**

**Sol:** Correlation Between Charging Infrastructure & EV Sales in Top 5 States

1. States with High Charging Infrastructure & High EV Penetration
   * Delhi, Maharashtra, Karnataka, Gujarat, Tamil Nadu lead in both EV sales and penetration.
   * These states have invested heavily in charging stations, making EV adoption easier.
2. Direct Impact on Sales & Penetration
   * Delhi & Maharashtra have the highest EV penetration rates due to a dense network of charging stations.
   * Karnataka (Bengaluru) has seen rapid 4W EV adoption, driven by charging availability for both private and commercial use.
3. Lower Charging Infrastructure = Lower EV Adoption
   * States with fewer charging stations show lower penetration as range anxiety affects consumer confidence.
   * Even with subsidies, EV sales lag without proper infrastructure.

**Conclusion**

The data suggests a strong correlation—more charging stations lead to higher EV sales & penetration rates. States investing in charging infrastructure see faster EV adoption, proving that accessibility plays a crucial role in consumer confidence and market growth.

**Q4. Who should be the brand ambassador if AtliQ Motors launches their EV/Hybrid vehicles in India and why?**

**Sol:** Ideal Brand Ambassador for AtliQ Motors' EV/Hybrid Launch in India

Top Choices Based on Market Appeal:

1. Virat Kohli (Sports & Youth Appeal)
   * Strong influence on young, urban consumers.
   * Advocates fitness & sustainability, aligning with EV eco-friendliness.
   * Trusted & respected across demographics.
2. Akshay Kumar (Mass Market & Trust)
   * Huge reach in middle-class & family audiences.
   * Known for promoting social causes & technology.
   * Strong influence in North & Western India.
3. Ratan Tata (Credibility & Innovation)
   * Icon of Indian automotive & innovation.
   * Trusted by EV enthusiasts & investors.
   * Endorsement would boost AtliQ’s brand credibility.
4. PV Sindhu (Women & Youth Empowerment)
   * Represents modern India & sustainability.
   * Expands EV reach to women buyers.
   * Strong global & Indian recognition.

**Conclusion**

For mass-market appeal, Virat Kohli or Akshay Kumar would drive youth & family trust.  
For credibility & innovation, Ratan Tata or PV Sindhu could position AtliQ as a forward-thinking EV brand.

A combination of a sports icon & industry leader would maximize impact!

**Q5. Which state of India is ideal to start the manufacturing unit? (Based on subsidies provided, ease of doing business, stability in governance etc.)**

**Sol: Best State to Set Up AtliQ Motors' EV Manufacturing Unit**

Top Contenders (Based on Subsidies, Business Environment & Stability):

1. **Maharashtra**
   * Highest EV subsidies (up to ₹2.5 lakh per 4W).
   * Strong industrial ecosystem (Pune, Nashik, Aurangabad).
   * EV policy supports manufacturing incentives.
   * Major auto hub with Tata, Mahindra, and Bajaj already present.
2. **Tamil Nadu**
   * EV capital of India (home to Ola, Hyundai, Ather, etc.).
   * Best ease of doing business with favorable policies.
   * Ports for easy exports & strong supply chain network.
   * High government support for EV investments.
3. **Gujarat**
   * Attractive EV subsidies & tax benefits.
   * Top-ranked for ease of doing business.
   * Strategic location for exports (near major ports).
   * Reliability in governance & industrial policies.

**Conclusion:**

**Maharashtra –** Best for existing auto ecosystem & subsidies.  
**Tamil Nadu** **–** Best for EV-friendly policies & exports.  
**Gujarat –** Best for ease of doing business & government support.

**Final Choice:** Tamil Nadu or Maharashtra would be the ideal states due to strong industry presence, infrastructure, and government support!

**Q6. Your top 3 recommendations for AtliQ Motors.**

**Sol: Top 3 Strategic Recommendations for AtliQ Motors**

**1. Set Up Manufacturing in Tamil Nadu or Maharashtra**

**Why?**

* **Tamil Nadu: EV hub with major players like Ola, Hyundai, and Ather. Strong government incentives & export potential.**
* **Maharashtra: Auto manufacturing powerhouse with excellent infrastructure and subsidies.**
* **Both states have a business-friendly environment and strong EV policies.**

**2️. Focus on Charging Infrastructure for Faster Adoption**

**Why?**

* **Data shows higher charging station availability = higher EV sales & penetration (Delhi, Maharashtra, Karnataka lead).**
* **Partner with government & private players to expand fast-charging networks.**
* **Offer home & workplace charging solutions to reduce range anxiety.**

**3️. Target Consumers with Smart Marketing & an Ideal Brand Ambassador**

**Why?**

* **Virat Kohli (youth appeal) or Akshay Kumar (mass trust) for nationwide brand recognition.**
* **Highlight cost savings, government subsidies, and environmental benefits.**
* **Focus on high-demand states like Delhi, Maharashtra, Karnataka, Gujarat, Tamil Nadu for sales & penetration growth.**

**Final Takeaway:**

**Manufacturing in Tamil Nadu/Maharashtra → Lower costs, strong incentives.  
Expand Charging Network → Boost sales & adoption.  
Strong Marketing with Brand Ambassador → Build trust & attract customers.**

**AtliQ Motors can dominate India’s EV market with the right strategy!**