

Energy Use Forecasting: City of Mesa, AZ



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Applied data science DSC 680

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Introduction

- Prices are on the rise for everything these days and 12 News reports that there will be an increase of 39% for the cost of electricity for the city of Mesa, AZ in 2025.
- The current average power bill is \$200 a month (Parker & Sons, 2025).
- Arizona wants to increase renewal energy consumption by 15% by the end of 2025 (Parker & Sons, 2025).

Project Goal

- A solar company is considering building a business location in the city of Mesa, AZ.
- They'd like to ensure there is a business opportunity in the area prior to building the location.
- The company wants a time series model built with the following questions answered:
 - Is energy usage expected to increase?
 - How is energy usage for properties with solar power changing overtime?
 - Are there any trends where electrical usage increases/decreases?
 - What would be the best model to show energy consumption forecasting?

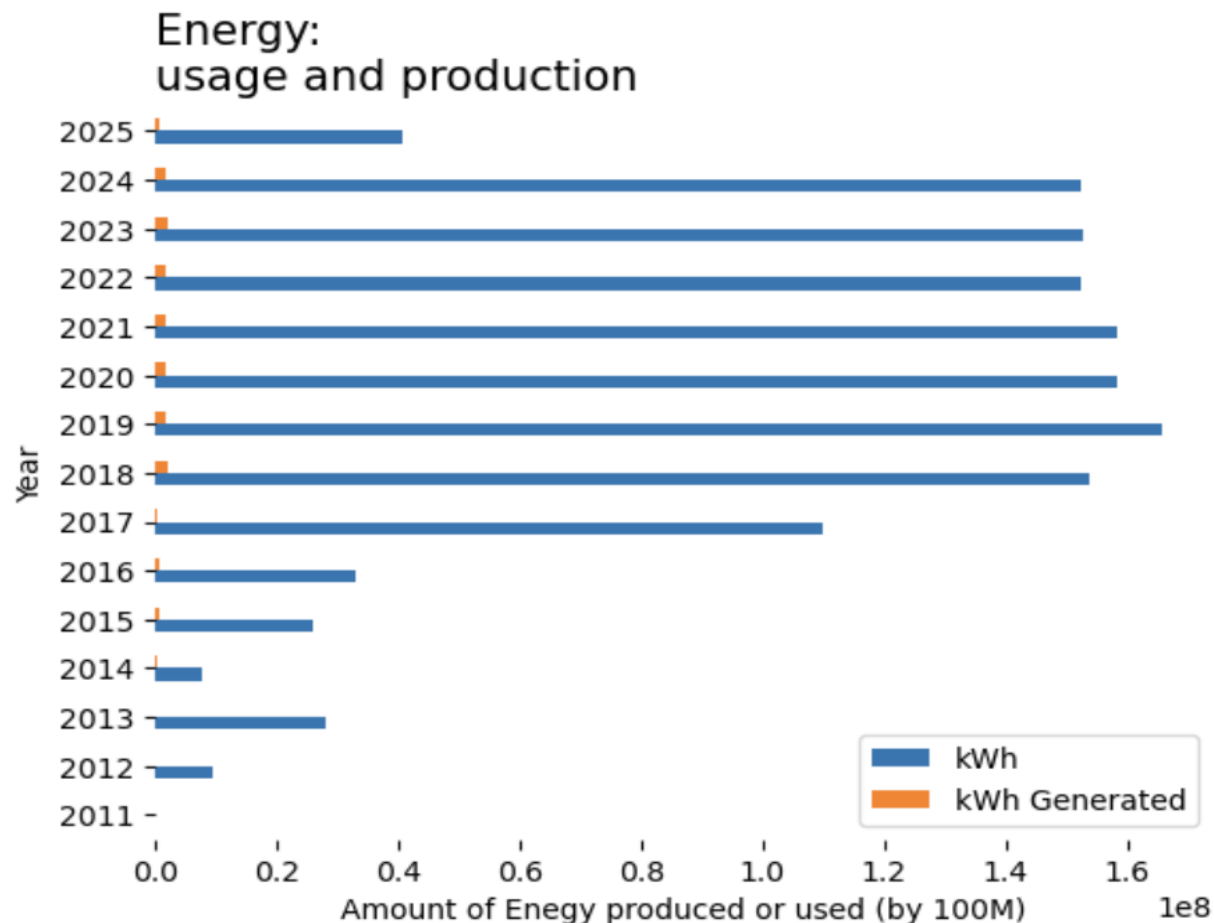
About The Data

- The data set was obtained from the City of Mesa website and is not anonymized.
- The data set consists of 22 columns with 135,710 rows of data.
- We'll be working with three of the columns: "Month Date", "Solar Flag", and "kWh".
- The remaining columns were removed as they appeared to provide no value to the time series models.

Data Preparation

- The data was split into two separate data frames. Those with solar and those without.
- The mean for the month was taken for all locations to obtain a value for that month.
- Once this was completed, the kWh values were replaced by a Lambda value based on quartile ranges of box plots.

Solar Vs. Non-Solar Energy Use/Production



Models Used

- While Many models were attempted (LSTM, SVR, Rolling Means... etc.) The best two were kept:
 - XGBoost with Elastic Net
 - Facebook's Profit

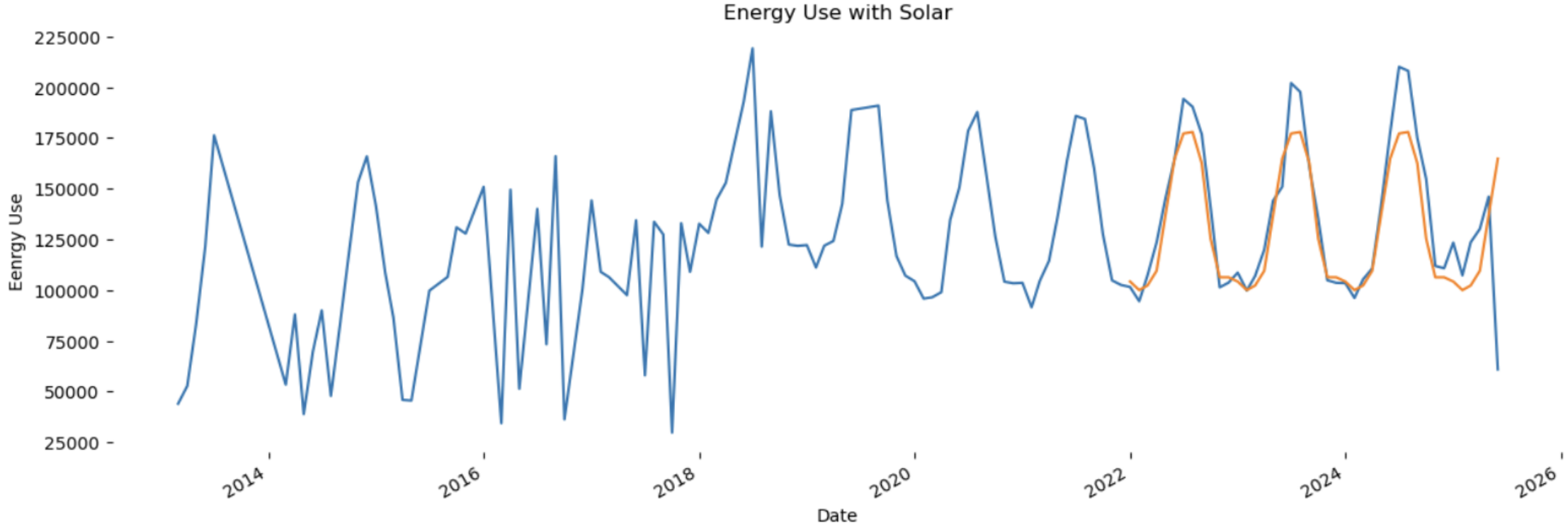
Evaluation Methods

- Mean Absolute Error.
- Mean Squared Error.
- Mean Absolute Percentage Error.

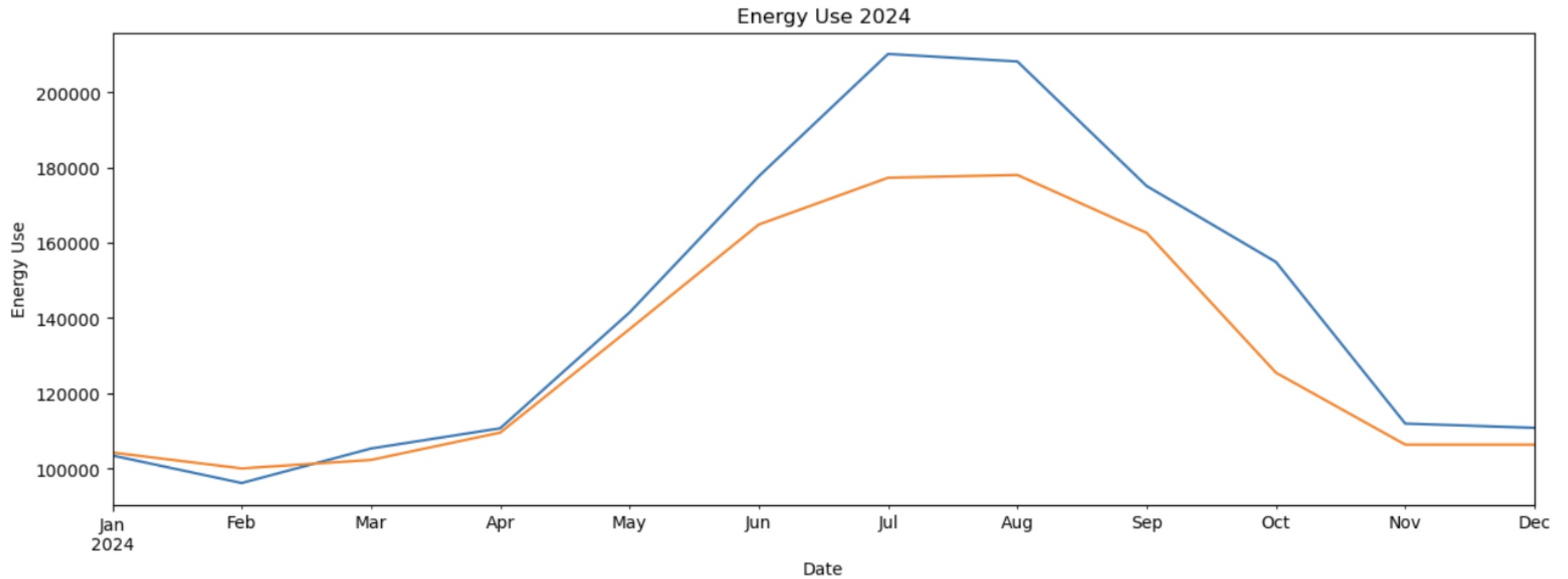
Model Results

	XGBOOST		Profit	
	Regression			
Method	Solar	Non-Solar	Solar	Non-Solar
Mean Absolute Error	12,526.35	0.013	36,897.81	0.117
Mean Squared Error	20,825.82	0.33	48,218.34	0.079
Mean Absolute Percentage Error	10.82%	0.4%	37.04%	2.3%

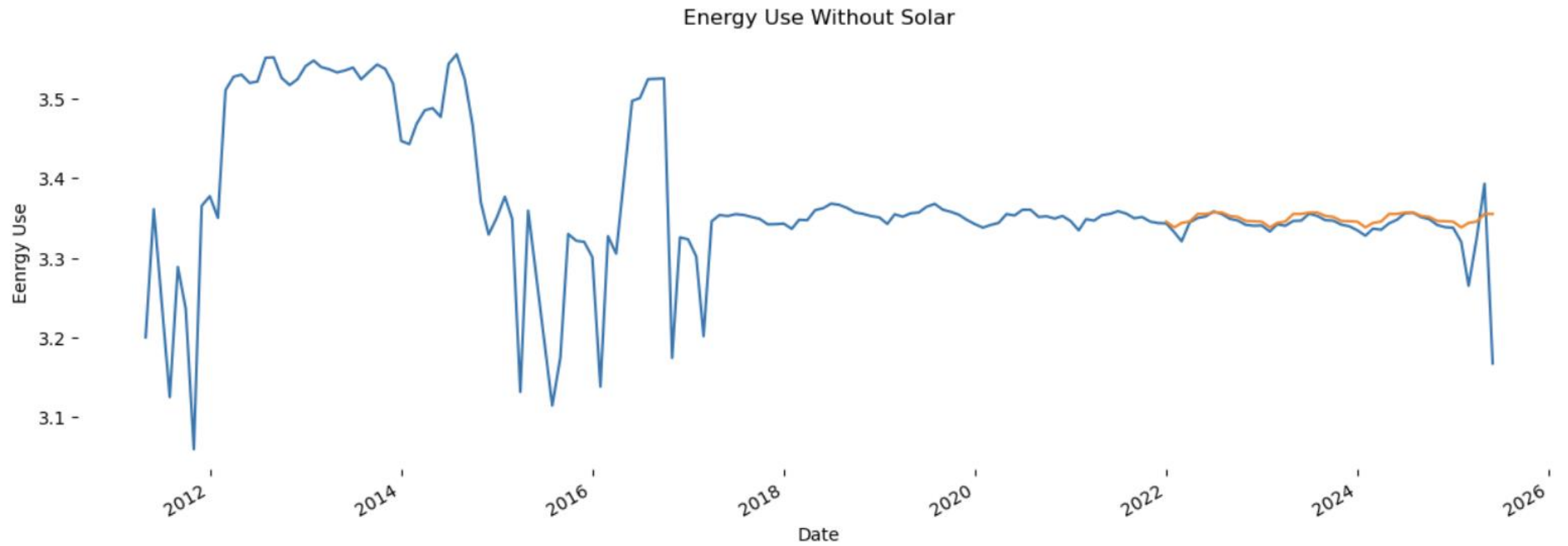
Model Solar Use (All-Time)



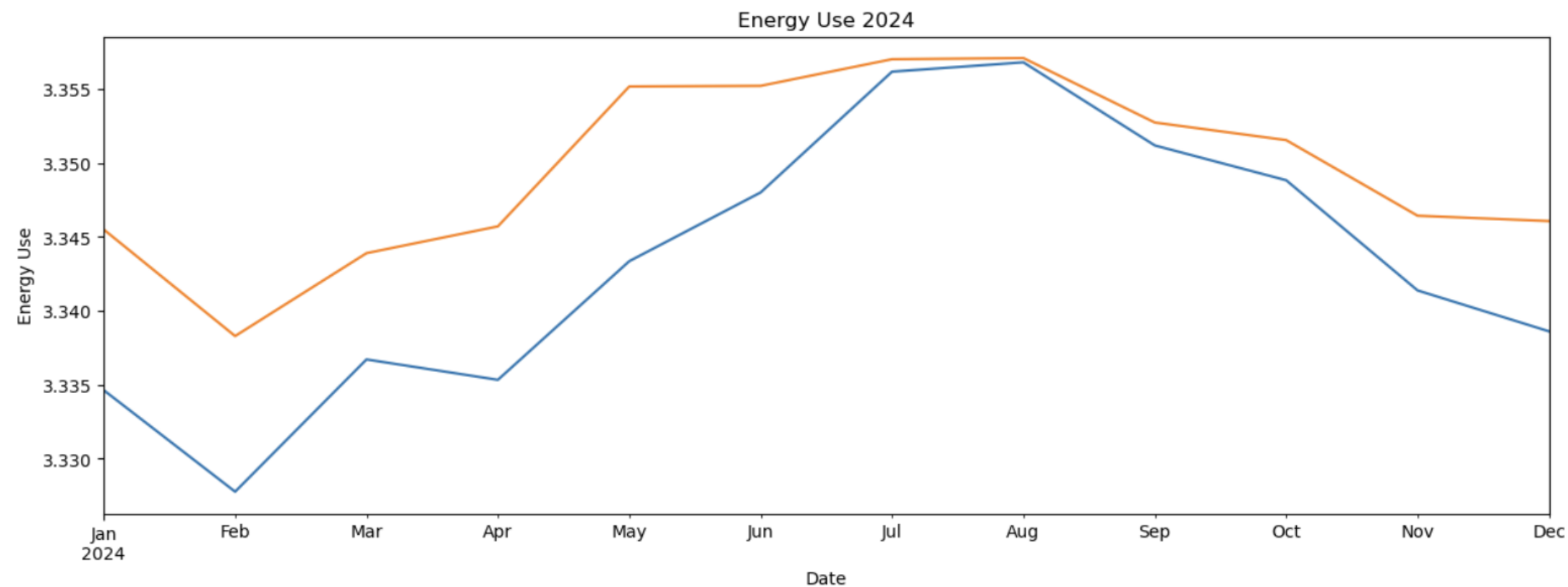
Model Solar Use (1-Year)



Model Non-Solar Use (All-Time)

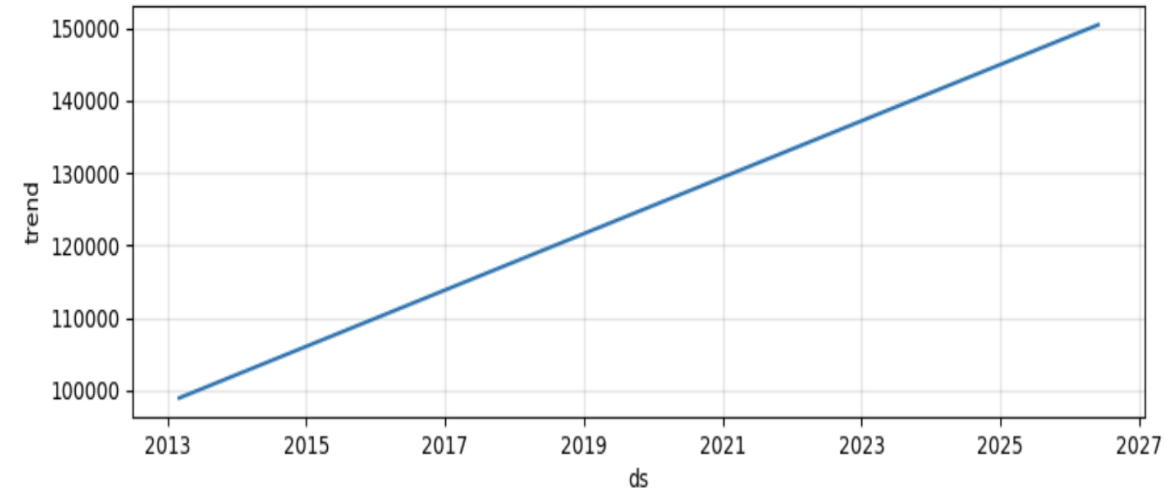


Model Non-Solar Use (1-Year)

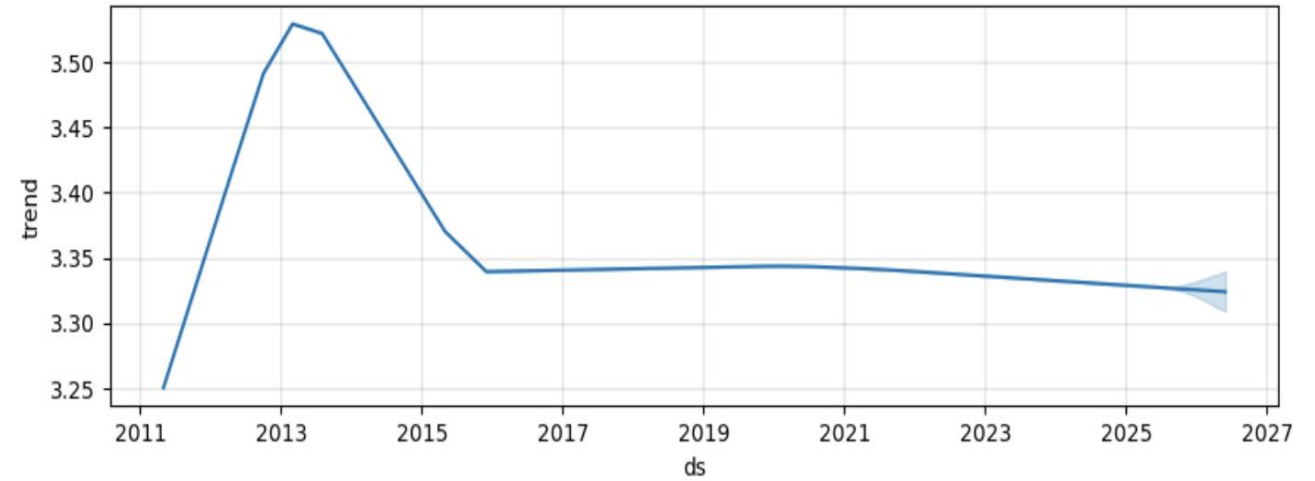


Trend model (Profit)

Solar Energy Use



Non-Solar Energy Use



Conclusion

- The models show an increase in energy consumption for all buildings.
- The increase in solar energy use is increasing slowly.
- There is seasonality in the model for the summer and winter months.
- The best model for forecasting energy usage is XGBoost Regression with Elastic Net.
- The models show a growing demand for solar power.

Recommendations

- HOA research is needed.
- Adding the following to the model may improve its accuracy:
 1. Population
 2. Weather patterns
 3. New business

Future Use Cases

- Other companies moving to the area can use the models to evaluate if the city can handle their electrical load needs.
- The city can use the model to monitor infrastructure for a growing population.
- The city can also use the model to determine the best time for infrastructure upgrades or to help evaluate their pricing.

References

- Parker & Sons, P. &. (2025). Understanding the Rising Cost of Today's Electrical Prices. Retrieved from <https://www.parkerandsons.com/blog/understanding-the-rising-cost-of-todays-electrical-prices>
- Reagan, K. (2024). Mesa City Council pass utility rate hike despite public objections 12news.com. Retrieved from <https://www.12news.com/article/news/local/valley/mesa-city-council-pass-utility-rate-hike-despite-objections-from-residents-arizona-mayor-john-giles/75-f80084ec-e6bf-4584-9704-618f764ad63f>
- Sustainability, E. and. (2025). City Energy Usage: City of Mesa Data Hub. Retrieved from https://data.mesaaz.gov/Environmental-and-Sustainability/City-Energy-Usage/ksen-g4gs/about_data