Energy Market Price Variation vs. Temperature Change in Houston, TX
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Background

- It is important to analyze how energy demand changes over time with increasing populations and rising global surface temperatures
- Regional Transmission Organizations (RTOs) monitor, distribute, and record energy usage throughout the United States
- The Electric Reliability Council of Texas (ERCOT) is the RTO solely responsible for the Texas energy marketplace
- ERCOT’s unique energy-only market combined with the rapid increase of Texas’ average surface temperatures allow for a unique case study
- Houston is of particular importance because it is a major economic hub and population center
- Settlement prices are set as predictions based on 15 minute intervals of constantly changing demand

Method

- Temperature data was taken from the National Weather Service (NWS) and plotted to compare the coldest (January) and hottest (July and August) months of the year
- Excel was used to plot daily settlement prices over the course of each month
- Each settlement price day is broken down into 24 one-hour increments

References


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Fig. 1
Average Daily Temperatures in January 2019
Fig. 2
Average Daily Temperatures in January 2019
Fig. 3
Average Daily Temperatures in January 2019
Fig. 4
Daily settlement prices in January 2019
Fig. 5
Daily settlement prices in July 2019
Fig. 6
Daily settlement prices in August 2019

Discussion

- Fig. 2 and 3 have more even distributions of temperature, reflecting a steady trend in price figures 5 and 6, not accounting for extreme outliers
- Fig. 5 and 6 have significantly higher standard deviations, indicating greatly fluctuating prices due to outliers
- Fig. 4 displays price lows that correspond with temperature highs in Fig. 1, possibly due to less demand for heating during warmer days in the winter
- Price highs in July and August occur in a daily cyclical nature from 14:00 to 18:00, in line with the times of day when most people are inside at work or escaping the mid-afternoon sun
- The correlation is positive yet weak, with only limited data available for historical settlement prices

Future Work

- Historical settlement prices are only available as far back as 2011, and further data is needed in order to test for a stronger relationship over a longer time period
- 2011 and 2012 are outlier years for high average annual surface temperatures, which may cause the data to be skewed
- Power grid locations are a national security concern, possibly increasing the occurrence of price variability due to unknown factors such as power line degradation
- Texas’ lack of regulation for wind power infrastructure is projected to enable wind to have an increasing share of the ERCOT energy market
- Wind generation can account for up to 9000MWH of demand daily which may greatly increase price variation and make it difficult to estimate prices based on demand
- Further research would include demand as a factor to analyze the effect of other factors such as population growth and increase in urban industrial facilities
- Data should be analyzed in order to create policy addressing increased energy demands and viability of renewables in order to meet these demands