Regional Retail Electricity Prices

Target Markets with Higher Sustained Prices and 20-year Trends from January 2001 to February 2020

Thinkful Capstone Project 1 - Experimental Design
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June 2020

Understanding the Landscape of Power Prices

Industry Structure

Long-term Revenue Contracts and Obligations

The power generation industry operates on a very long-term basis, with most company revenue contracts and fixed asset investment horizons ranging from ten (10) to thirty (30) years long.

Industry Risk

Rapidly Changing Industry with Long-term Contracts

When making large, long-term investments and commitments in an industry with rapidly changing technology and regulation, power generators are exposed to significant risks.

Energy Markets

Significant Risk from Fluctuating Energy Prices

Today, generators are exposed more to fluctuating energy market prices with the establishment of independent system operators (ISOs), throughout and at renewal of revenue contracts.

Power Generation Industry: Regional Strategy

Consistently Higher Power Prices

Are there certain regions with consistently higher retail electricity prices that a national power generation company should focus on targeting for growth in?

Consistently higher power prices could show areas of opportunities to build or acquire power plants with more efficient supply chain operations, deploy more expensive new generation technologies, or purchase land for future development near key grid sites.

Power Price Stability and Trends

Have any of these regions' retail electricity prices significantly changed over the past 20 years that should be considered as an additional risk in the region?

To avoid the risk of being impacted by low power market prices with fixed obligations, the pricing difference by region is helpful but the long-term trends over time will provide additional data to strategically guide power generators with long-term decision risks.

Analytical Process

Consistently Higher Power Prices

- A meaningful difference in regional power prices was established.
- The range of expected price differences were reviewed against the national average.
- Comparing the retail electricity prices to the national averages will establish a total potential economic value (for generator, utility, and transmission operator combined).

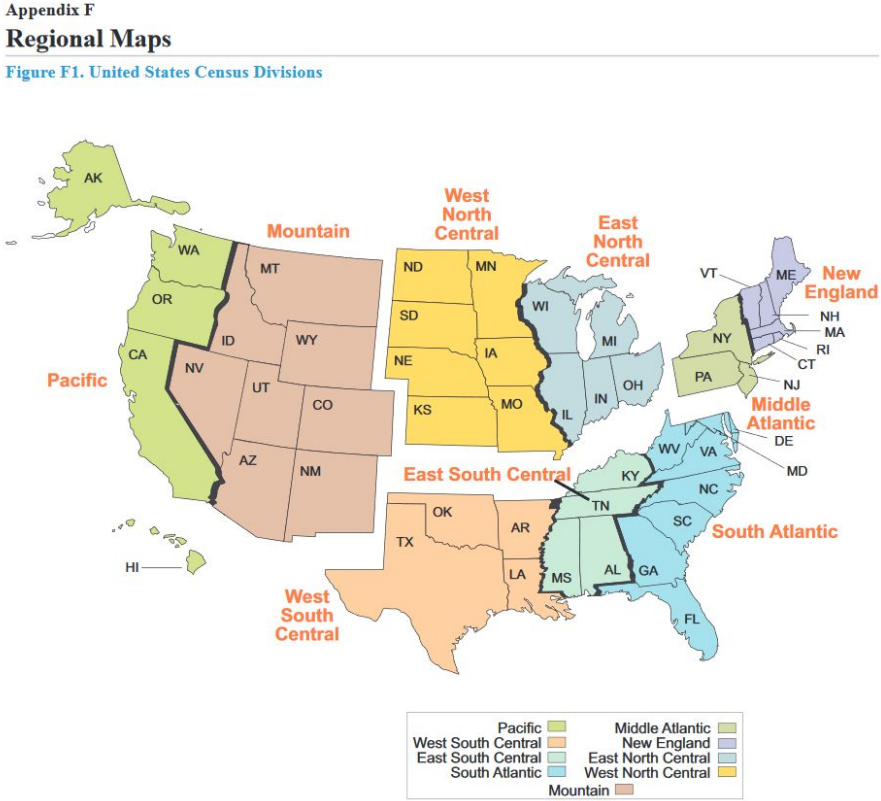
Power Price Stability and Trends

- A meaningful difference in each region's power prices over separate time periods was established (Jan. 2001 to Dec. 2009, and Jan. 2010 to Feb. 2020).
- The overall trend of each region's prices over time was reviewed visually.
- The trends were further understood along additional variables, such as monthly seasonality patterns and industry sector.

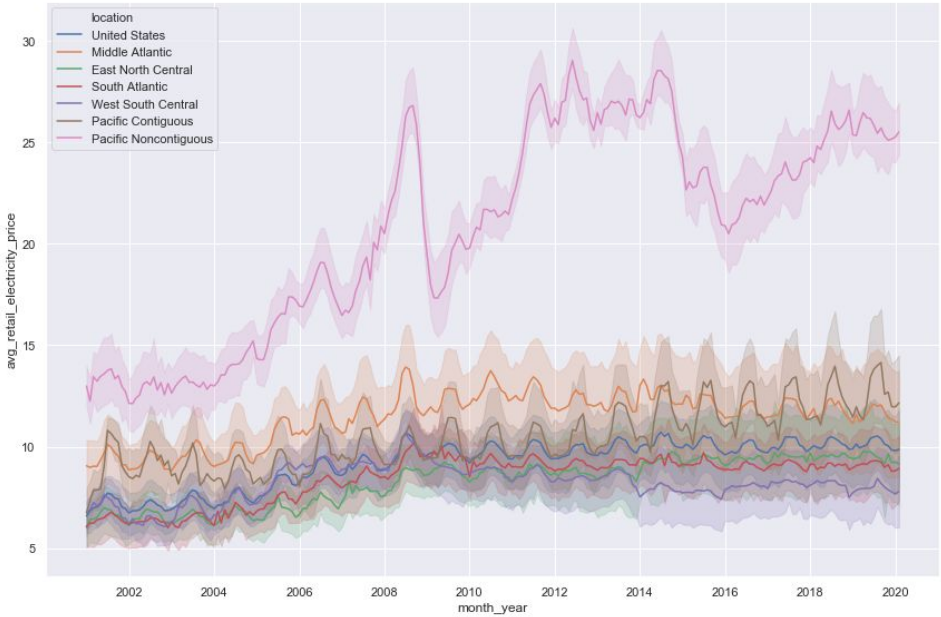
Data Reviewed - Monthly Retail Electricity Prices

Energy Information Administration

- The data consists of monthly average retail electricity prices in kilowatt-hours (kWh) from January 2001 to February 2020, and is broken down by regional location and industry sector.
- The data was downloaded from the Energy Information Administration (EIA) website at https://www.eia.gov/electricity/data/browser/.
- Contains 7,844 observations, with 1,150 observations in the South Atlantic, East North Central, Pacific Contiguous, Middle Atlantic, West South Central, and United States regions, and 944 in the Pacific Noncontiguous region.



Consistently Higher Power Prices



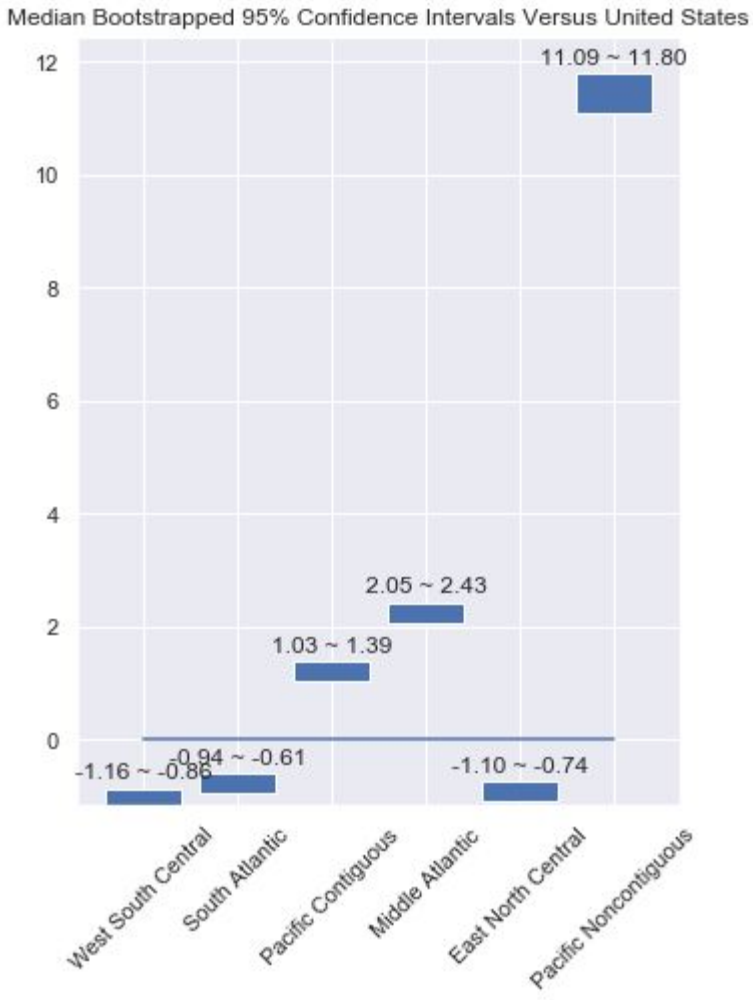
Energy Prices: First Look

The Pacific Noncontiguous region was clearly an outlier compared to the rest of the regional power prices. Therefore it was excluded from the seasonality and trend graphs to see data clearer.

When comparing different regions retail electricity prices from 2001 to 2020, we can conclude that there are statistically significant differences in the medians (Kruskal-Wallis test, $p<0.001$) and distributions (Mann-Whitney rank test, $p<0.001$ generally) of the data for all geographic regions, except for East North Central when compared to West South Central ($p=0.536$).

South Atlantic also shows less of a difference when compared to the East North Central and West South Central regions ($p=0.007$, $p=0.001$).

Consistently Higher Power Prices



Expected Margins

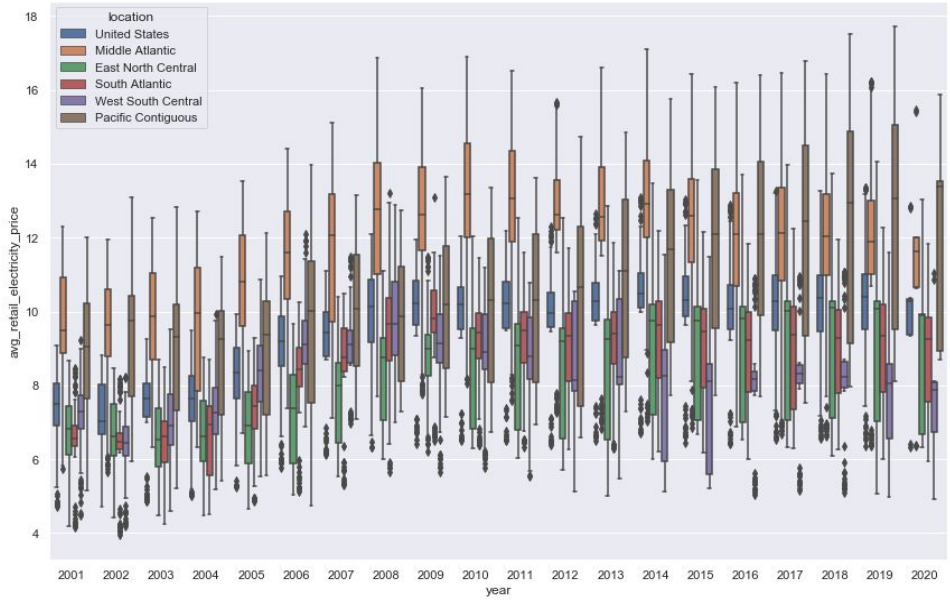
The bootstrapped confidence intervals at 95% confidence are based on medians compared to the United States because the data was not normally distributed. **The intervals indicated that the Pacific Noncontiguous, Middle Atlantic, and Pacific Contiguous regions have demonstrated higher retail power prices on a consistent basis.**

There is a 95% confidence that the future differences of these regions' median retail power price compared to the median retail power price of the United States will be higher by a margin within:

- **$11.08 to $11.79 for Pacific Noncontiguous**
- **$2.06 to $2.45 for Middle Atlantic**
- **$1.03 to $1.39 for Pacific Contiguous**

Consistently Higher Power Prices

Power Price Stability and Trends



Energy Prices: No Outliers

The boxplot shows the middle quartiles of each regions' price ranges in colored boxes, which show separation between regions' price distributions. Seasonality and industry sector impact this range.

Retail electricity prices for each geographic region within the United States were analyzed by comparing price ranges from 2001 to 2009 and 2010 to 2020.

All regions had a significant difference in the medians (Kruskal-Wallis test, $p<0.001$) and distributions (Mann-Whitney rank test, $p<0.001$ generally) of the two time-delineated groups, except for West South Central ($p=0.188$).

With a time frame of 2010-2014 and 2015-2020, the West South Central region showed a significant difference in its distribution of prices ($p=0.023$).

Power Price Stability and Trends

Energy Prices: No Outliers

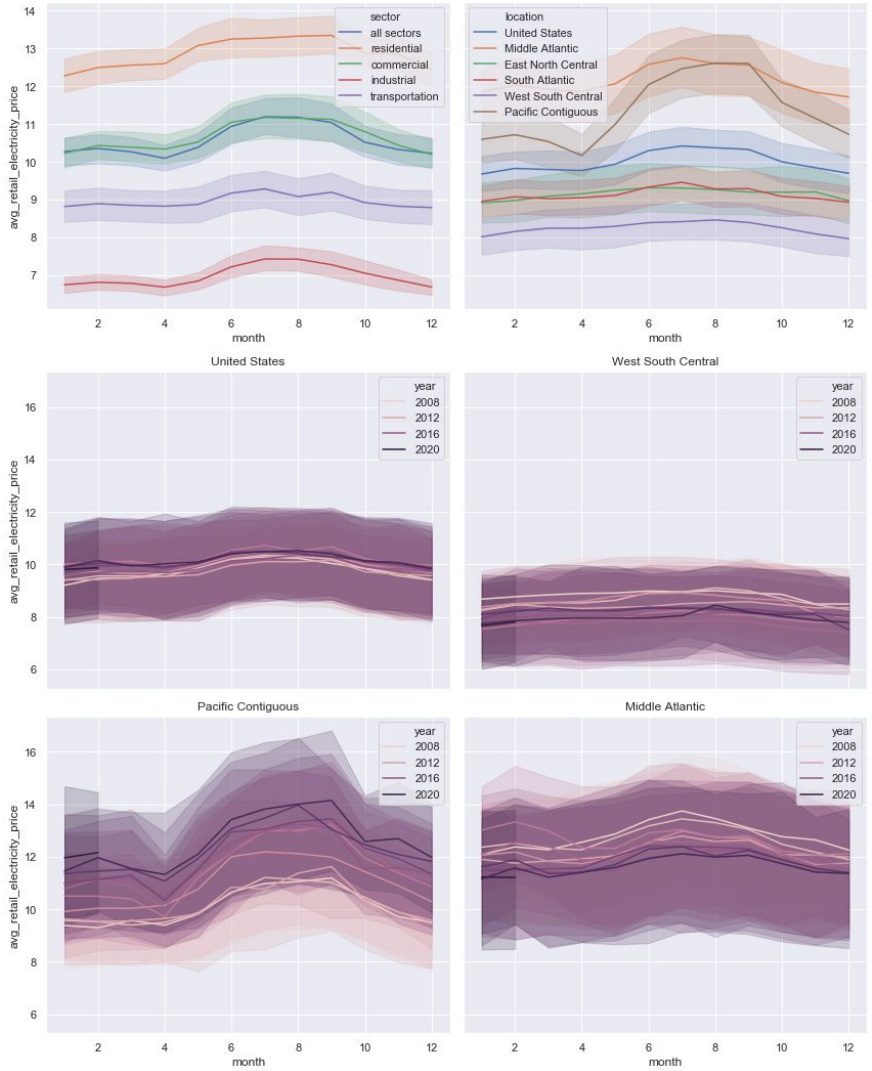
Pricing data from 2001 to 2020 showed an increasing trend to 2009, but have been mostly flat since.

In the Pacific Contiguous region, prices continued to increase throughout and are the highest-priced.

The Middle Atlantic region showed an increasing trend until 2010, a modest decline to 2020, and is the second highest-priced.

West South Central region prices increased until 2009, decreased through 2015, and were flat to 2020.

Power Price Stability and Trends



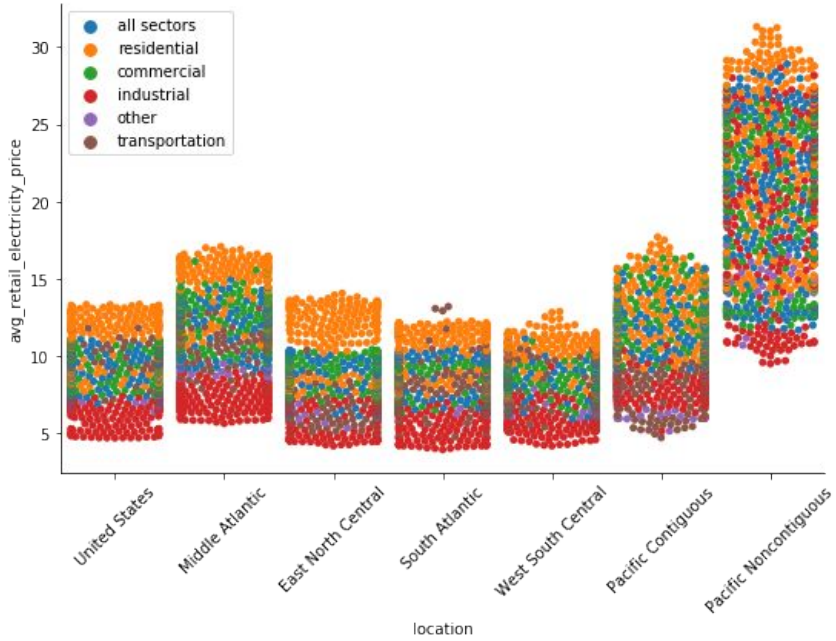
Seasonality by Month

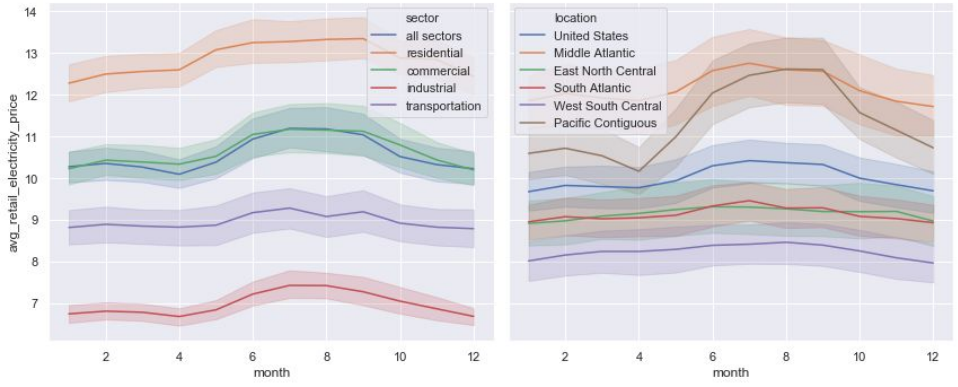
The Pacific Contiguous region displays increasing retail electricity pricing and the strongest seasonality effect, logically, through the summer months with strong electricity consumption from air conditioning. Interestingly, the majority of this seasonality has manifested in the last five years as can be seen on the bottom left.

The Middle Atlantic region displays decreasing retail electricity pricing and moderate seasonality; however, most of this seasonality effect on pricing has dissipated in the last five years to be nearly-flat.

The West South Central region displays decreasing retail electricity pricing, and has not shown any seasonality in pricing in the past five years.

Power Price Stability and Trends





Prices by Industry Sector

Seasonality does not vary by industry sector. Industry sectors displayed fixed energy price margins between them with a substantial difference due to the economics of electricity transmission and distribution in combination with purchasing economies of scale.

Costs include transmission to move electricity to the demand areas, distribution from the grid to homes and businesses, and administrative overhead.

Industrial sites buy the most per interconnection typically, and are located nearby power plant areas or are co-located in a parcel to avoid or reduce transmission costs per kWh.

Commercial sites often buy more electricity than residential, so distribution costs are less per kWh.

Power Price Stability and Trends

Recommendations

Conclusions and Recommendations

Conclusions

- Three regions have demonstrated higher retail power prices than the national average with median 95% confidence intervals of:
  - +$11.08 to $11.79, Pacific Noncontiguous
  - +$2.06 to $2.45, Middle Atlantic
  - +$1.03 to $1.39, Pacific Contiguous
- All regions are rapidly changing and have shown significant differences in the medians and distributions of prices over 10-year or 5-year increments.

Next Steps for Further Research

Enhance and expand analysis with:

- Additional data on utility cost structures and PPA contract records to estimate the cost of power production for competitive power purchase agreement (PPA) pricing.
- Additional data on generator operating costs by region for a full context of power production activity, its changing impact on electricity prices, and reduced acquisition risk of other generation facilities.

Questions and Discussion

Thank You