

# Data Analysis Of EV Sales In India 2014-2024



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September 23, 2025

As a part of my online 4 month internship at [Unified Mentor Private Limited](#), I have been given various datasets to perform data analysis, data manipulation and data visualization on them.

As a part of this project, I have chosen to perform these tasks on the Electric Vehicle Sales by State in India for the years 2014-2024. I analyzed, cleaned, manipulated, modelled and visualized over 96,800 rows of data across 8 columns in a dataset. Various data pivots were created in order to dive deeper into the insights of the data provided.

The data analysis, modelling, manipulation tasks were primarily carried out using [Microsoft SQL Server](#). I also used [Microsoft Copilot](#) for debugging my query for errors, showcasing my skills as a Data Analyst as well as Artificial Intelligence prompt query writing.

The data visualization was performed using [Power BI](#) as my primary go to tool in order to explore and validate my skills in the requisite visualization tool. I have been using primarily Tableau for data visualization till this project, in order to build a strong foundation for my future endeavors in complex data visualization using other tools like Microsoft Power-BI and Google Looker Studio.

## **Methodology**

- Data Cleaning, Preparation and Manipulation:- Microsoft SQL Server was used primarily for verification of data integrity, accuracy, cleaning, preparing and manipulating data for further analysis. All the null values were removed as a part of the data cleaning process. The schema of all the columns of data was checked in order to process the data for further manipulation.

```

1
2
3
4 SELECT *
5 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
6
7
8
9
10
11

```

|       | years | month_name | dated      | state_name      | vehicle_class                | vehicle_category | vehicle_type | ev_sales_quantity |
|-------|-------|------------|------------|-----------------|------------------------------|------------------|--------------|-------------------|
| 96812 | 2023  | dec        | 2023-12-01 | Delhi           | MAXI CAB                     | Others           | Others       | 0                 |
| 96813 | 2023  | dec        | 2023-12-01 | Delhi           | M-CYCLE/SCOOTER              | 2-Wheelers       | 2W_Personal  | 5380              |
| 96814 | 2023  | dec        | 2023-12-01 | Delhi           | M-CYCLE/SCOOTER-WITH SIDE... | 2-Wheelers       | 2W_Personal  | 0                 |
| 96815 | 2023  | dec        | 2023-12-01 | Delhi           | MOPED                        | 2-Wheelers       | 2W_Personal  | 0                 |
| 96816 | 2023  | dec        | 2023-12-01 | Delhi           | MOTOR CAB                    | 4-Wheelers       | 4W_Shared    | 84                |
| 96817 | 2023  | dec        | 2023-12-01 | Delhi           | MOTOR CAR                    | 4-Wheelers       | 4W_Personal  | 727               |
| 96818 | 2023  | dec        | 2023-12-01 | Delhi           | THREE WHEELER (GOODS)        | 3-Wheelers       | 3W_Goods     | 681               |
| 96819 | 2023  | dec        | 2023-12-01 | Delhi           | THREE WHEELER (PASSENGER)    | 3-Wheelers       | 3W_Shared    | 8                 |
| 96820 | 2023  | dec        | 2023-12-01 | Goa             | ADAPTED VEHICLE              | Others           | Others       | 0                 |
| 96821 | 2023  | dec        | 2023-12-01 | Goa             | AGRICULTURAL TRACTOR         | Others           | Others       | 0                 |
| 96822 | 2023  | dec        | 2023-12-01 | Goa             | BUS                          | Bus              | Bus          | 6                 |
| 96823 | 2023  | dec        | 2023-12-01 | Goa             | CONSTRUCTION EQUIPMENT V...  | Others           | Others       | 0                 |
| 96824 | 2023  | dec        | 2023-12-01 | Goa             | GOODS CARRIER                | Others           | Others       | 4                 |
| 96825 | 2023  | dec        | 2023-12-01 | Goa             | HEARSES                      | Others           | Others       | 0                 |
| 96826 | 2023  | dec        | 2023-12-01 | Goa             | MAXI CAB                     | Others           | Others       | 0                 |
| 96827 | 2023  | dec        | 2023-12-01 | Goa             | M-CYCLE/SCOOTER              | 2-Wheelers       | 2W_Personal  | 799               |
| 96828 | 2023  | dec        | 2023-12-01 | Goa             | MOTOR CAB                    | 4-Wheelers       | 4W_Shared    | 0                 |
| 96829 | 2023  | dec        | 2023-12-01 | Goa             | MOTOR CAR                    | 4-Wheelers       | 4W_Personal  | 71                |
| 96830 | 2023  | dec        | 2023-12-01 | Goa             | MOTOR CYCLE/SCOOTER-SIDE...  | Others           | Others       | 0                 |
| 96831 | 2023  | dec        | 2023-12-01 | Goa             | MOTOR CYCLE/SCOOTER USE...   | 2-Wheelers       | 2W_Shared    | 0                 |
| 96832 | 2023  | dec        | 2023-12-01 | Goa             | THREE WHEELER (GOODS)        | 3-Wheelers       | 3W_Goods     | 0                 |
| 96833 | 2023  | dec        | 2023-12-01 | Goa             | THREE WHEELER (PASSENGER)    | 3-Wheelers       | 3W_Shared    | 2                 |
| 96834 | 2023  | dec        | 2023-12-01 | Goa             | THREE WHEELER (PERSONAL)     | 3-Wheelers       | 3W_Personal  | 1                 |
| 96835 | 2023  | dec        | 2023-12-01 | Andaman & Ni... | CONSTRUCTION EQUIPMENT V...  | Others           | Others       | 0                 |
| 96836 | 2023  | dec        | 2023-12-01 | Andaman & Ni... | GOODS CARRIER                | Others           | Others       | 0                 |
| 96837 | 2023  | dec        | 2023-12-01 | Andaman & Ni... | MAXI CAB                     | Others           | Others       | 0                 |

## Data Cleaning

- During the process of data preparation, I noticed that few of the column headers were clashing with the syntaxes of Microsoft SQL. In order to avoid this I renamed all the clashing column headers and also ran data validation for all NULL and missing values.
- For my Data Manipulation, I found out that the data provided is large, vague and not insightful for data visualization, presentation, recommendations. In order to make the data more readily available for easier and quicker analysis, I went ahead and performed data pivoting operations of various kind to gain more insights. During this process I had a question in my mind "What if the dataset gets updated later on? How can I automate this process based on data being updated automatically at backend?". Hence, I discovered Dynamic SQL for data calling which pulls and pivots the data in real time automatically, regardless of the data being updated any number of time.

```

1  SELECT *
2  FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
3
4  --1 pivoting by vehicle class and total sales code
5
6  SELECT
7  state_name,
8  vehicle_class,
9  SUM(ev_sales_quantity) AS total_ev_sales_per_state
10 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
11 GROUP BY state_name, vehicle_class
12 ORDER BY state_name ASC, total_ev_sales_per_state DESC
13 --1 pivoting by vehicle class and total sales code
14 --2 pivoting based on sale per year for each state
15 SELECT *
16 FROM(
17 SELECT years, state_name, ev_sales_quantity
18 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
19 ) AS source_table
20 PIVOT(
21 SUM(ev_sales_quantity)
22 FOR years IN ([2014],[2015],[2016],[2017],[2018],[2019],[2020],[2021],[2022],[2023])
23 )AS pivot_table
24 ORDER BY state_name;
25 --2 pivoting based on sale per year for each state
26 --3 pivoting based on sum of all vehicles per vehicle categories per state
27 SELECT *
28 FROM(
29 SELECT state_name, vehicle_category, ev_sales_quantity
30 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
31 ) AS source_table
32 PIVOT(
33 SUM(ev_sales_quantity)
34 FOR vehicle_category IN ([Others],[Bus],[2-Wheelers],[4-Wheelers],[3-Wheelers])
35 ) AS pivot_vehiclecategory_evsalesquantity
36 ORDER BY state_name;
37 --3 pivoting based on sum of all vehicles per vehicle categories per state
38 --4 Dynamic pivot of ev sales by state per year
39

```

```

40 DECLARE @total_per_sate_per_year NVARCHAR(MAX),
41         @no_of_years NVARCHAR(MAX),
42         @new_pivot_table_per_state_per_year NVARCHAR(MAX);
43 --Get sum of all years of sales into one column dynamically
44 SELECT @total_per_sate_per_year = STRING_AGG(QUOTENAME(years), '+')
45 FROM
46 ( SELECT DISTINCT years
47 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
48 ) AS sum_of_years;
49 --Get all the years inserted dynamically into columns
50 SELECT @no_of_years = STRING_AGG(QUOTENAME(years), ',')
51 FROM(
52 SELECT DISTINCT years
53 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
54 ) AS aggregated_years;
55 --Create Dynamic SQL pivot as new_pivot_table_per_state_per_year
56 SET @new_pivot_table_per_state_per_year =
57 '
58 SELECT state_name, ' + @no_of_years + ', ' + @total_per_sate_per_year + ' AS sum_of_all_years_sales
59 FROM
60 (SELECT state_name,
61 years,
62 ev_sales_quantity
63 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
64 ) AS primary_table_for_pivot
65 PIVOT(
66 SUM(ev_sales_quantity) FOR years IN (' + @no_of_years + ')
67 ) AS pivoted_table
68 ORDER BY state_name;
69 '
70 EXEC sp_executesql @new_pivot_table_per_state_per_year
71 --4 Dynamic pivot of ev sales by state per year
72 --5 Dynamic pivot of ev sales per state per vehicle types
73

```

```

76 DECLARE
77 @total_vehicle_sales_alltypes NVARCHAR(MAX),
78 @vehicle_types NVARCHAR(MAX),
79 @pivoted_table_statewise NVARCHAR(MAX)
80
81 SELECT @total_vehicle_sales_alltypes = STRING_AGG('ISNULL(' + QUOTENAME(vehicle_type) + ', 0)', ' + ')
82 FROM(
83 SELECT DISTINCT vehicle_type
84 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
85 ) AS vehicles_aggregated
86
87 SELECT @vehicle_types = STRING_AGG(QUOTENAME(vehicle_type), ',')
88 FROM(
89 SELECT DISTINCT vehicle_type
90 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
91 ) AS vehicle_types_aggregated;
92
93 SET @pivoted_table_statewise =
94 '
95 SELECT state_name, ' + @vehicle_types + ', ' + @total_vehicle_sales_alltypes + ' AS total_sales
96 FROM(
97 SELECT state_name, vehicle_type, ev_sales_quantity
98 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
99 ) AS primary_table
100 PIVOT
101 ( SUM(ev_sales_quantity) FOR vehicle_type IN (' + @vehicle_types + ')
102 ) AS pivoted_table
103 ORDER BY state_name;
104 '
105 EXEC sp_executesql @pivoted_table_statewise
106 --5 Dynamic pivot of ev sales per state per vehicle types
107

```

```
109 --6 Dynamic pivot of yearly ev sales based on vehicle category
110
111 DECLARE @vehicle_sales_yearly NVARCHAR(MAX) , @total_vehicle_sales NVARCHAR(MAX) , @pivot_table_vehicle_type NVARCHAR(MAX)
112
113 SELECT @vehicle_sales_yearly = STRING_AGG(QUOTENAME(years), ',')
114 FROM
115 (
116 SELECT DISTINCT years
117 FROM [ev_sales_india_project].dbo.ev_sales_statewise_india
118 ) AS years_aggregated_for_pivot;
119
120 SELECT @total_vehicle_sales = STRING_AGG(QUOTENAME(years), '+')
121 FROM
122 (SELECT DISTINCT years
123 FROM [ev_sales_india_project].dbo.ev_sales_statewise_india
124 ) AS total_years_aggregated
125
126 SET @pivot_table_vehicle_type = '
127 SELECT vehicle_category , ' + @vehicle_sales_yearly + ' , ' + @total_vehicle_sales+ ' AS total_vehicle_sales
128 FROM
129 (
130 SELECT
131 vehicle_category,
132 years,
133 ev_sales_quantity
134 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india]
135 ) AS primary_source_table
136 PIVOT
137 ( SUM(ev_sales_quantity) FOR years IN (' + @vehicle_sales_yearly+ ' )
138 ) AS pivoted_table
139 ORDER BY vehicle_category;
140
141 EXEC sp_executesql @pivot_table_vehicle_type
142 --6 Dynamic pivot of yearly ev sales based on vehicle category
143
144
```

SQL Server Enterprise Edition (64-bit) - SQL Query (74) | SQL Query2.s...hunte (67) | SQL Query1.sql...20/hunte (72) | SQL Query piv...20/hunte (71)

Object Explorer: Connect to server: SINISTIR-MSI-20 (SQL Server 16.0.1000.6) | Databases: bellabeat\_project, coca\_cola\_project, cyclistic\_practice, ev\_sales\_india\_project, Database Diagrams, Tables, System Tables, FileTables, External Tables, Graph Tables, dbo.ev\_sales\_statewise\_india, Dropped Ledger Tables, Views, External Resources, Synonyms, Programmability, Query Store, Service Broker, Storage, Security, Server Objects, Replication, Always On High Availability, Management, SQL Server Agent (Agent XPs disabled), XEvent Profiler

SQL Query (74) | SQL Query2.s...hunte (67) | SQL Query1.sql...20/hunte (72) | SQL Query piv...20/hunte (71)

```
4 -- Dynamic pivot of ev sales per state based on vehicle type
5 DECLARE @vehicle_types NVARCHAR(MAX) , @pivot_states_vehicle_type NVARCHAR(MAX);
6 --Declaring new dataset with vehicle_types as columns and whole query as pivot_states_vehicle_type
7 SELECT @vehicle_types = STRING_AGG(QUOTENAME(vehicle_type), ',')
8 FROM (
9 SELECT DISTINCT vehicle_type
10 FROM
11 [ev_sales_india_project].dbo.[ev_sales_statewise_india]
12 ) AS vehicle_type_aggregated;
13 --Building Dynamic SQL pivot for execution by first creating a new table by concatenating state_name and vehicle_types
14 SET @pivot_states_vehicle_type = '
15 SELECT state_name , ' + @vehicle_types + '
16 FROM
17 (SELECT state_name, vehicle_type, ev_sales_quantity
18 FROM [ev_sales_india_project].dbo.[ev_sales_statewise_india] ) AS primary_source_table
19 PIVOT
20 (SUM(ev_sales_quantity)
21 FOR vehicle_type IN (' + @vehicle_types + ' )
22 )AS pivoted_table
23 ORDER BY state_name;
24
25 --Command to execute @pivot_states_vehicle_type
26 EXEC sp_executesql @pivot_states_vehicle_type
27
```

Results | Messages | No issues found | 120 % | Ltr: 28 | Ch: 1 | TABS | CRLF

| state_name               | 2W_Personal | Others | 2W_Personal | 4W_Shared | 4W_Personal | 2W_Shared | Institution Bus | Bus  | 2W_Goods | 2W_Shared_LowSpeed | 2W_Shared | 2W_Goods_LowSpeed |
|--------------------------|-------------|--------|-------------|-----------|-------------|-----------|-----------------|------|----------|--------------------|-----------|-------------------|
| Andaman & Nicobar Island | 0           | 2      | 11          | 7         | 92          | 20        | NULL            | 40   | 0        | 1                  | 0         | 29                |
| Andhra Pradesh           | 1           | 765    | 69019       | 51        | 3213        | 1         | 0               | 120  | 409      | 1502               | 1412      | 863               |
| Arunachal Pradesh        | 0           | 0      | 10          | 0         | 28          | NULL      | 0               | 0    | 2        | NULL               | 0         | NULL              |
| Assam                    | 0           | 423    | 5208        | 53        | 465         | NULL      | 0               | 193  | 324      | 137952             | 4026      | 2343              |
| Bihar                    | 0           | 47     | 28116       | 16        | 865         | 0         | NULL            | 27   | 655      | 174880             | 5678      | 2981              |
| Chandigarh               | NULL        | 40     | 3395        | 12        | 1489        | 0         | 0               | 80   | 128      | 4684               | 414       | 1211              |
| Chhattisgarh             | 68          | 1578   | 48828       | 42        | 1686        | 0         | 0               | 2    | 771      | 15943              | 3949      | 2408              |
| Delhi                    | 0           | 417    | 85358       | 7143      | 12021       | NULL      | 0               | 1731 | 12344    | 134439             | 1415      | 13670             |
| Daman and Diu            | 1           | 8      | 256         | 3         | 65          | 0         | 0               | 25   | 32       | 2                  | 39        | NULL              |
| Goa                      | 8           | 90     | 15151       | 2         | 1921        | 0         | 0               | 108  | 16       | 12                 | 14        | 60                |
| Gujarat                  | 35          | 751    | 157870      | 143       | 10865       | 1         | 0               | 623  | 3415     | 778                | 1253      | 979               |
| Haryana                  | 0           | 252    | 27318       | 1314      | 2657        | 52        | 0               | 16   | 1249     | 63732              | 3701      | 4929              |

The screenshot shows the SQL Server Enterprise Manager interface. The Object Explorer on the left displays the database structure for 'SINIST3R-MSI-20 (SQL Server 16.0.1000.6)'. The central query window, titled 'SQLQuery4...hunte (68)', contains a T-SQL script that creates a pivot table named 'new\_pivot\_table\_per\_state\_per\_year'. The script uses a CTE to aggregate sales data by state and year, then applies a PIVOT operator to transform the data into a wide table format. The results grid at the bottom displays the output of the query, showing columns for 'state\_name' and years from 2024 to 2015, with an additional column for 'sum\_of\_all\_years\_sales'.

| state_name               | 2024 | 2021  | 2022  | 2016  | 2019  | 2014 | 2020  | 2023  | 2017  | 2018  | 2015 | sum_of_all_years_sales |
|--------------------------|------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|------------------------|
| Andaman & Nicobar Island | 3    | 92    | 23    | 0     | 2     | 0    | 38    | 28    | 0     | 20    | 0    | 202                    |
| Andhra Pradesh           | 2363 | 9540  | 29008 | 20    | 2123  | 12   | 1623  | 31106 | 0     | 1165  | 8    | 77258                  |
| Arunachal Pradesh        | 7    | 2     | 2     | 1     | 1     | 0    | 5     | 21    | 0     | 1     | 0    | 40                     |
| Assam                    | 4262 | 15633 | 40720 | 19    | 10867 | 2    | 8357  | 60798 | 3833  | 7403  | 23   | 151917                 |
| Bihar                    | 8275 | 23082 | 55762 | 1100  | 12380 | 12   | 12447 | 88186 | 3593  | 8489  | 69   | 213465                 |
| Chandigarh               | 553  | 724   | 2719  | 1     | 308   | 0    | 369   | 8323  | 23    | 212   | 2    | 11453                  |
| Chhattisgarh             | 3578 | 4214  | 22363 | 192   | 2744  | 123  | 1459  | 37838 | 645   | 1922  | 88   | 75276                  |
| Delhi                    | 7067 | 25815 | 62265 | 21888 | 23222 | 48   | 12378 | 73487 | 18042 | 20961 | 3585 | 268538                 |
| DNH and DD               | 35   | 29    | 140   | 2     | 19    | 0    | 24    | 160   | 1     | 19    | 2    | 431                    |
| Goa                      | 928  | 1095  | 5888  | 34    | 41    | 9    | 80    | 9440  | 39    | 26    | 4    | 17382                  |
| Grand                    | 2008 | 9726  | 69097 | 142   | 845   | 76   | 1120  | 88812 | 174   | 488   | 81   | 178711                 |

The screenshot shows the SQL Server Enterprise Manager interface. The Object Explorer on the left displays the database structure for 'SINIST3R-MSI-20 (SQL Server 16.0.1000.6)'. The central query window, titled 'SQLQuery1...hunte (66)', contains a T-SQL script that creates a pivot table named 'pivoted\_table\_statewise'. The script uses a CTE to aggregate sales data by state and vehicle type, then applies a PIVOT operator to transform the data into a wide table format. The results grid at the bottom displays the output of the query, showing columns for 'state\_name' and various vehicle types, with an additional column for 'total\_sales'.

| state_name               | 2W_Personal | Others | 2W_Personal | 4W_Shared | 4W_Personal | 2W_Shared | Institution Bus | Bus | 3W_Goods | 3W_Shared_LowSpeed | 3W_Shared | 3W_Goods_LowSpeed | total_sales |
|--------------------------|-------------|--------|-------------|-----------|-------------|-----------|-----------------|-----|----------|--------------------|-----------|-------------------|-------------|
| Andaman & Nicobar Island | 0           | 2      | 11          | 7         | 82          | 20        | NULL            | 40  | 0        | 1                  | 0         | 29                | 202         |
| Andhra Pradesh           | 1           | 765    | 69019       | 51        | 3213        | 1         | 0               | 120 | 409      | 1502               | 1412      | 883               | 77358       |
| Arunachal Pradesh        | 0           | 0      | 10          | 0         | 28          | NULL      | 0               | 0   | 2        | NULL               | 0         | NULL              | 40          |
| Assam                    | 0           | 423    | 5268        | 53        | 495         | NULL      | 0               | 193 | 324      | 17982              | 4926      | 2343              | 151917      |
| Bihar                    | 0           | 47     | 28116       | 16        | 865         | 0         | NULL            | 27  | 855      | 174880             | 5678      | 2981              | 213465      |
| Chandigarh               | NULL        | 40     | 3395        | 12        | 1489        | 0         | 0               | 80  | 128      | 4684               | 414       | 1211              | 11453       |
| Chhattisgarh             | 88          | 1578   | 48828       | 42        | 1686        | 0         | 0               | 2   | 771      | 15943              | 3949      | 2408              | 75276       |
| Delhi                    | 0           | 417    | 85358       | 7143      | 12021       | NULL      | 0               | 1   | 12344    | 134439             | 1415      | 13670             | 268538      |

- Data Visualization: PowerBI software was used to transform the various datasets into meaningful and insightful visual representations of data in form of charts, graphs, trend lines for business and financial analysis.



1. In terms of total electric vehicle per state, Uttar Pradesh has seen the most number of sales, followed by Maharashtra and Karnataka. This shows the confidence of Indian consumers in the electric vehicles.
2. Electric Vehicles are also gaining popularity in many other states which are primarily consisting of Tier-2, Tier-3, Tier-4 cities and rural areas.
3. Two wheeler is the most popular electric vehicle among all types of electric vehicles, showcasing the strong confidence of middle class on the EV initiative and lower carbon emissions.

State which are lagging behind are primarily the one's with a weak road and electricity infrastructure.

## **Recommendations:**

- Invest in building of more EV charging infrastructure across all states and metropolitan cities in order to boost consumer confidence in electric vehicles to push for lower carbon footprint of India.
- Invest in small sized nuclear power stations for all major cities in order to reduce reliance on coal power plants.
- Reduce all forms of taxes on all personal use electric vehicles in order to boost sales among middle class.
- Giving tax benefits to companies manufacturing and selling electric vehicles in India under government supervision for funding of Research and Development department of the private firms.
- Built and increase road connectivity and infrastructure across India to build confidence in potential consumers in rural areas as well in order to boost sales and lower national emissions.

## **Data Visualization:**

You can view all my codes, queries, visuals and spreadsheets on my [GitHub project](#).

-Salil Panwar