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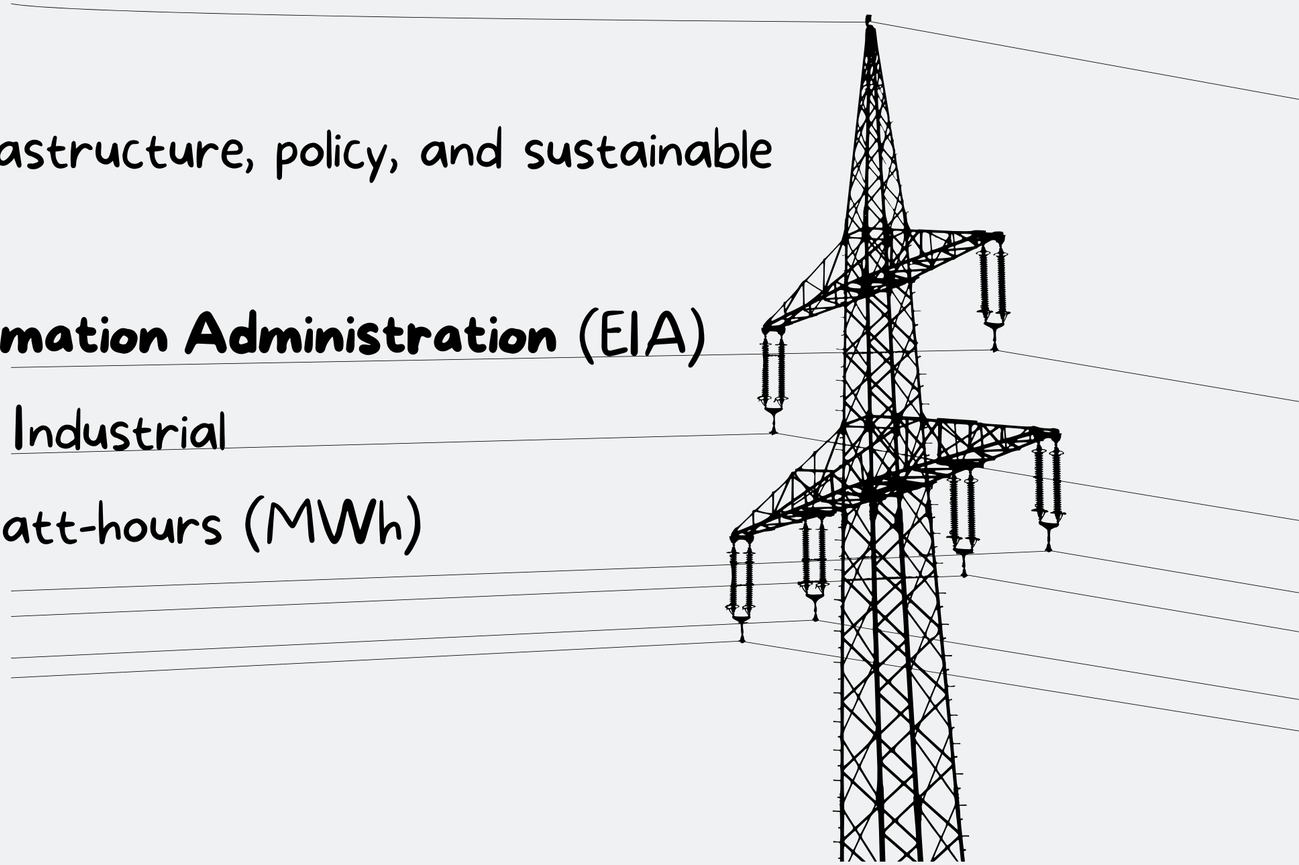
Forecasting STRATEGISTS

-- Electricity Forecasting Using Time Series --

INTRODUCTION

PROJECT OBJECTIVE & DATA SOURCE

- Goal: Forecast monthly electricity sales by sector and state for the year **2025-2026**
- Why it matters: Helps with infrastructure, policy, and sustainable energy planning
- Data Source: **U.S. Energy Information Administration** (EIA)
- Sectors: Residential, Commercial, Industrial
- Units: Sales measured in Megawatt-hours (MWh)



Data Processing

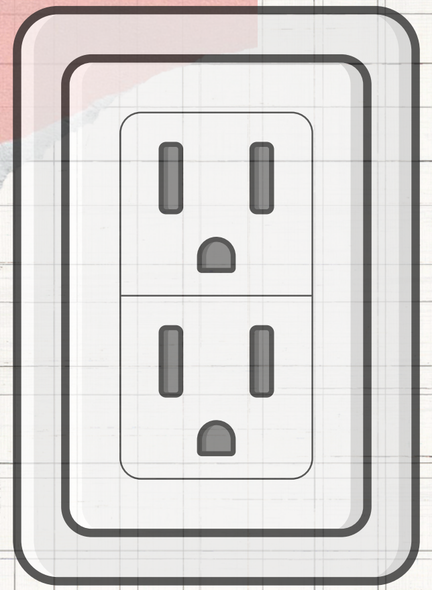
- Filtered time range: **2010–2025 → 2021–2024** (recent trends only)

- Dropped sectors with heavy nulls (e.g., Transportation)

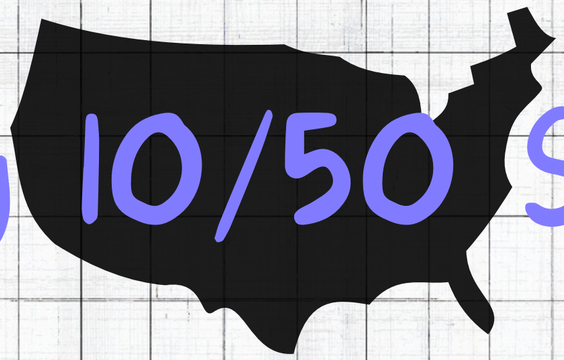
- Focused on sales data — a direct measure of energy demand
- Kept **3** clean sectors: Residential, Commercial, Industrial

- Selected **10** key states:
- 📈 **5** high-growth (e.g., New Mexico, Nevada)
- 📉 **5** low-growth (e.g., Massachusetts, Minnesota)

- Excluded **2025** from training; used only for **forecast validation**



Selecting 10/50 States



States with Growing Sales

- New Mexico (NM)
- Nevada (NV)
- Oklahoma (OK)
- Arizona (AZ)
- North Dakota (ND)

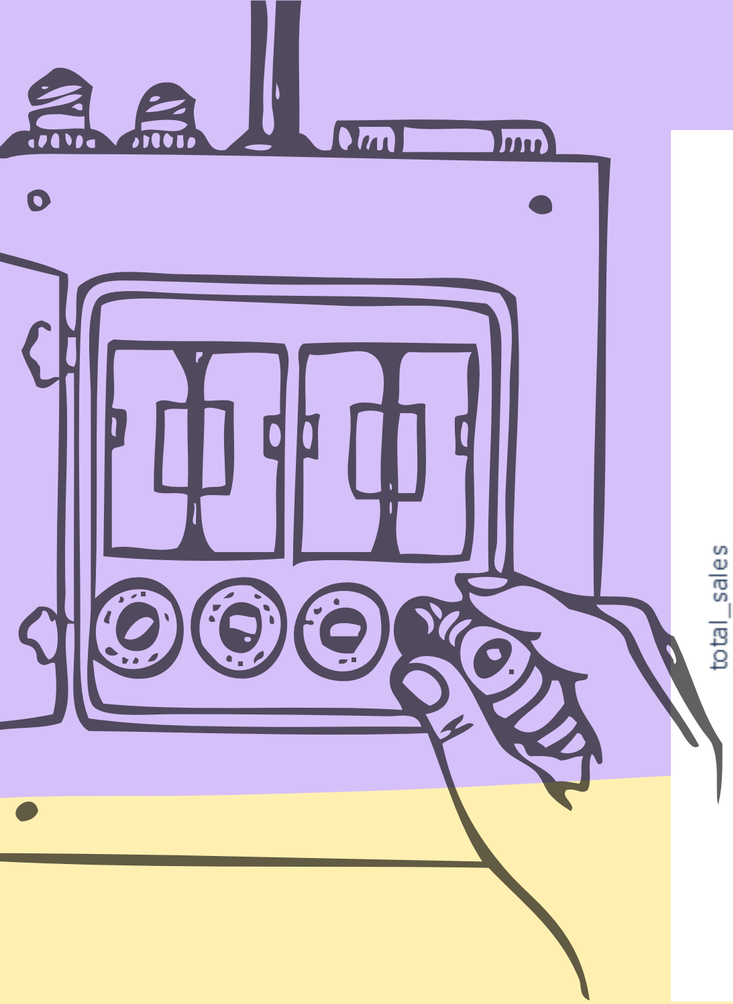
Why?

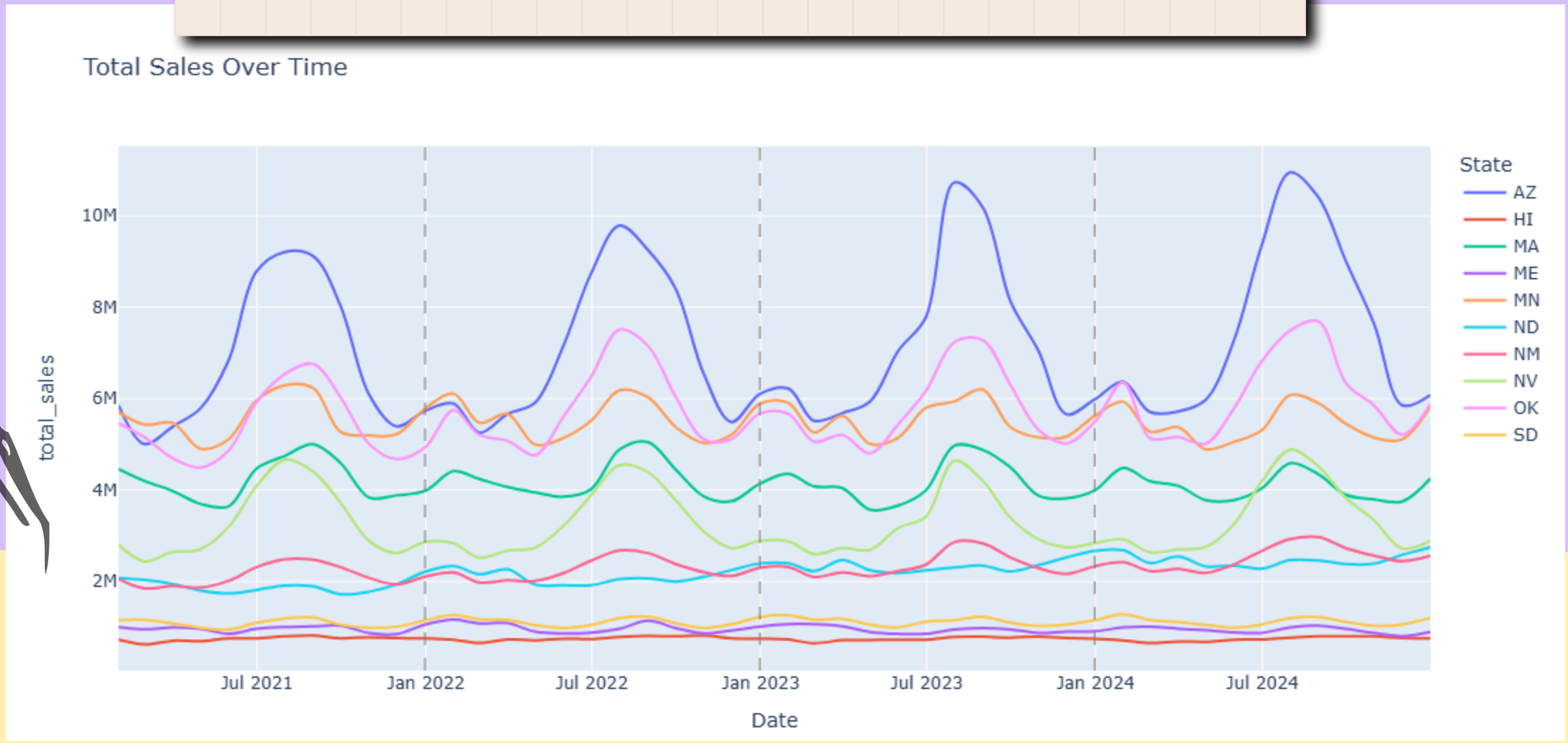
- This contrast helps highlight **emerging vs. underperforming** markets
- Reduces model and visual noise to interpret trends clearly

States with declining sales

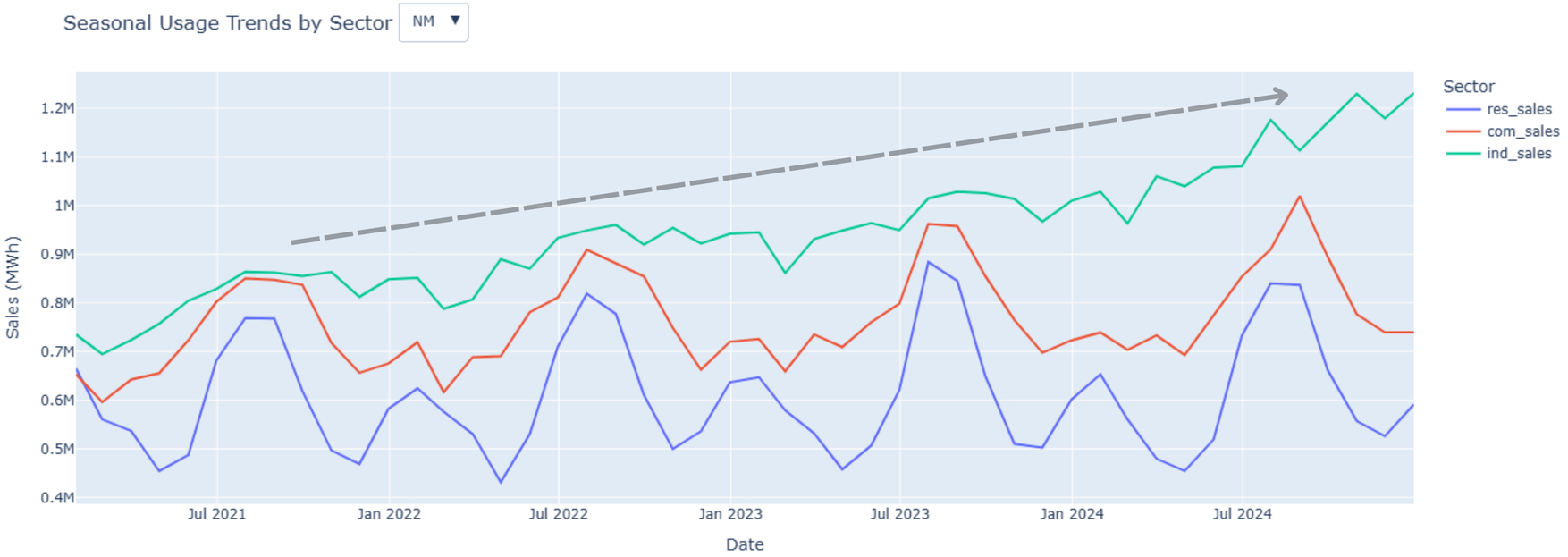
- Massachusetts (MA)
- Minnesota (MN)
- Maine (ME)
- Hawaii (HI)
- South Dakota (SD)

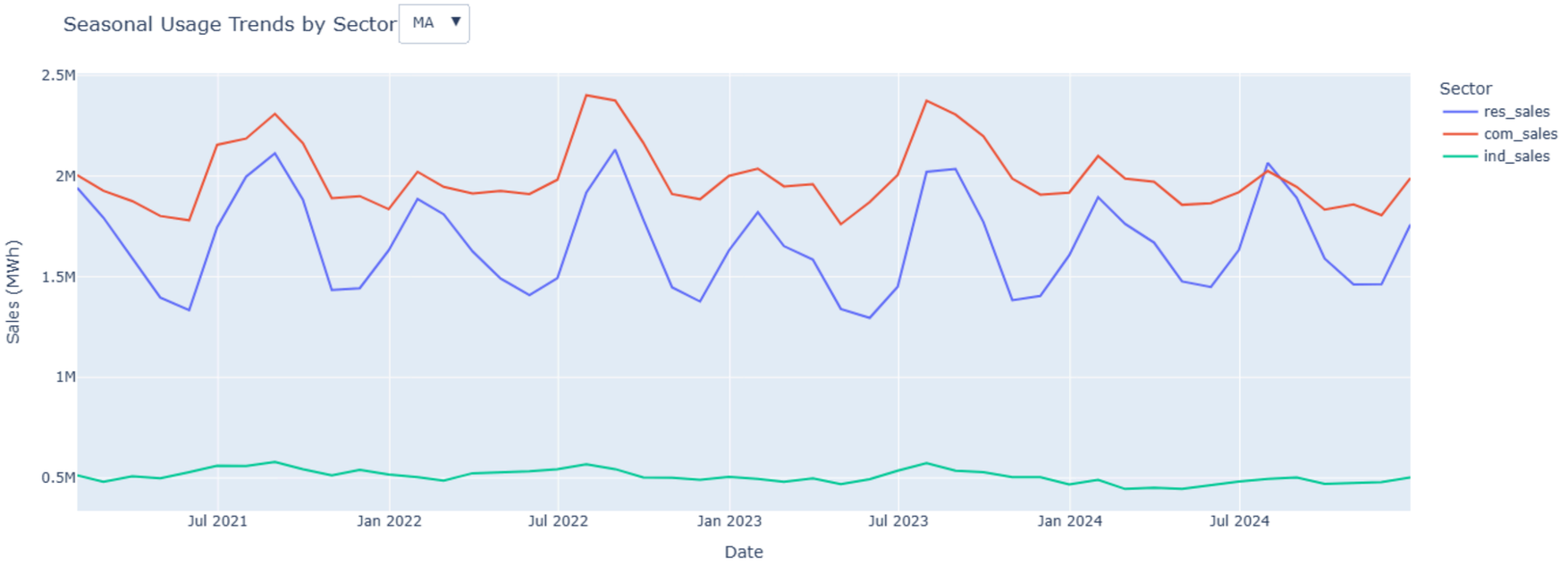
Trends from 2021-2024





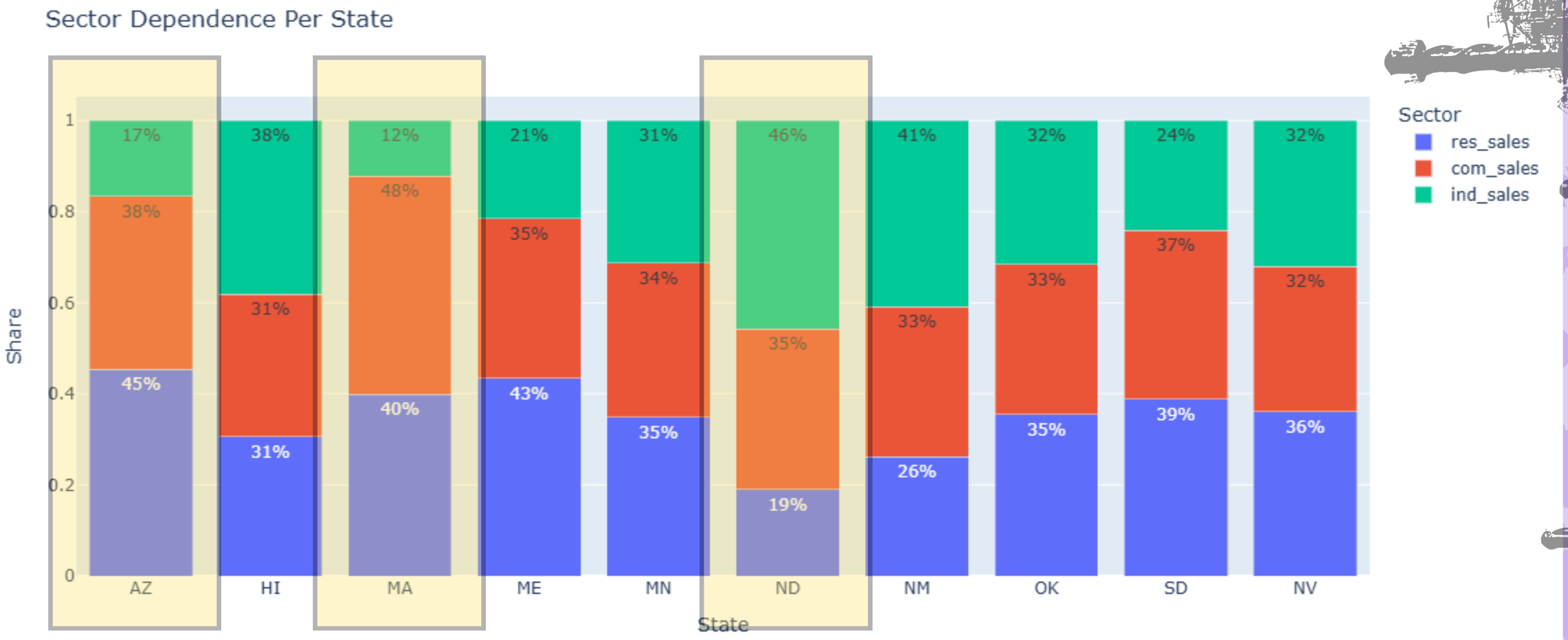
- The selected states show a **balanced** representation — both high-demand and low-demand — useful for making generalizable forecasts.
- Clear **seasonal peaks** are visible mid-year (typically summer)
- Arizona (AZ) and Oklahoma (OK) **consistently** have higher sales
- South Dakota (SD) and Maine(ME) maintain lower, **flatter curves**





Key Highlights

- **New Mexico's** energy market is **growing** steadily across all sectors
- Commercial and industrial demand in **NM shows consistent upward trends**.
- **Massachusetts** sees strong seasonal residential and commercial usage, but **growth is flat**
- **Industrial sales** in MA **remain low,** suggesting limited expansion in that sector

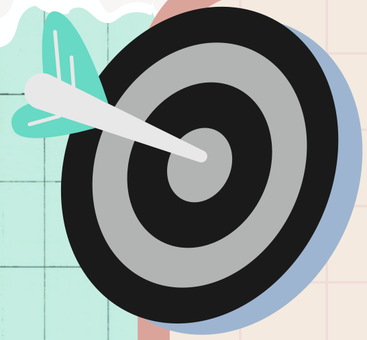


- Arizona (AZ) shows high residential demand (45%), pointing to strong consumer usage
- **Massachusetts** (MA) has a **dominant commercial share** (48%), reflecting business-driven consumption
- **North Dakota** (ND) leads in **industrial usage** (46%), signaling a manufacturing-heavy economy
- These states show distinct sector focus, unlike others with more balanced splits
- Remaining states share a common trend of residential and commercial interdependence

Time Series Forecasting with Prophet

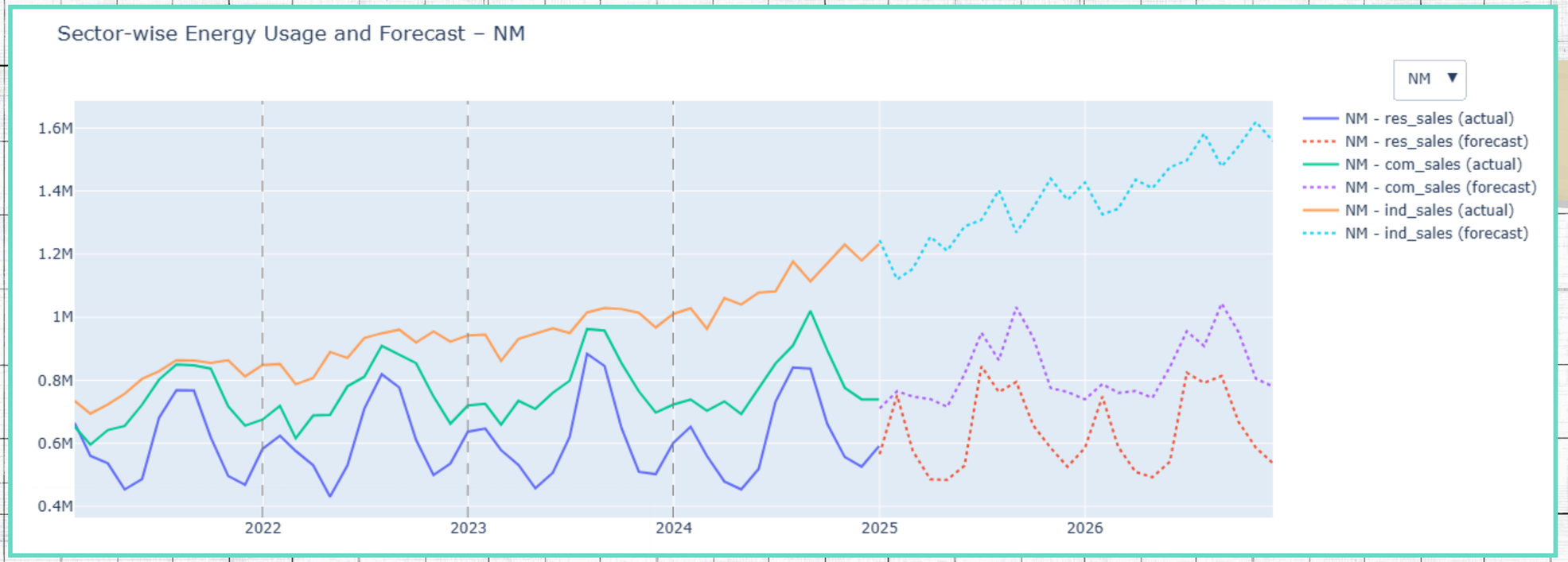
- Used **Prophet** to model electricity sales for each sector and state.
- Focused on monthly predictions for **2025–2026 (24 months)**.
- Trained using historical data from **2021 to 2024**.
- Automatically handled trends and seasonality patterns.
- Forecasted each sector (**Residential, Commercial, Industrial**) separately.

```
model =
Prophet(yearly_seasonality=
True,
weekly_seasonality=False,
daily_seasonality=False)
```



Forecasting Accuracy

- **Compared** model predictions **with real January 2025** data.
- Mean Absolute Error (MAE): ~78143.80
  - On average, our predictions were off by around **78,000** units.
- Mean Absolute Percentage Error (MAPE): **5.71%**
  - Our predictions were **off by only 5.71%** from the actual values.
- Errors remain reasonable given the scale (sales in millions).
- Low error confirms the model captured seasonal trends effectively



PAST + FUTURE SALES FORECAST

- Forecasted sales are **rising in New Mexico and North Dakota**
- **Commercial and industrial** sectors show the most **growth**

- **Residential** sales remain **steady** with seasonal patterns
- New Mexico shows sharper industrial growth than North Dakota
- Commercial sales increase steadily in both states

Conclusion And Strategies

Growth Observed

- **New Mexico and North Dakota** show steady increases in the **commercial and industrial** sectors.
- This suggests expanding business activity and infrastructure development in these states.
- **Residential sales remain stable** across all states, indicating consistent consumer demand across all states.

Stagnation & Decline

- States like Massachusetts and **South Dakota exhibit flat** or declining sales.
- Industrial usage in Massachusetts remains low, hinting at limited manufacturing growth.
- These regions may face challenges from efficiency upgrades or population shifts.

For Business & policymakers:

- **Invest** in industrial capacity **in high-growth states** (e.g., New Mexico), where manufacturing and commercial activity are rising.
- Offer targeted incentives to commercial and industrial clients to lock in long-term contracts.
- In declining markets, reallocate infrastructure investments or pivot to green and **renewable energy** initiatives.