PROJECT PRESENTATION

Konstantinos Sarinopoulos
Neil Anand Mankodi

INTRODUCTION

- Growing Energy Demand
- Challenges of Traditional Energy Production
- Impact of Unsustainable Practices
- Importance of the Project
- U.S. Energy Information Administration (EIA) Data

GOALS

Time Series Forecasting
Develop optimized models to analyze energy consumption patterns across various sectors

Time Series Clustering
Develop models to cluster states based on energy usage trends. Identify shared behaviors to facilitate policy development

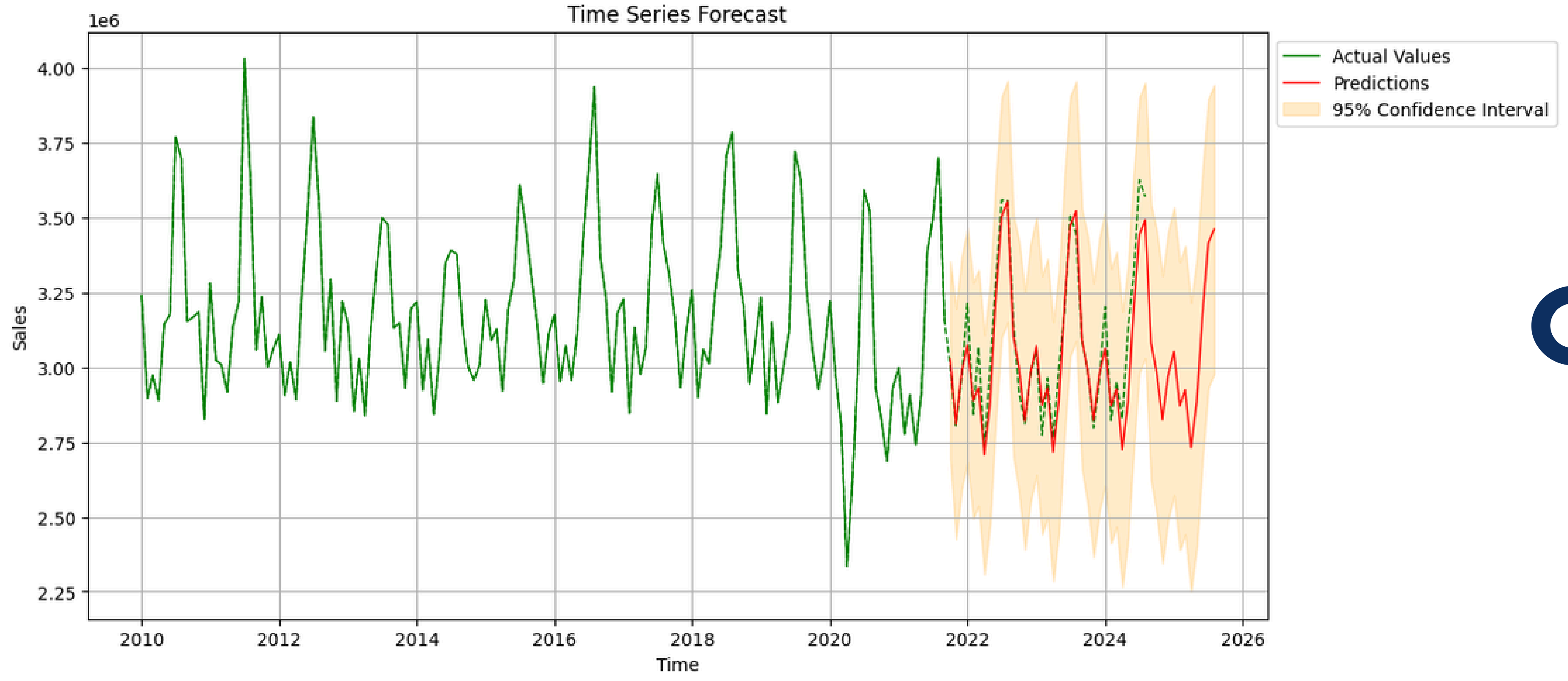
Forecasting

METHOD

1. Models (ARIMA, SARIMA)
2. Data Split
3. Stationarity
4. ACF & PACF
5. Hyperparameter Optimization
6. Model Evaluation (RMSE, MAE, R2)

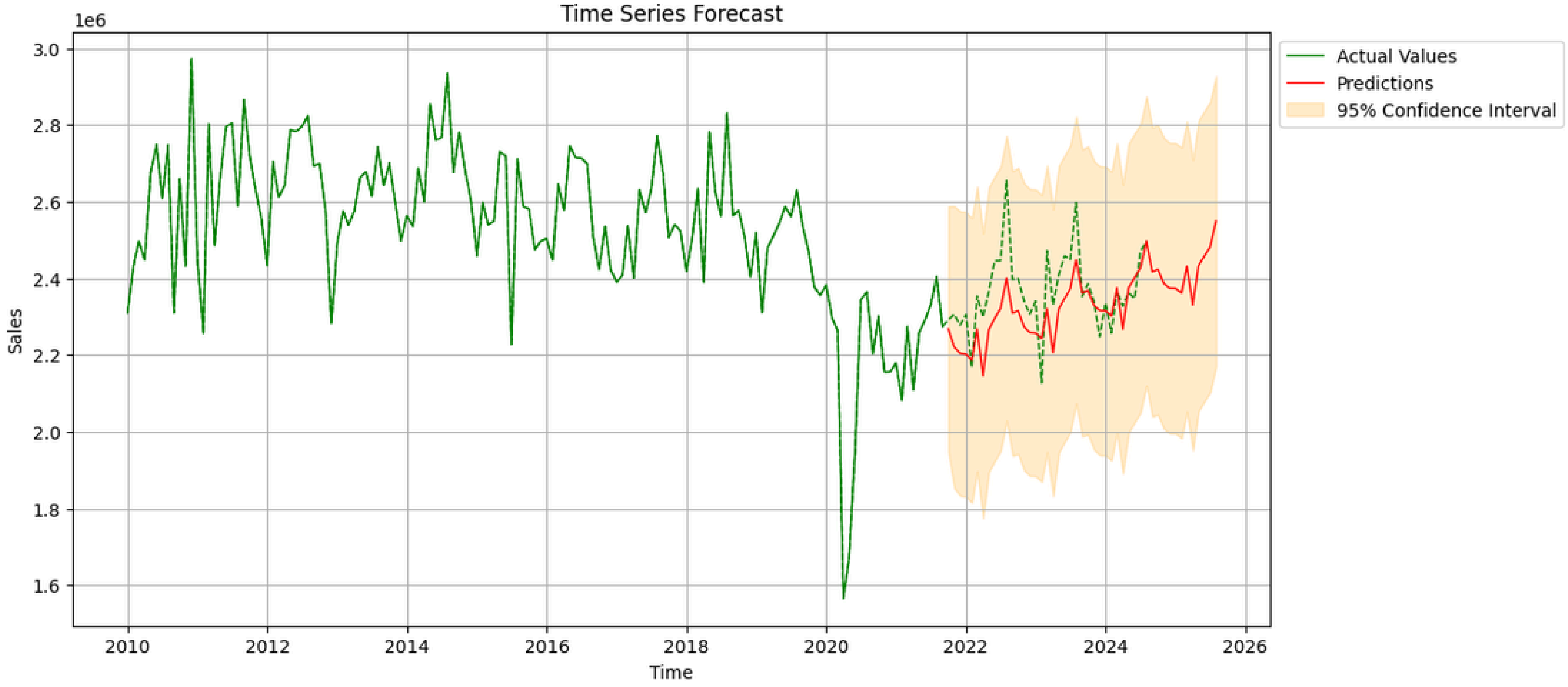
RESULTS

Sector	R2	RMSE	MAE	Std Dev (Target)
Residential	0.75	209,445 (43%)	151,761 (31%)	483,162
Commercial	0.83	98,414 (36%)	80,545 (29%)	276,385
Industrial	0.96	42,152 (20%)	15,379 (7%)	208,203
Transport	0.29	74 (54%)	55 (40%)	137



Commercial Sector

Industrial Sector



Clustering

METHOD

Similarity Measures

Euclidean Distance: Captures simple patterns.
Dynamic Time Warping (DTW): Handles complex, misaligned trends.

Clustering Approach

Applied K-Means; optimal cluster count (2) determined using Silhouette Scores.
Sector-specific clustering for Residential, Commercial, Industrial, and Transportation sectors.

Post-Clustering Analysis

Statistical summaries and geographic mapping to validate results.

Alternative Configurations

Tested non-optimal clusters for robustness.

Visualization

Summary plots and geographic maps for clear interpretation.

RESULTS SUMMARY

BIG-SMALL STATE SPLIT

- CLEAR DISTINCTION BETWEEN HIGH-DEMAND AND LOW-DEMAND STATES CLUSTERS

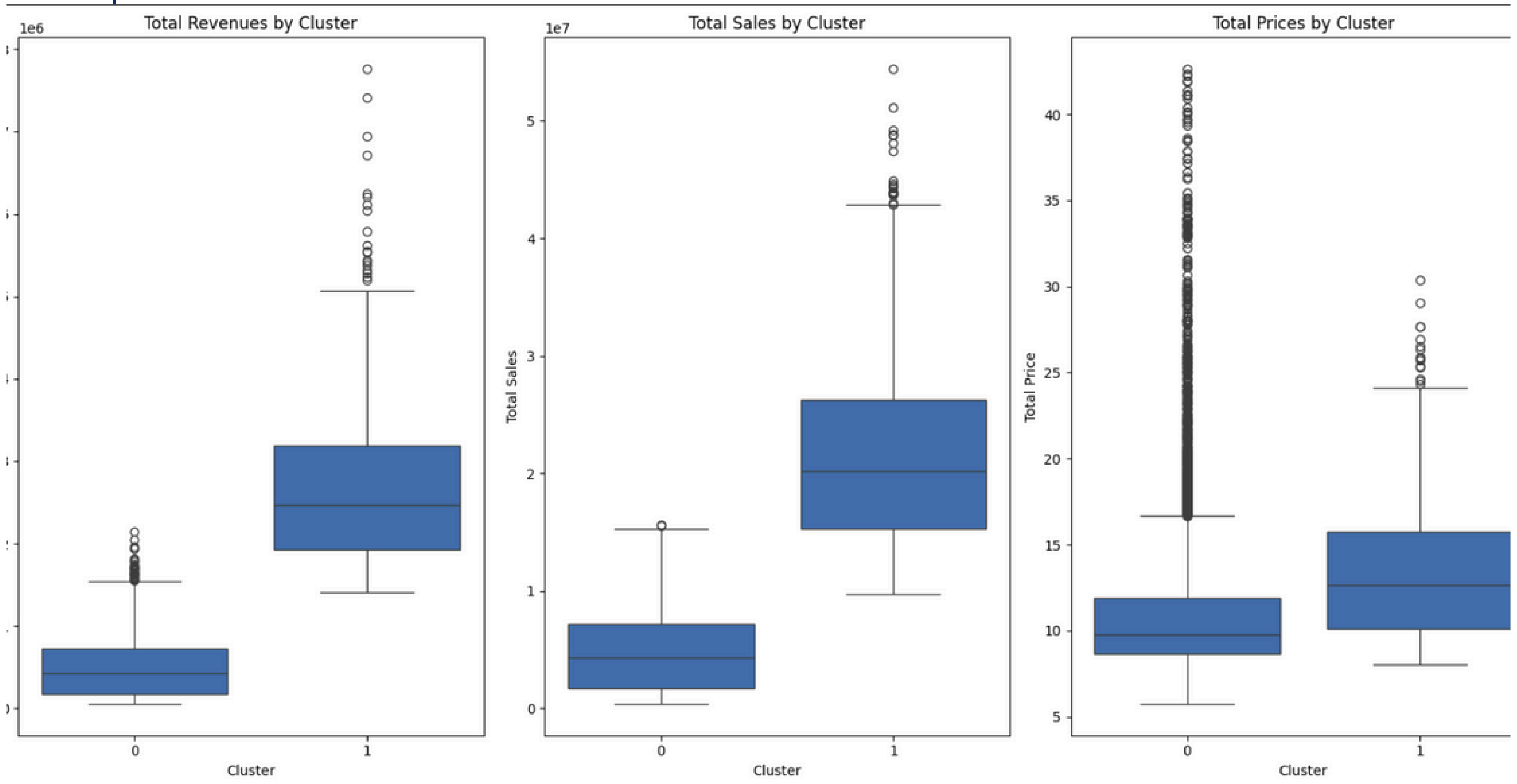
ROBUST METHODS

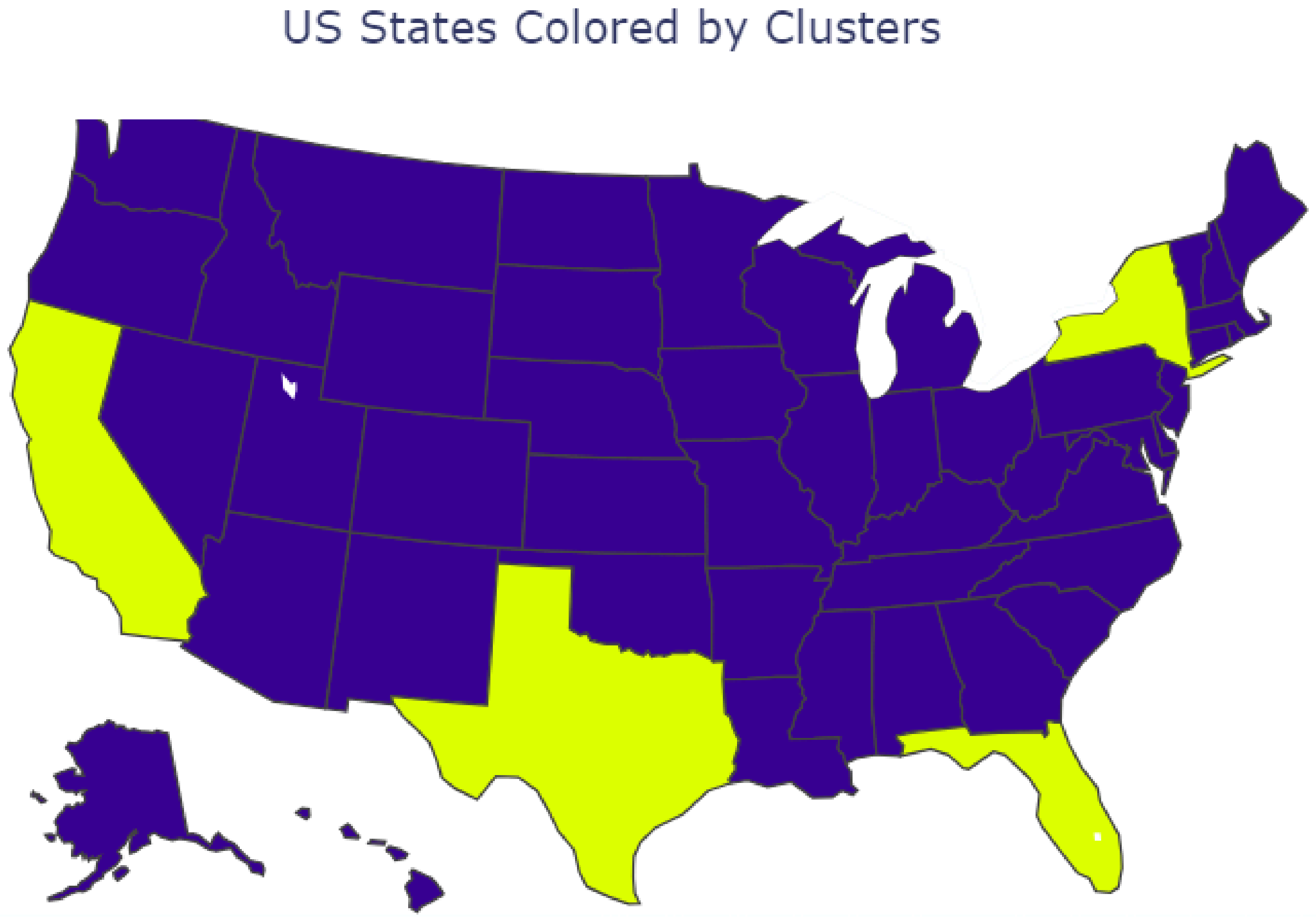
- CONSISTENT RESULTS USING BOTH EUCLIDEAN DISTANCE AND DYNAMIC TIME WARPING.

SECTOR CONSISTENCY

- CLUSTERS REMAIN CONSISTENT ACROSS ALL SECTORS

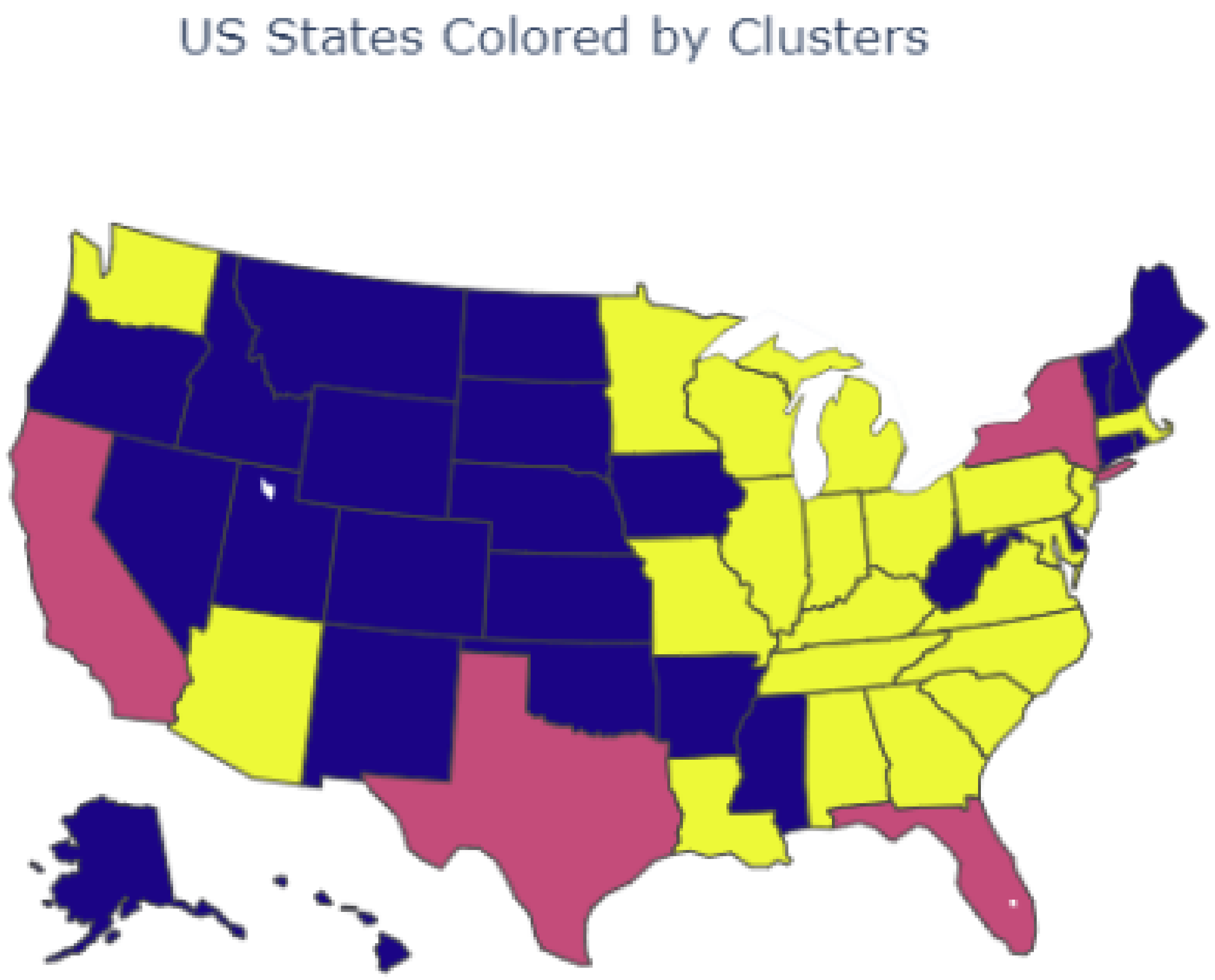
OPTIMAL RESULTS



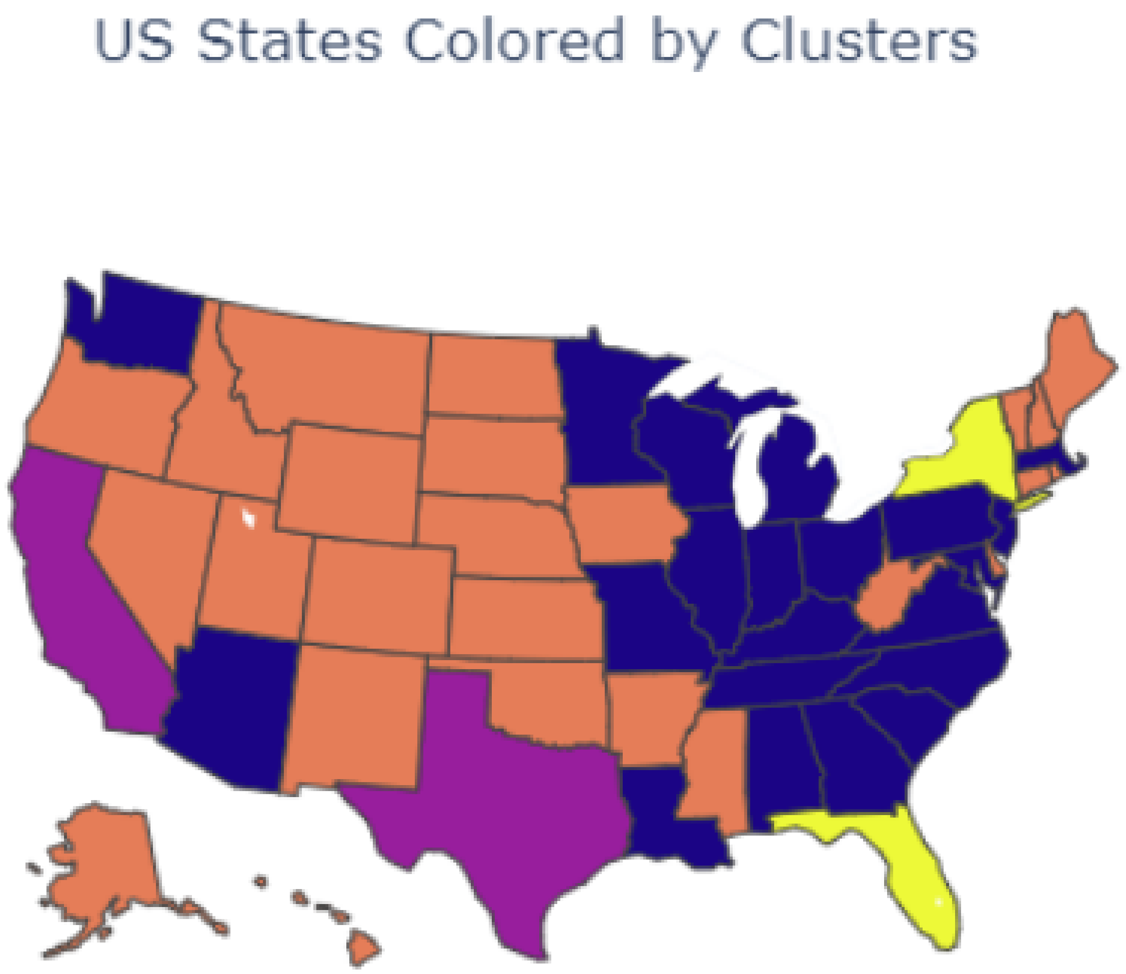


NON-OPTIMAL RESULTS

3-MEANS CLUSTER



4-MEANS CLUSTER



IMPLICATIONS

ACTIONABLE INSIGHTS FOR POLICYMAKERS

- TAILOR STATE-SPECIFIC ENERGY POLICIES; FOSTER REGIONAL COLLABORATION FOR SUSTAINABLE RESOURCE ALLOCATION.

STAKEHOLDER BENEFITS

- ALIGN PRODUCTION WITH TRENDS; DEVELOP INNOVATIVE PRICING MODELS.

SECTOR-SPECIFIC OPTIMIZATION

- PRIORITIZE CROSS-SECTOR STRATEGIES IN HIGH-DEMAND STATES; ENHANCE EFFICIENCY WITH SEASONAL FORECASTS.

STRATEGIC PLANNING FOR ENERGY TRANSITION

- FACILITATE RENEWABLE ENERGY INTEGRATION; IDENTIFY SHARED INFRASTRUCTURE INVESTMENT OPPORTUNITIES.

Thank You