

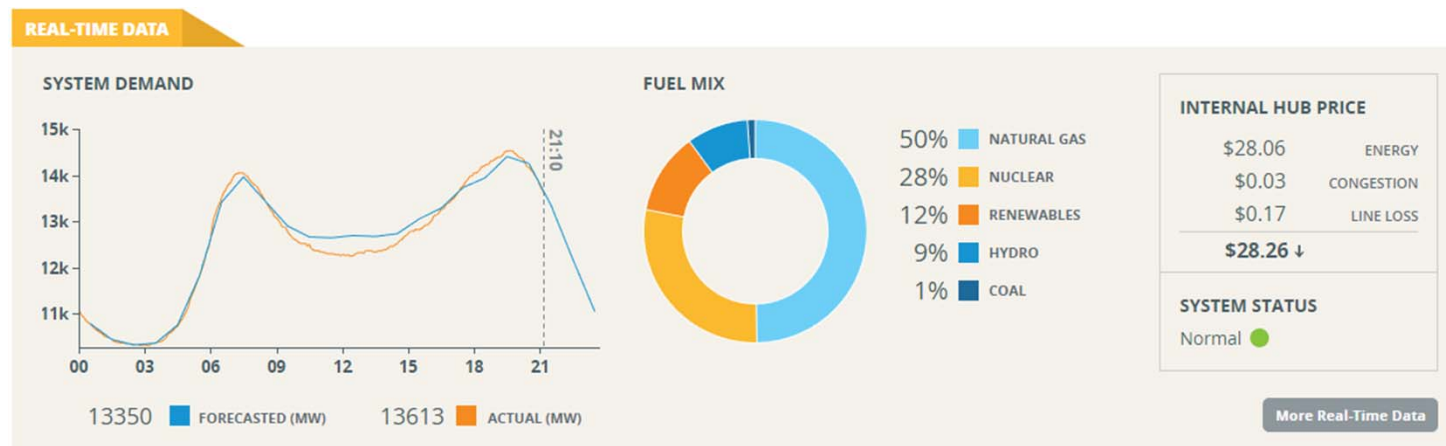
# Electricity Demand Forecasting

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APMA E4990 Project Proposal

# Problem Statement

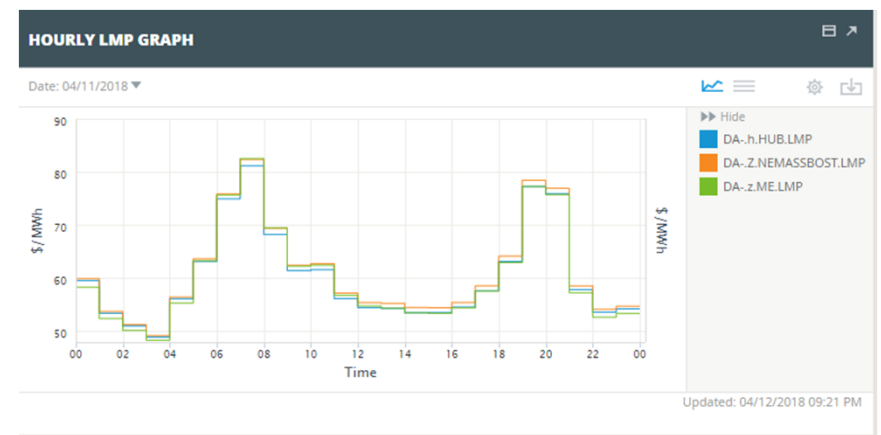
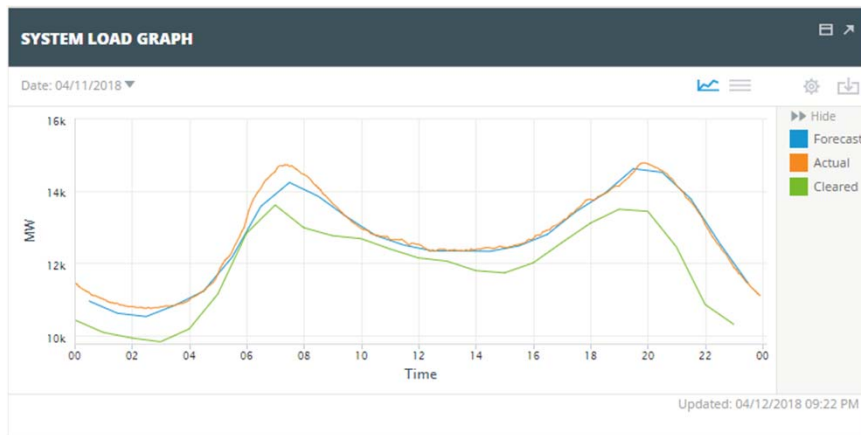
- As a residential customer of Electricity, you could potentially save money each month as a Variable Rate Customer - quite a bit in comparison to the fixed cost most SSO (Standard Service Offer) customers pay.
- However, in doing so you will bear the Market Risk of the Power Prices in your area.
- These prices are highly correlated with the Demand for Electricity in your region, and are billed hourly.



\*Source: ISO - NE

# Problem Statement

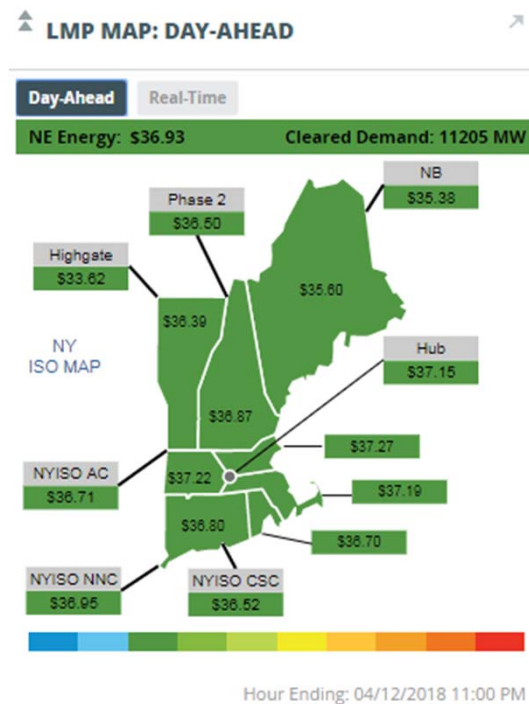
- Take a look at the Hourly System Load for ISO New England\*, alongside the Market Prices for Power in Boston.



- Notice that the hours with the highest demand (around 15,000 MW around both 7:00 AM and 8:00 PM) are also coincident with the highest prices.
- If you were a Variable Rate Customer and you knew the Peak Hours in advance, you could change your usage pattern – say using Heating / AC a couple of hours before the peak to significantly reduce your monthly bill.

# Solution

- Build an app which will forecast the load in your area, and tell you where the Peak Load Hours will occur. This way you can plan in advance and adapt your usage pattern.
- This will be set up for a few locations within New England.



# Methodology

- Use Historical Data for Locational Weather to forecast power demand.
- Specifically, look at the following X variables
  - Hourly Temperatures for nearby weather stations ( Dry Bulb, Heat Index, Apparent Temperatures)
  - Humidity, Cloud Cover, and Wind Speed
  - Population Growth / Demand Growth or decline over time
  - Seasonal Information (Month of the year, season) and Hour, Weekday/Weekend
- The Y variable will be hourly demand for the region in which you live.
- Techniques we may choose to explore are:
  - Random Forest Regression
  - Neural Networks
  - Linear Regression on Transformed Variables
- We will use cross validation to see how well our model generalizes, with potential metrics of MAPE (mean absolute percentage error), Accuracy, and R squared.

# Methodology

Some sample data of Actual Load alongside weather for within the PJM ISO and Day Ahead forecasts of Zonal Load\*:

| Load Region   | Source of Data | Weather Station Name   | Local Datetime (Hour Beginning) | Time Zone | Load MW | Temperature (Dry Bulb) - Fahrenheit | Temperature (Wet Bulb) - Fahrenheit | Relative Humidity Percent | Wind Speed mph |
|---------------|----------------|------------------------|---------------------------------|-----------|---------|-------------------------------------|-------------------------------------|---------------------------|----------------|
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 0:00 EDT               |           | 2015.7  | 42.8                                |                                     | 55                        | 10.3570146     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 1:00 EDT               |           | 1963    | 42.8                                |                                     | 58                        | 11.507794      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 2:00 EDT               |           | 1940.5  | 44.6                                |                                     | 52                        | 12.6585734     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 3:00 EDT               |           | 1949.4  | 44.6                                |                                     | 55                        | 11.507794      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 4:00 EDT               |           | 1994.4  | 44.6                                |                                     | 55                        | 17.261691      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 5:00 EDT               |           | 2074.3  | 46.4                                |                                     | 55                        | 12.6585734     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 6:00 EDT               |           | 2180.6  | 48.2                                |                                     | 55                        | 17.261691      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 7:00 EDT               |           | 2293.4  | 48.2                                |                                     | 62                        | 16.1109116     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 8:00 EDT               |           | 2331.4  | 51.8                                |                                     | 58                        | 13.8093528     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 9:00 EDT               |           | 2324.6  | 55.4                                |                                     | 52                        | 18.4124704     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 10:00 EDT              |           | 2308.3  | 57.2                                |                                     | 49                        | 23.015588      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 11:00 EDT              |           | 2299.8  | 57.2                                |                                     | 46                        | 17.261691      |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 12:00 EDT              |           | 2302.8  | 55.4                                |                                     | 49                        | 19.5632498     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 13:00 EDT              |           | 2241.8  | 53.6                                |                                     | 38                        | 20.7140292     |
| .Z.NEMASSBOST | NE             | Beverly Municipal Arpt | 4/1/2018 14:00 EDT              |           | 2189.3  | 55.4                                |                                     | 36                        | 20.7140292     |

Data Sources:

<https://www.iso-ne.com/> (ISO- New England's Website)

Energy Velocity Database

Questions?