India Electric Vehicle Market Analysis

PROBLEM STATEMENT

An automotive company planning to enter the Indian electric vehicle (EV) market requires a data-driven analysis of EV adoption, market penetration, and growth trends across states and vehicle categories to support strategic market entry decisions.

TOOLS USED

- MySQL – solved all primary business questions
- Power BI – executive dashboard & insights
- Excel – validation and growth calculations

Key Business Questions Answered

- Which EV makers lead and lag the market?
- Which states drive EV adoption and penetration?
- How do EV sales vary by category and quarter?
- Which segments and regions show highest growth potential?

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

SQL

```sql
WITH maker_sales AS (
    SELECT
        sd.fiscal_year,
        ems.maker,
        SUM(ems.ev_sold) AS total_2w_sold
    FROM ev_maker_sales ems
    JOIN sales_date sd
        ON ems.date = sd.date
    WHERE sd.fiscal_year IN (2023, 2024)
        AND ems.vechile_category = '2-Wheelers'
    GROUP BY sd.fiscal_year, ems.maker
),
ranked_makers AS (
    SELECT
        fiscal_year,
        maker,
        total_2w_sold,
        RANK() OVER (
            PARTITION BY fiscal_year
            ORDER BY total_2w_sold DESC
        ) AS sales_rank_desc,
        RANK() OVER (
            PARTITION BY fiscal_year
            ORDER BY total_2w_sold ASC
        ) AS sales_rank_asc
    FROM maker_sales
)
```

```sql
SELECT
    fiscal_year,
    maker,
    total_2w_sold,
    CASE
        WHEN sales_rank_desc <= 3 THEN 'Top 3'
        WHEN sales_rank_asc <= 3 THEN 'Bottom 3'
    END AS category
FROM ranked_makers
WHERE sales_rank_desc <= 3
    OR sales_rank_asc <= 3
ORDER BY fiscal_year, category, total_2w_sold DESC;
```

fiscal_year	maker	total_2w_sold	category
2023	PURE EV	11556	Bottom 3
2023	BEING	11018	Bottom 3
2023	JITENDRA	152583	Bottom 3
2023	OLA ELECTRIC	152583	Top 3
2023	OKINAWA	96945	Top 3
2023	HERO ELECTRIC	88993	Top 3
2024	KINETIC GREEN	9585	Bottom 3
2024	REVOLT	7254	Bottom 3
2024	BATTRE ELECTRIC	4841	Bottom 3
2024	OLA ELECTRIC	322489	Top 3
2024	TVS	180743	Top 3
2024	ATHER	107552	Top 3

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

```sql
WITH penetration AS (
    SELECT
        s.state,
        s.vechile_category,
        SUM(s.ev_sold) AS ev_sold,
        SUM(s.total_vechile_sold) AS total_sold,
        ROUND(
            SUM(s.ev_sold) * 1.0 / SUM(s.total_vechile_sold),
            4
        ) AS penetration_rate
    FROM state_sales s
    JOIN sales_date d
        ON s.date = d.date
    WHERE d.fiscal_year = 2024
        AND s.vechile_category IN ('2-Wheelers', '4-Wheelers')
    GROUP BY s.state, s.vechile_category
),
ranked_states AS (
    SELECT *,
        RANK() OVER (
            PARTITION BY vechile_category
            ORDER BY penetration_rate DESC
        ) AS rnk
    FROM penetration
)
```

```sql
SELECT
    state,
    vechile_category,
    ev_sold,
    total_sold,
    penetration_rate
FROM ranked_states
WHERE rnk <= 5
ORDER BY vechile_category, penetration_rate DESC;
```

state	vechile_category	ev_sold	total_sold	penetration_rate
Goa	2-Wheelers	9768	54290	0.1799
Kerala	2-Wheelers	64769	478887	0.1352
Karnataka	2-Wheelers	148111	1279767	0.1157
Maharashtra	2-Wheelers	183052	1817343	0.1007
Delhi	2-Wheelers	38094	405218	0.0940
Kerala	4-Wheelers	9169	159227	0.0576
Chandigarh	4-Wheelers	1020	22651	0.0450
Delhi	4-Wheelers	8630	201130	0.0429
Karnataka	4-Wheelers	12878	302221	0.0426
Goa	4-Wheelers	1031	24234	0.0425

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

```sql
WITH state_totals AS (
    SELECT
        s.state,
        SUM(s.ev_sold) AS total_ev_sold,
        SUM(s.total_vechile_sold) AS total_vehicle_sold
    FROM state_sales s
    JOIN sales_date d ON s.date = d.date
    WHERE d.fiscal_year = 2024
      AND s.state IN ('Delhi', 'Karnataka')
    GROUP BY s.state
)
SELECT
    state,
    total_ev_sold,
    total_vehicle_sold,
    ROUND(total_ev_sold * 1.0 / NULLIF(total_vehicle_sold,0), 4) AS penetration_rate
FROM state_totals;
```

state	total_ev_sold	total_vehicle_sold	penetration_rate
▶ Delhi	46724	606348	0.0771
Karnataka	160989	1581988	0.1018

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

```sql
WITH top_makers AS (
    SELECT
        ems.maker,
        SUM(ems.ev_sold) AS total_ev_sold
    FROM ev_maker_sales ems
    JOIN sales_date sd
        ON ems.date = sd.date
    WHERE sd.fiscal_year BETWEEN 2022 AND 2024
        AND ems.vechile_category = '4-Wheelers'
    GROUP BY ems.maker
    ORDER BY total_ev_sold DESC
    LIMIT 5
),
yearly_sales AS (
    SELECT
        ems.maker,
        sd.fiscal_year,
        SUM(ems.ev_sold) AS ev_sold
    FROM ev_maker_sales ems
    JOIN sales_date sd
        ON ems.date = sd.date
    JOIN top_makers tm
        ON ems.maker = tm.maker
    WHERE ems.vechile_category = '4-Wheelers'
        AND sd.fiscal_year IN (2022, 2024)
    GROUP BY ems.maker, sd.fiscal_year
),
pivoted AS (
    SELECT
        maker,
        MAX(CASE WHEN fiscal_year = 2022 THEN ev_sold END) AS ev_2022,
        MAX(CASE WHEN fiscal_year = 2024 THEN ev_sold END) AS ev_2024
    FROM yearly_sales
    GROUP BY maker
)
SELECT
    maker,
    ev_2022,
    ev_2024,
    ROUND(
        POWER(ev_2024 * 1.0 / NULLIF(ev_2022, 0), 1.0 / 2) - 1,
        4
    ) AS cagr_2022_2024
FROM pivoted
WHERE ev_2022 IS NOT NULL
    AND ev_2024 IS NOT NULL
ORDER BY cagr_2022_2024 DESC;
```

maker	ev_2022	ev_2024	cagr_2022_2024
BYD India	33	1466	5.6652
Hyundai Motor	110	1390	2.5548
Mahindra & Mahindra	4042	23346	1.4033
MG Motor	1647	8829	1.3153
Tata Motors	12708	48181	0.9471

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

```sql
WITH monthly_sales AS (
    SELECT
        MONTH(s.date) AS month_num,
        SUM(s.ev_sold) AS total_ev_sold
    FROM state_sales s
    JOIN sales_date d
        ON s.date = d.date
    WHERE d.fiscal_year BETWEEN 2022 AND 2024
    GROUP BY MONTH(s.date)
),
ranked_months AS (
    SELECT
        month_num,
        total_ev_sold,
        RANK() OVER (ORDER BY total_ev_sold DESC) AS peak_rank,
        RANK() OVER (ORDER BY total_ev_sold ASC) AS low_rank
    FROM monthly_sales
)
SELECT
    month_num,
    total_ev_sold,
    CASE
        WHEN peak_rank = 1 THEN 'Peak Season'
        WHEN low_rank = 1 THEN 'Low Season'
    END AS season_type
FROM ranked_months
WHERE peak_rank = 1
    OR low_rank = 1
ORDER BY total_ev_sold DESC;
```

month_num	total_ev_sold	season_type
3	291587	Peak Season
6	106709	Low Season

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?

```sql
WITH penetration_2024 AS (
    SELECT
        s.state,
        SUM(s.ev_sold) AS ev_2024,
        SUM(s.total_vechile_sold) AS total_2024,
        SUM(s.ev_sold) * 1.0 / SUM(s.total_vechile_sold)
        AS penetration_rate
    FROM state_sales s
    JOIN sales_date d
        ON s.date = d.date
    WHERE d.fiscal_year = 2024
    GROUP BY s.state
),
top_states AS (
    SELECT *
    FROM penetration_2024
    ORDER BY penetration_rate DESC
    LIMIT 10
),
yearly_ev_sales AS (
    SELECT
        s.state,
        d.fiscal_year,
        SUM(s.ev_sold) AS ev_sold
    FROM state_sales s
    JOIN sales_date d
        ON s.date = d.date
    WHERE d.fiscal_year IN (2022, 2024)
    GROUP BY s.state, d.fiscal_year
),
pivoted AS (
    SELECT
        state,
        MAX(CASE WHEN fiscal_year = 2022 THEN ev_sold END) AS ev_2022,
        MAX(CASE WHEN fiscal_year = 2024 THEN ev_sold END) AS ev_2024
    FROM yearly_ev_sales
    GROUP BY state
),
cagr_calc AS (
    SELECT
        p.state,
        p.ev_2024,
        ROUND(
            POWER(p.ev_2024 * 1.0 / NULLIF(p.ev_2022, 0), 1.0 / 2) - 1,
            4
        ) AS cagr
    FROM pivoted p
    JOIN top_states t
        ON p.state = t.state
)
SELECT
    state,
    ev_2024,
    cagr,
    ROUND(
        ev_2024 * POWER(1 + cagr, 6),
        0
    ) AS projected_ev_2030
FROM cagr_calc
ORDER BY projected_ev_2030 DESC;
```

state	ev_2024	cagr	projected_ev_2030
Maharashtra	197169	1.0189	13351421
Kerala	73938	1.3283	11778808
Karnataka	160989	0.9324	8382593
Chhattisgarh	28540	1.5089	7117936
Odisha	39118	1.0294	2732641
Goa	10799	1.4645	2419672
Tamil Nadu	94314	0.5995	1579362
Delhi	46724	0.681	1054257
Chandigarh	2877	1.6458	986920
Puducherry	3098	1.0544	232912

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 of 85000 for 2-wheelers and 1500000 for 4-wheelers.

```sql
WITH yearly_units AS (
    SELECT
        s.vechile_category,
        d.fiscal_year,
        SUM(s.ev_sold) AS ev_units
    FROM state_sales s
    JOIN sales_date d
        ON s.date = d.date
    WHERE d.fiscal_year IN (2022, 2023, 2024)
      AND s.vechile_category IN ('2-Wheelers', '4-Wheelers')
    GROUP BY s.vechile_category, d.fiscal_year
),
revenue_calc AS (
    SELECT
        vechile_category,
        fiscal_year,
        ev_units,
        CASE
            WHEN vechile_category = '2-Wheelers' THEN ev_units * 85000
            WHEN vechile_category = '4-Wheelers' THEN ev_units * 1500000
        END AS revenue
    FROM yearly_units
),
```

```sql
pivoted AS (
    SELECT
        vechile_category,
        MAX(CASE WHEN fiscal_year = 2022 THEN revenue END) AS rev_2022,
        MAX(CASE WHEN fiscal_year = 2023 THEN revenue END) AS rev_2023,
        MAX(CASE WHEN fiscal_year = 2024 THEN revenue END) AS rev_2024
    FROM revenue_calc
    GROUP BY vechile_category
)
SELECT
    vechile_category,
    ROUND((rev_2024 - rev_2022) * 1.0 / NULLIF(rev_2022, 0), 4) AS growth_2022_2024,
    ROUND((rev_2024 - rev_2023) * 1.0 / NULLIF(rev_2023, 0), 4) AS growth_2023_2024
FROM pivoted;
```

vechile_category	growth_2022_2024	growth_2023_2024
2-Wheelers	2.6928	0.2813
4-Wheelers	3.6779	0.8308

POWER BI

India's EV Market: Small Base, Rapid Acceleration
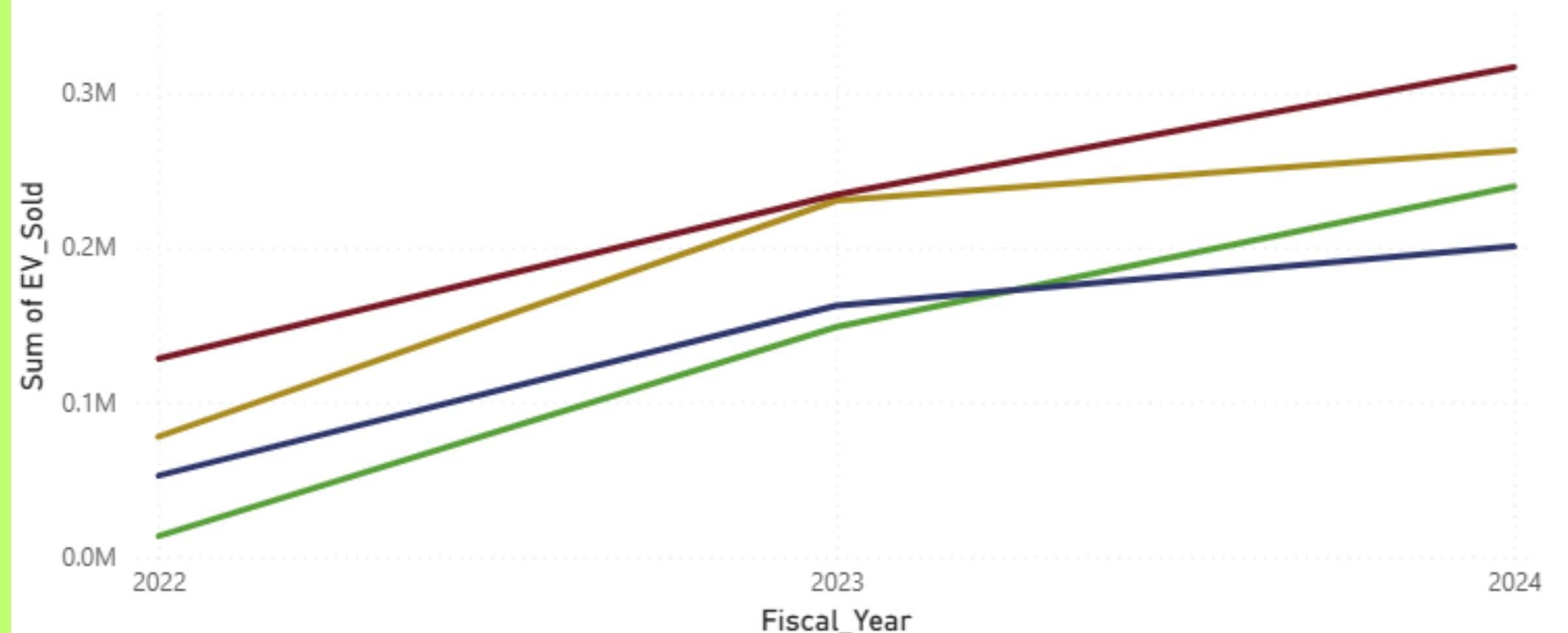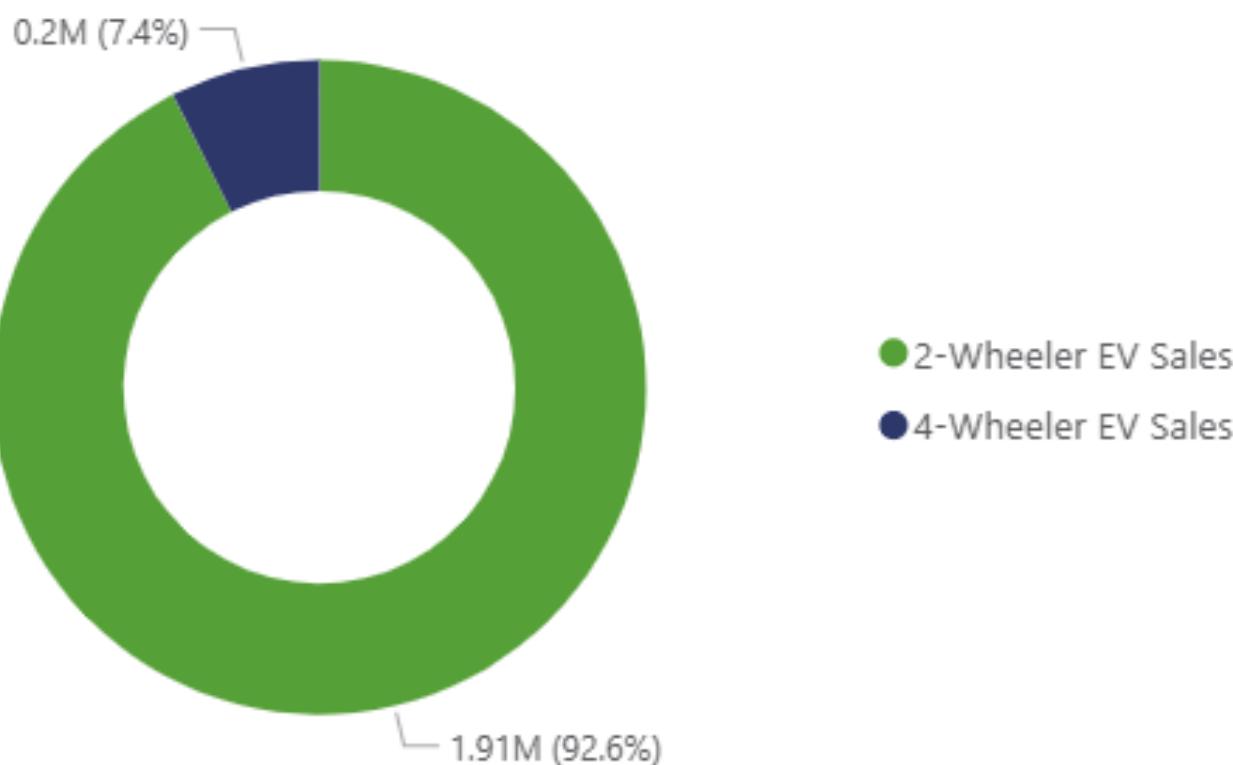
| 2M	1.91M	3.61%	31.5%	152.9K
Total EV Sold	2-Wheeler EV Sales	EV Penetration Rate	YoY Growth % – 2024	4-Wheeler EV Sales

EV Sales Trend
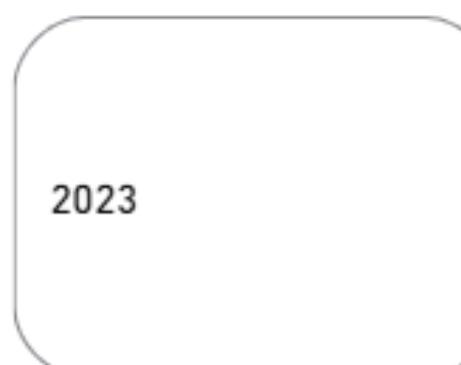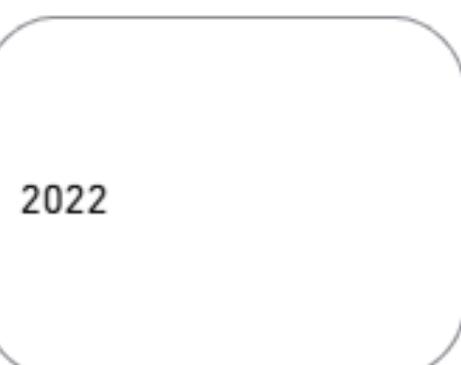
Quarter ● Q1 ● Q2 ● Q3 ● Q4

EV Market Share by Vehicle Category

0.2M (7.4%)

● 2-Wheeler EV Sales
● 4-Wheeler EV Sales

1.91M (92.6%)
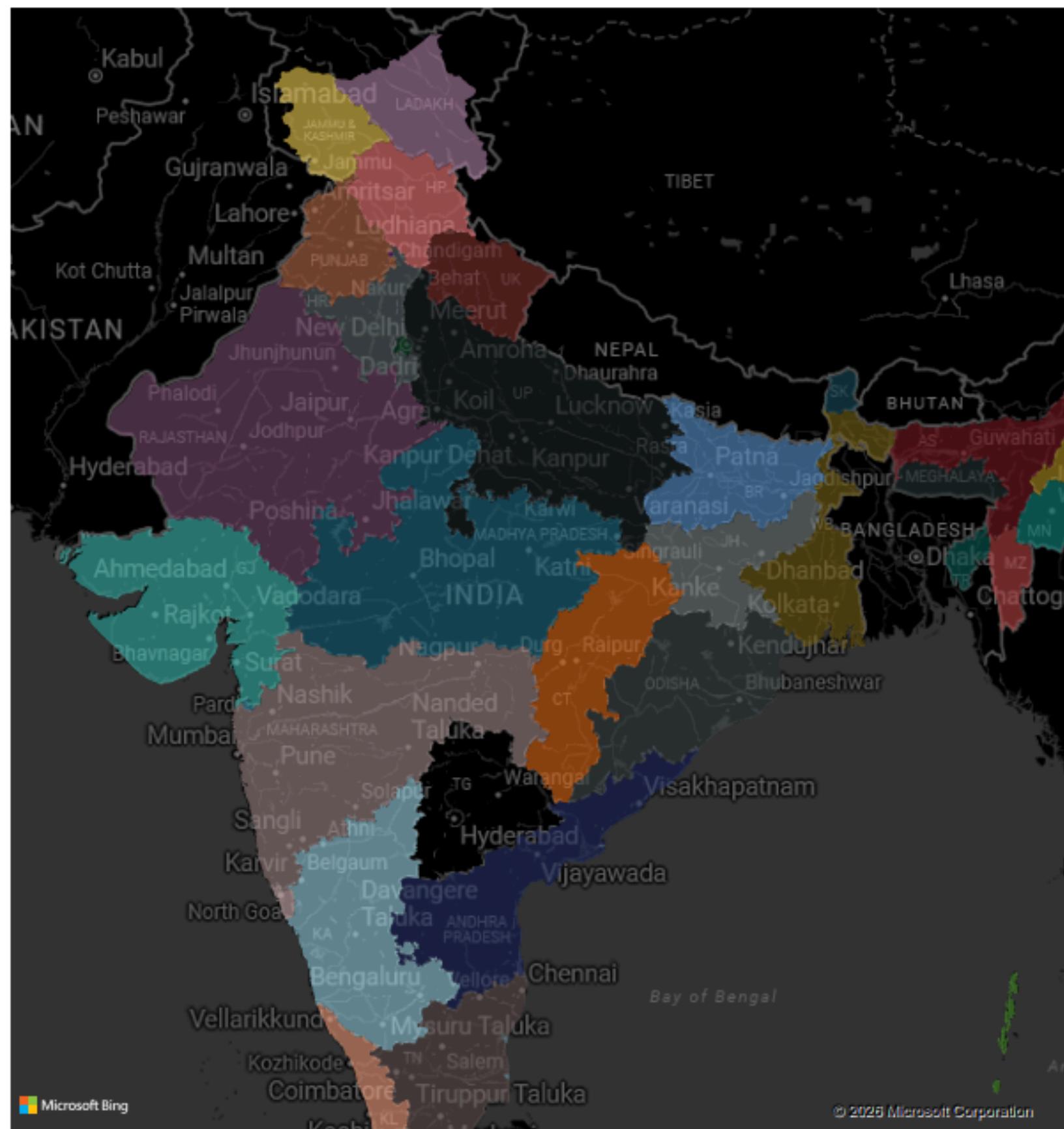
☐ Andaman & Nicobar Island
☐ Andhra Pradesh
☐ Arunachal Pradesh
☐ Assam
☐ Bihar

2-Wheelers	4-Wheelers

2022	2023	2024

STATE-LEVEL MARKET ANALYSIS

Total EV Sold by State

State ● Andaman ... ● Andhra Pr... ● Arunach... ● Assam ● Bihar ● Chandig... ● Chhattis... ● Delhi ▶

EV Adoption Is Led by Policy-Driven States
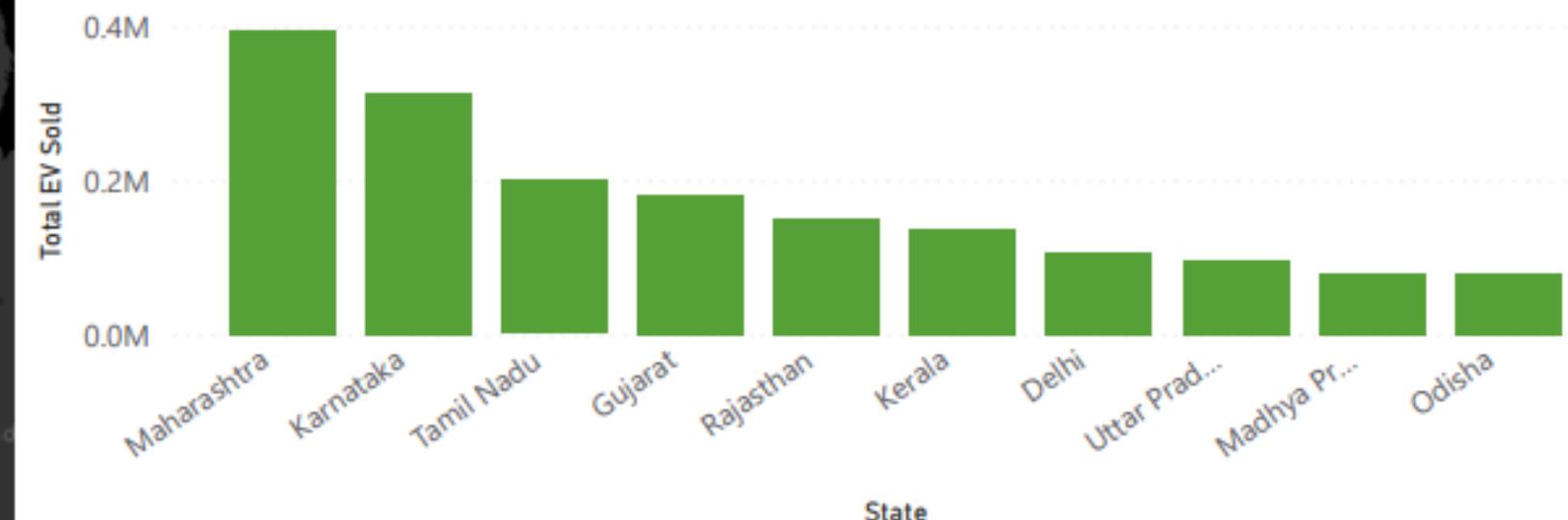
State	Total EV Sold	EV Penetration Rate ▼
Karnataka	312995	7.84%
Delhi	107312	6.76%
Total	**420307**	**7.53%**

57M
Total Vehicle Sold

2M
Total EV Sold

Top 10 States by EV Penetration

States shown: Goa, Karnataka, Delhi, Kerala, Maharash..., Odisha, Rajasthan, Gujarat, Tamil Nadu, Chandigarh

Top 10 States by EV Sold

States shown: Maharashtra, Karnataka, Tamil Nadu, Gujarat, Rajasthan, Kerala, Delhi, Uttar Prad..., Madhya Pr..., Odisha
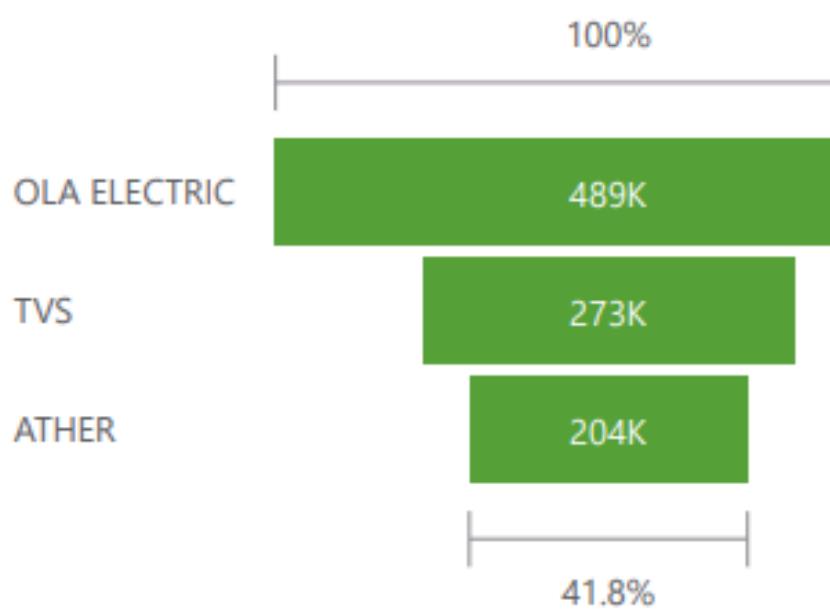
MAKER & CATEGORY ANALYSIS

Sum of Total_Vechile_Sold	Total EV Sold	Vechile_Category	EV Penetration Rate
46918768	1913168	2-Wheelers	4.08%
10301484	152943	4-Wheelers	1.48%
57220252	**2066111**		**3.61%**
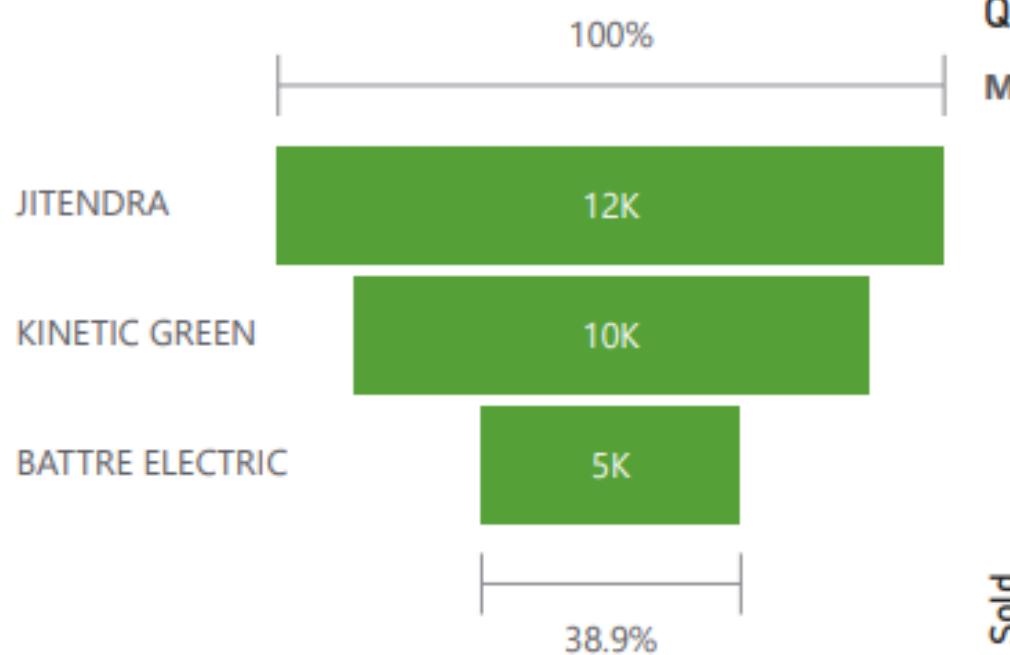
Two-Wheelers Dominate Today, Growth Shifts Tomorrow

Vechile_Category	Sum of EV_Sold	Fiscal_Year
2-Wheelers	252573	2022
2-Wheelers	727903	2023
2-Wheelers	932692	2024
4-Wheelers	18577	2022
4-Wheelers	47465	2023
4-Wheelers	86901	2024
Total	**2066111**	

Top 3 2-Wheeler EV Makers

100%

- OLA ELECTRIC — 489K
- TVS — 273K
- ATHER — 204K

41.8%
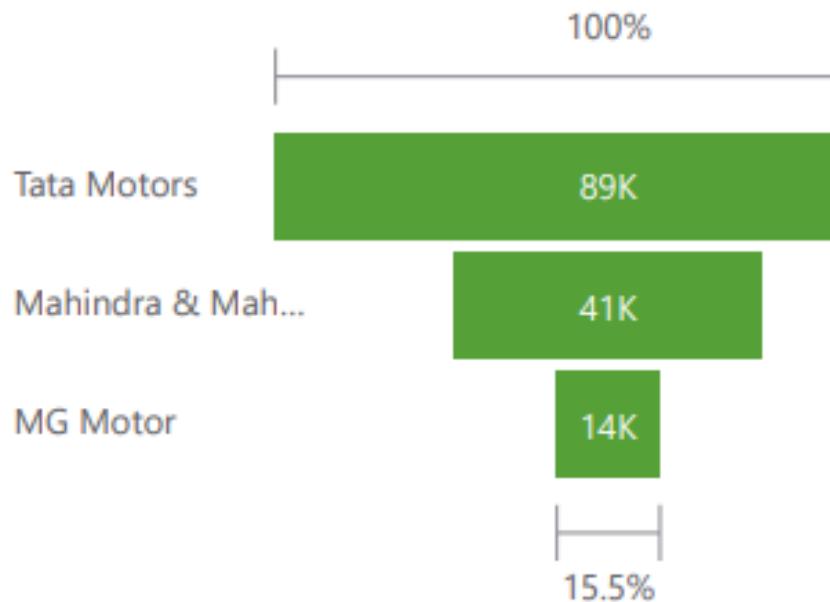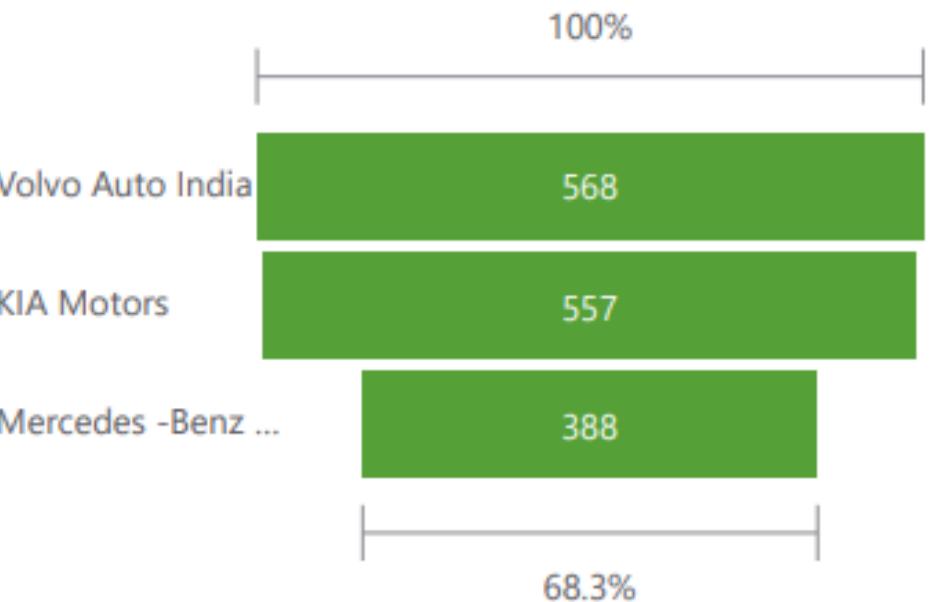
Bottom 3 2-Wheeler EV Makers

100%

- JITENDRA — 12K
- KINETIC GREEN — 10K
- BATTRE ELECTRIC — 5K

38.9%

Quarterly Trends for Top 5 2-Wheeler EV Makers

Maker ● AMPERE ● ATHER ● HERO ELECTRIC ● OLA ELECTRIC ● TVS

Top 3 4-Wheeler EV Makers

100%

- Tata Motors — 89K
- Mahindra & Mah... — 41K
- MG Motor — 14K

15.5%

Bottom 3 4-Wheeler EV Makers

100%

- Volvo Auto India — 568
- KIA Motors — 557
- Mercedes -Benz ... — 388

68.3%

# Targeted Entry Can Outpace Market Growth

Top 5 4W EV Makers by CAGR

Vechile_Category ● 4-Wheelers
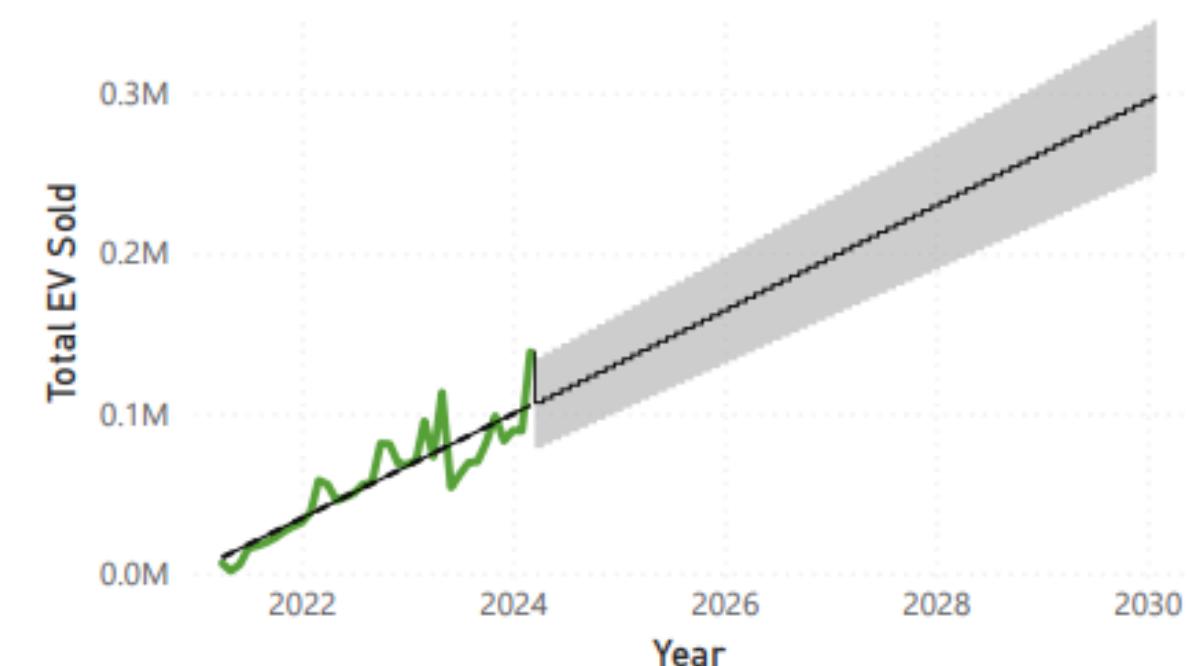
STRATEGIC INSIGHTS
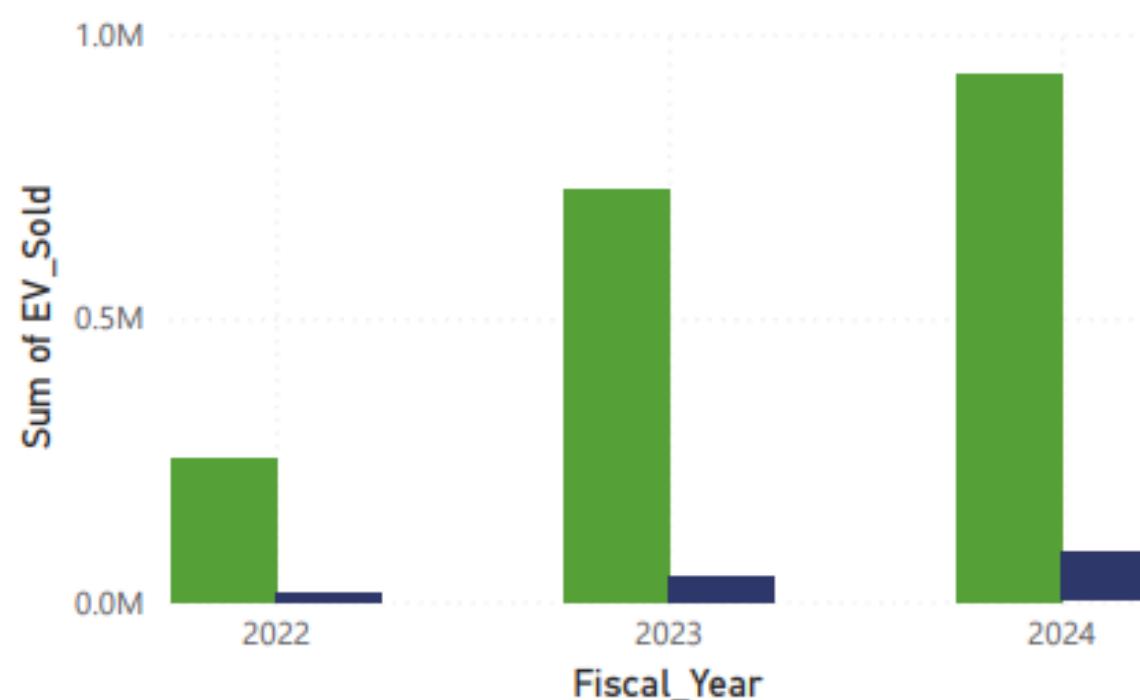
- 2-Wheelers drive volume, but 4-Wheelers drive value through higher growth and pricing

- Policy-enabled states consistently outperform in EV penetration

- Legacy auto makers dominate today, but new-age EV players show higher growth momentum

## EV Sales Forecast Till 2030
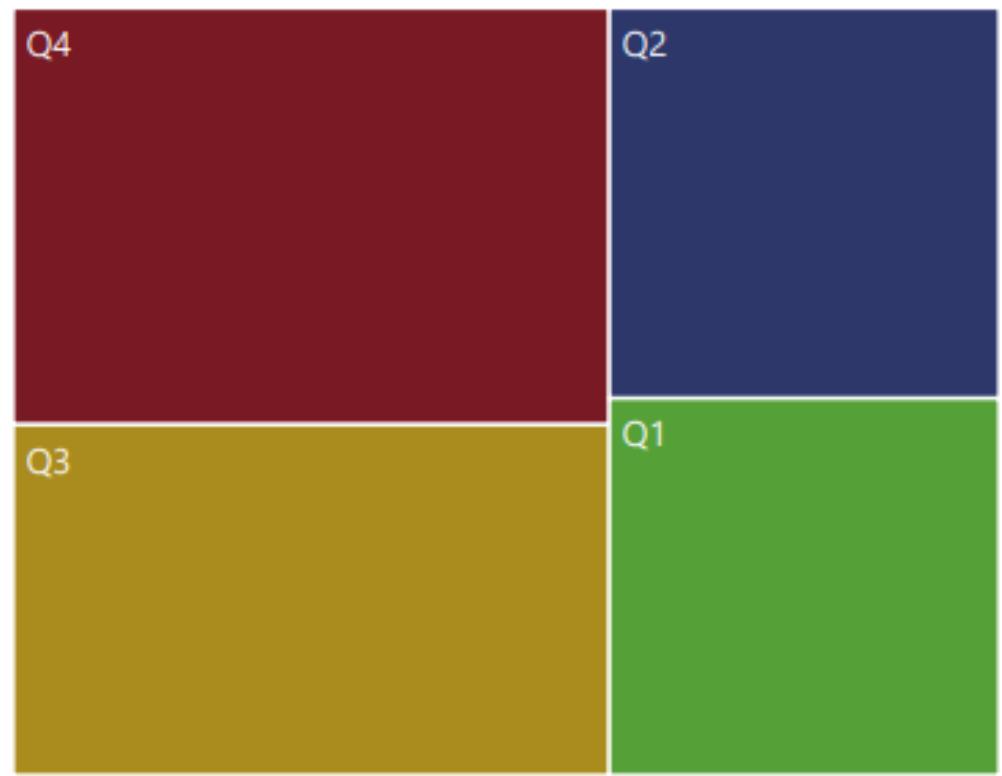
Total EV Sales Growth by Category
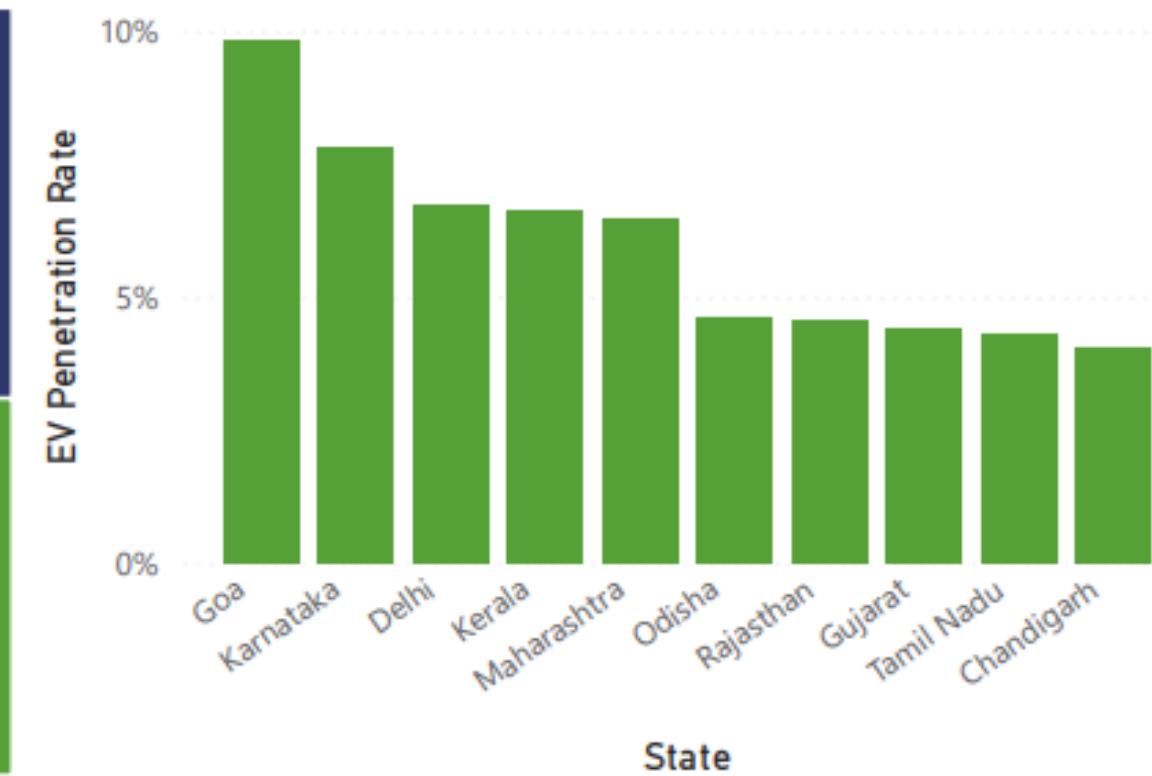
Vechile_Category ● 2-Wheelers ● 4-Wheelers

Total EV Sold by Quarter

EV Penetration Rate by State

BUSINESS QUESTIONS ANSWERED

Why are customers choosing 4-wheeler EVs ?

- Lower long-term ownership and maintenance costs compared to ICE vehicles
- Rising fuel prices make EVs more cost-effective over time
- Government subsidies and tax benefits reduce upfront purchase costs
- Improved vehicle range, safety, and charging reliability
- Growing environmental awareness, especially in urban and metro regions

BUSINESS QUESTIONS ANSWERED

How do government incentives impact EV adoption?

- Purchase subsidies directly lower the initial cost of EVs
- Tax exemptions and registration benefits improve affordability
- Infrastructure support increases consumer confidence
- Clear state-level EV policies accelerate adoption

BUSINESS QUESTIONS ANSWERED

How does charging infrastructure affect EV sales and penetration?

- Higher availability of charging stations leads to higher EV penetration
- Reduced range anxiety encourages first-time EV buyers
- Urban states with dense charging networks show faster adoption
- Infrastructure growth supports long-distance and daily commuting use cases

BUSINESS QUESTIONS ANSWERED

Who should be the brand ambassador for an EV/Hybrid launch and why?

- A well-known, trustworthy public figure with a clean, modern image
- Should resonate with urban and environmentally conscious consumers
- Strong appeal among middle-class and premium buyers
- Association with innovation and sustainability enhances brand positioning

BUSINESS QUESTIONS ANSWERED

Which Indian state is ideal for setting up a manufacturing unit?

- Karnataka and Tamil Nadu emerge as strong candidates due to:
- Supportive EV manufacturing policies
- Availability of skilled automotive workforce
- Strong infrastructure and supply chain ecosystem
- Stable governance and ease of doing business

BUSINESS QUESTIONS ANSWERED

Top 3 strategic recommendations

- Focus initial market entry on high-growth, policy-driven states
- Prioritize 4-wheeler EVs for long-term value creation
- Align product positioning with sustainability, affordability, and reliability

THANK YOU