



# IMPROVING THE RELIABILITY OF THE TEXAS ELECTRICAL GRID WITH IMPROVED FORECASTING

Andy Roberts

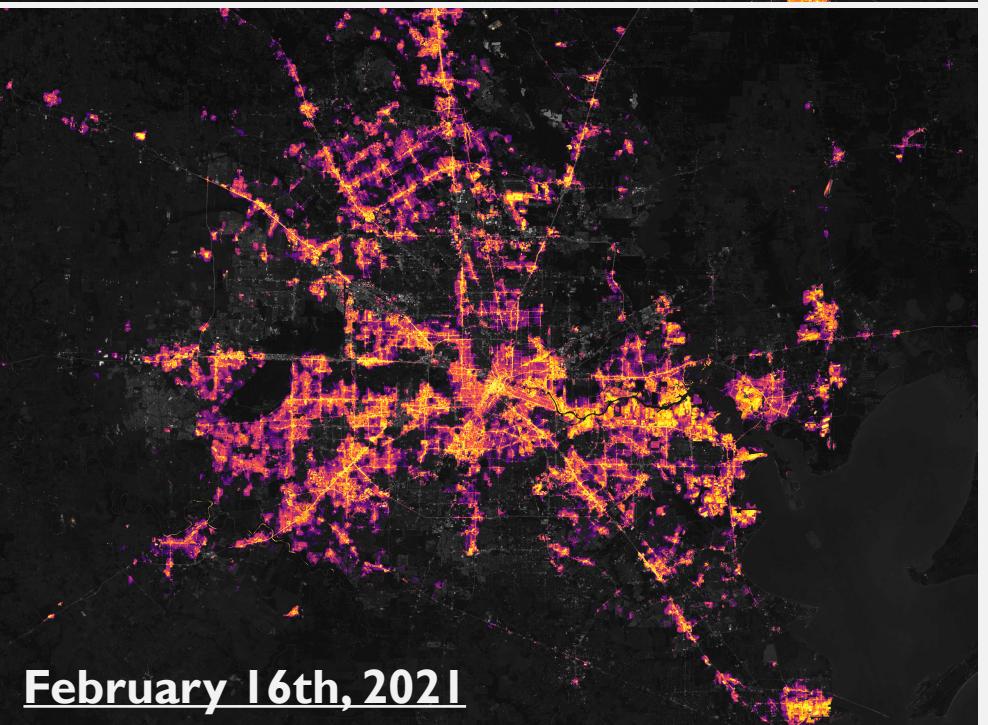
April 19<sup>th</sup>, 2021

# AGENDA

- Winter Storm Uri
- ERCOT
- EDA
- Univariate Models
- Multivariate Model
- Conclusions



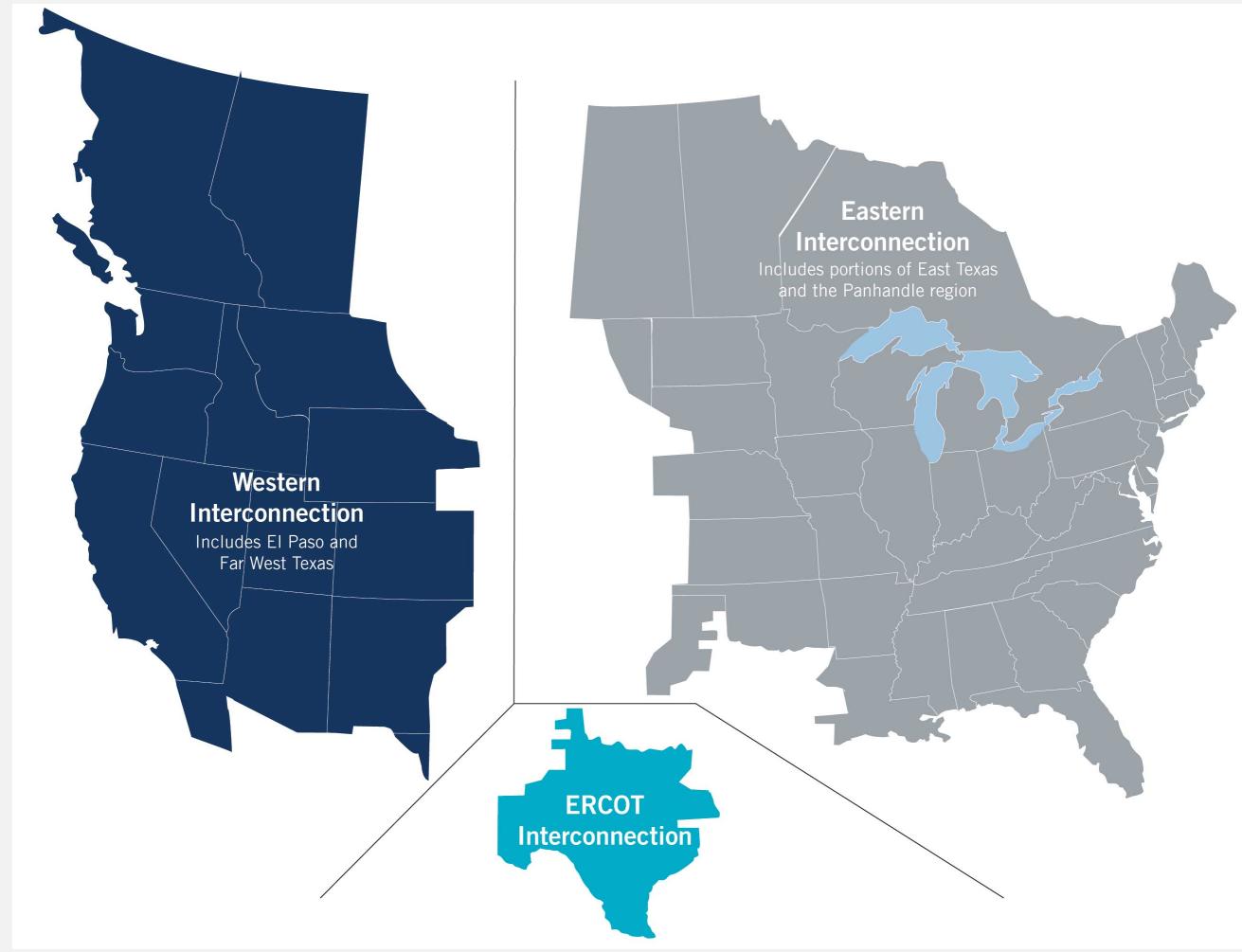
February 7th, 2021



February 16th, 2021

## WINTER STORM URI

- February 13-17, 2021
- Typical Feb. power demand – 55 GW
- > 74 GW load peak
- 4.5 million without power at peak
- Over 100 deaths
- Widespread property damage



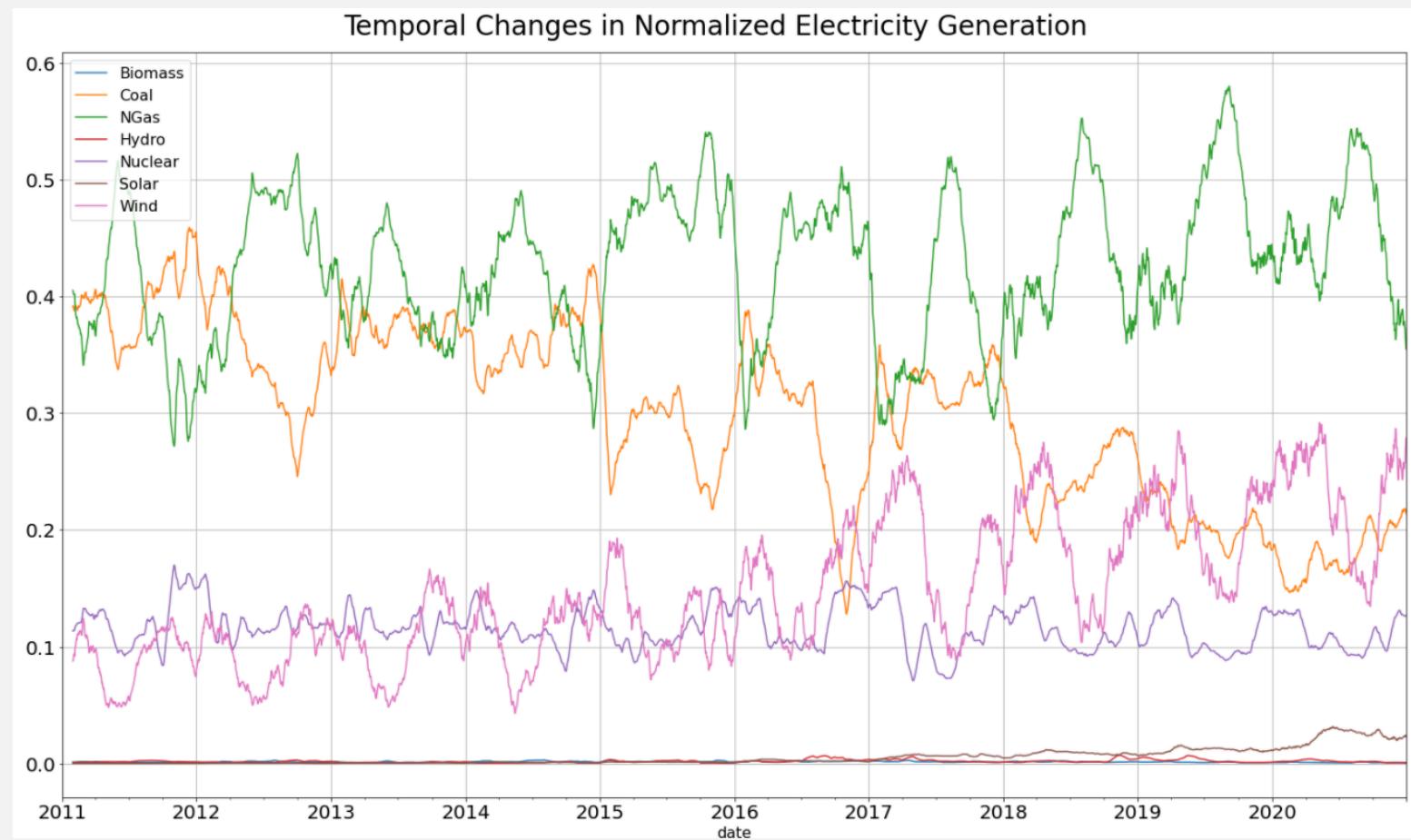
<http://www.ercot.com/news/mediakit/maps/>

## ELECTRIC RELIABILITY COUNCIL OF TEXAS

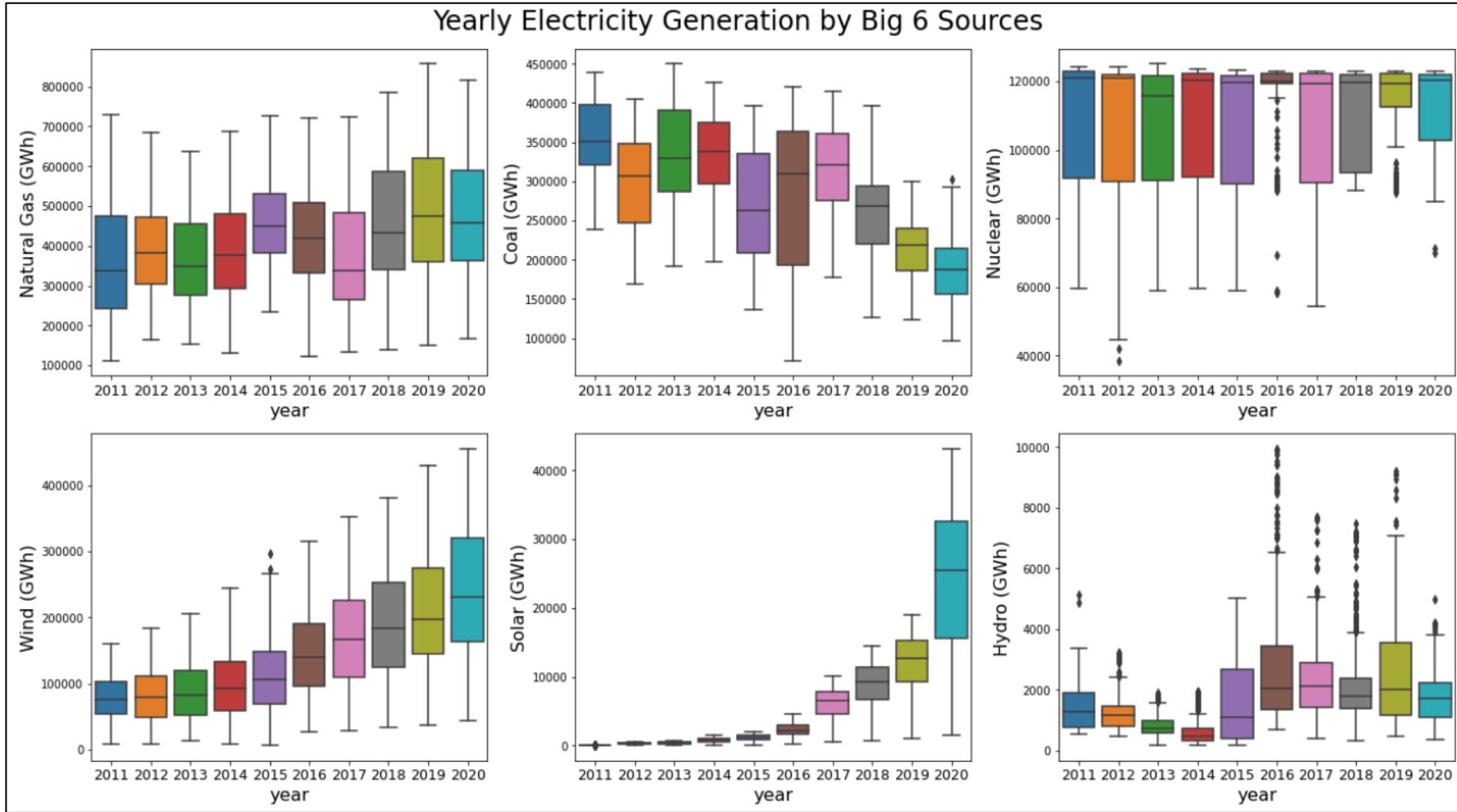
- Nation's only pure “energy only” electricity market
- Provides affordability at the expense of reliability

# ENERGY SOURCES THROUGH TIME

- Natural gas dominates
- Wind emerges
- Coal in decline



## Yearly Electricity Generation by Big 6 Sources



# VARIATION BY SOURCE

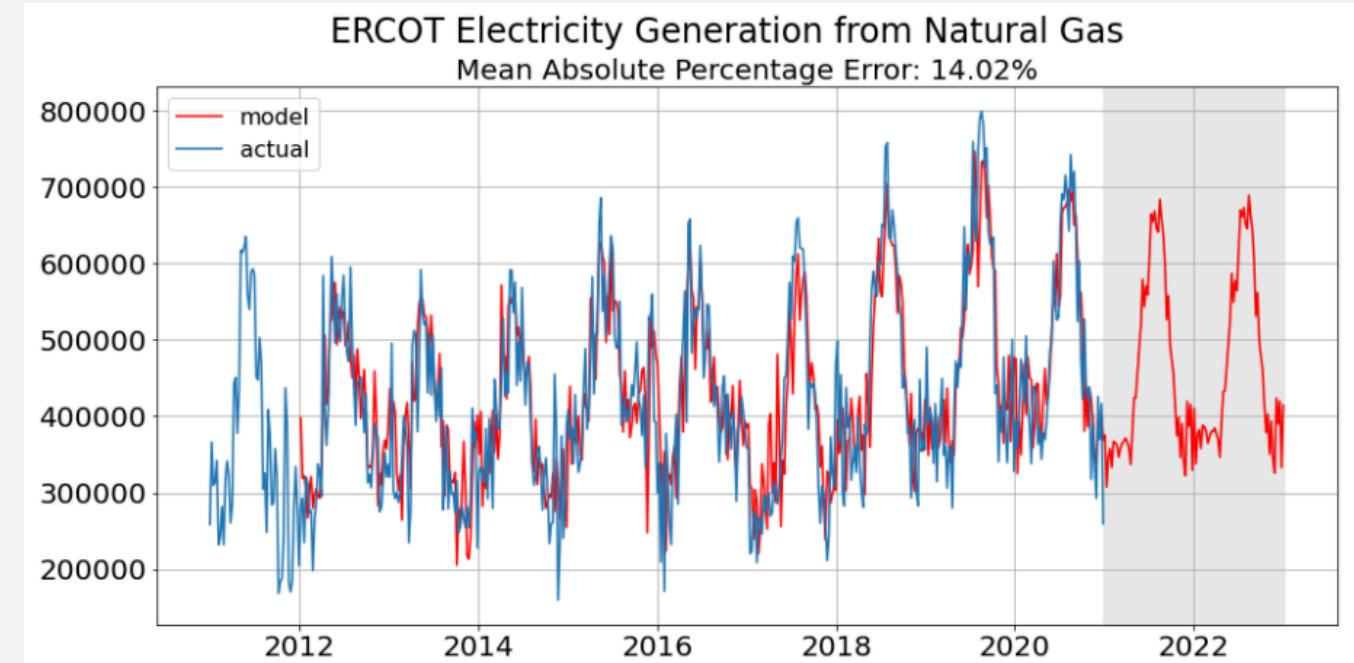
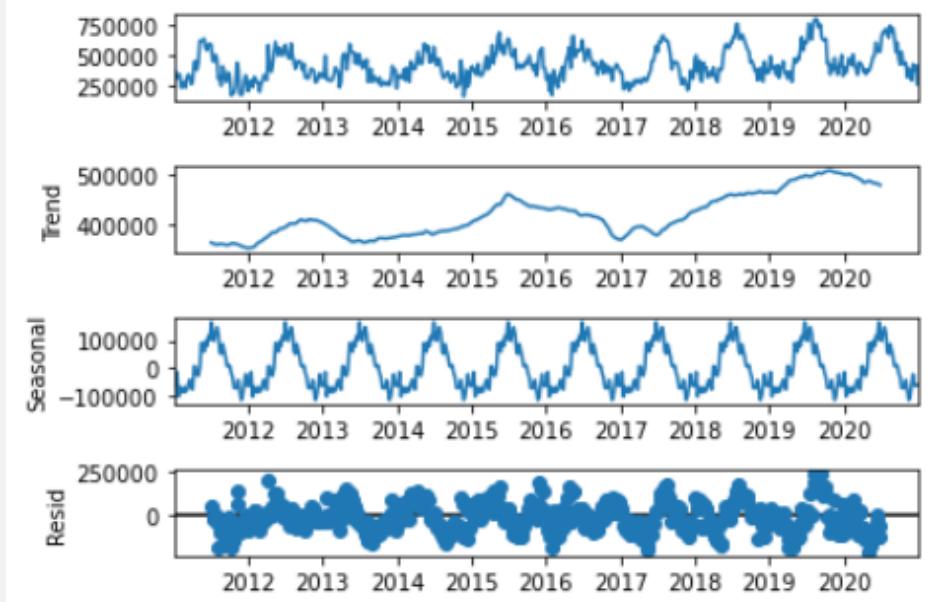
$$\text{ARIMA } \underbrace{(p, d, q)}_{\begin{array}{c} \text{Non-seasonal part} \\ \text{of the model} \end{array}} \quad \underbrace{(P, D, Q)_m}_{\begin{array}{c} \text{Seasonal part} \\ \text{of the model} \end{array}}$$

[https://bradzzz.gitbooks.io/go-seattle-dsi/content/dsi/dsi\\_09\\_time\\_series/4.1-lesson/readme.html](https://bradzzz.gitbooks.io/go-seattle-dsi/content/dsi/dsi_09_time_series/4.1-lesson/readme.html)

## SARIMA EXPLAINED

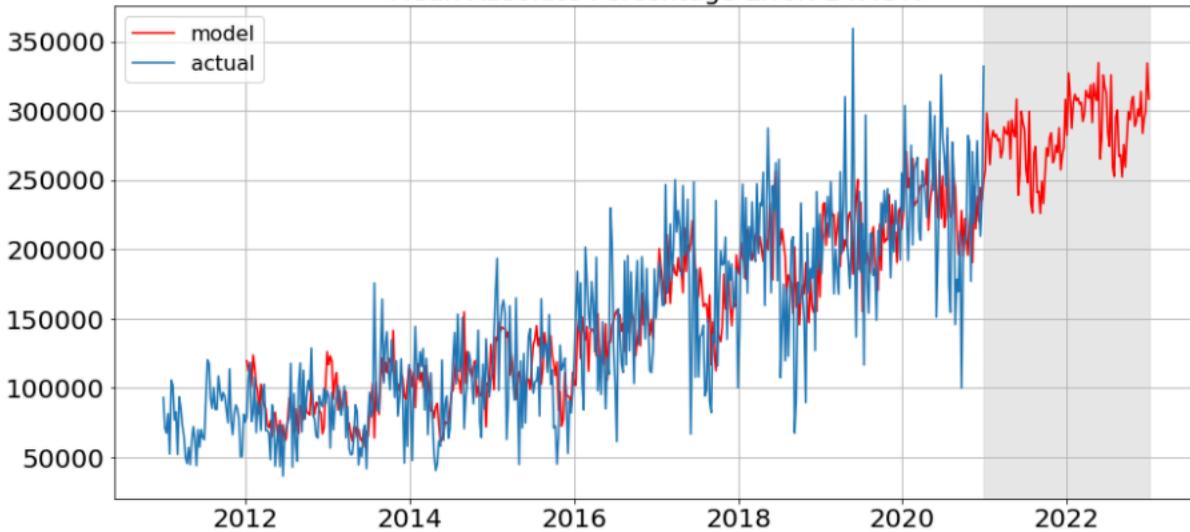
# NATURAL GAS FORECAST

- Optimized for minimum AIC
- SARIMA  $(2, 1, 3)(0, 1, 0)$ [52]
- MAPE – 14.02%





ERCOT Electricity Generation from Wind  
Mean Absolute Percentage Error: 24.43%

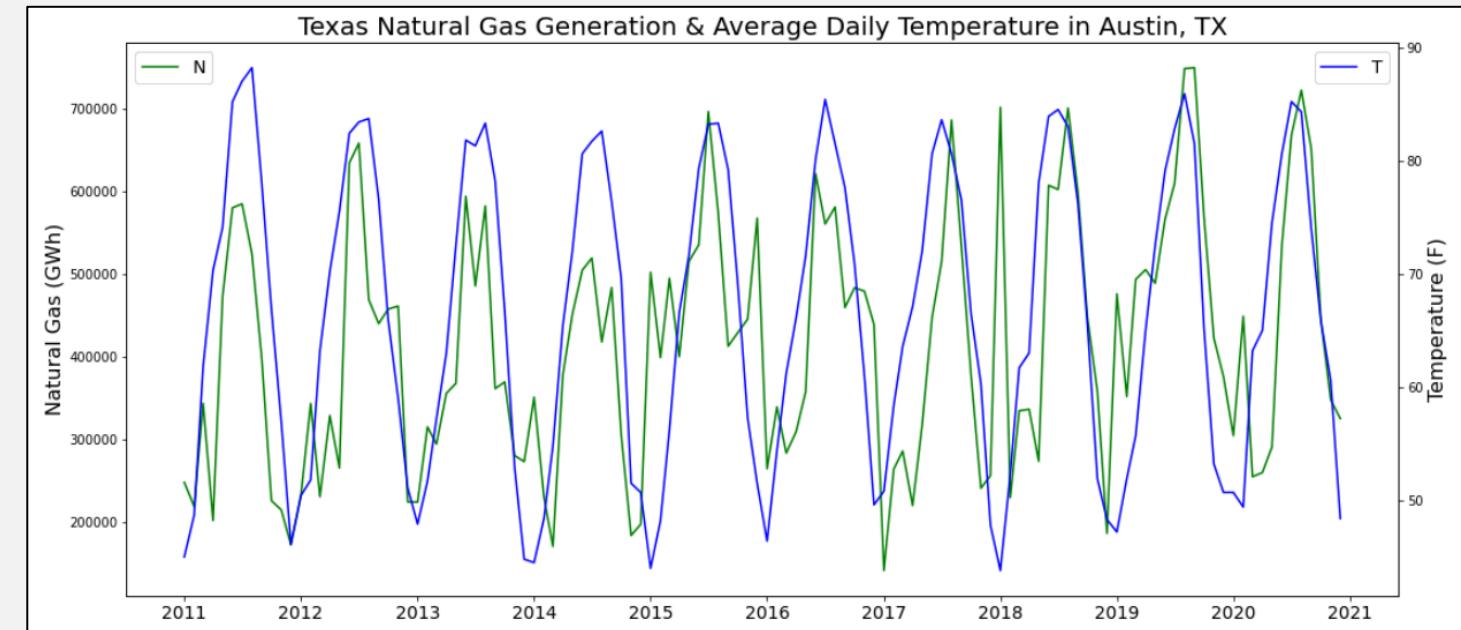


## WIND ENERGY FORECAST

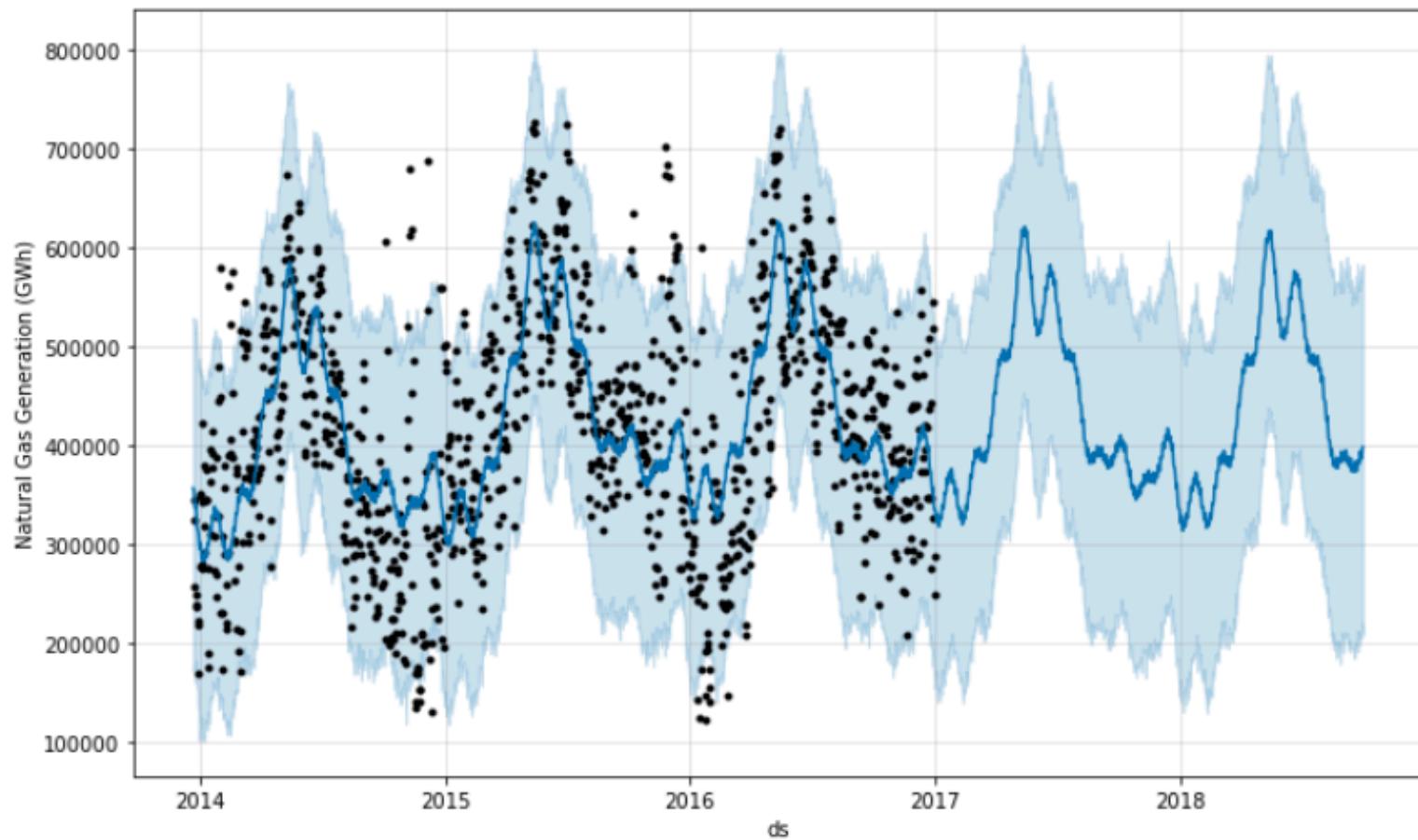
- Optimized for minimum AIC
- SARIMA  $(2, 1, 2)(0, 1, 0)$ [52]
- MAPE – 24.43%

# MULTIVARIATE FORECASTING

- Incorporating multiple features to predict one target through time
  - Natural Gas and Temperature (monthly)
- Facebook Prophet works well with seasonal data



- Daily natural gas & temperature data from 2014-2017
- Prophet model with yearly seasonality
- Cross validated MAPE – 17%



## CONCLUSIONS

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Winter Storm Uri increased attention on the Texas power grid

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Machine learning models can assist with producing better forecasts for generation planning

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Univariate had lower MAPE than multivariate, but requires further investigation