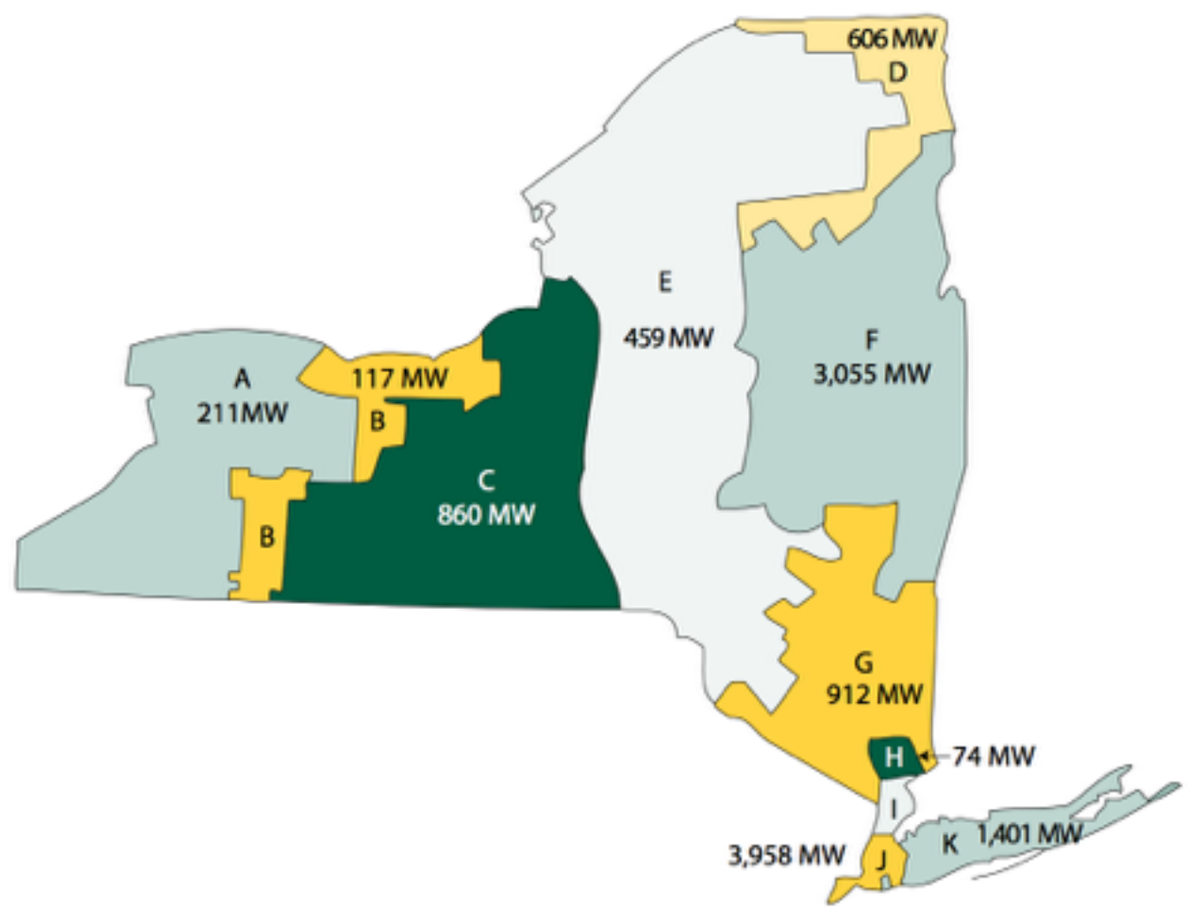



# Forecasting Energy Demand

Dan Yawitz
March 2016

- In New York State, the price of energy is based on forecasts.

- Utility companies try to save costs by forecasting what the demand will be.

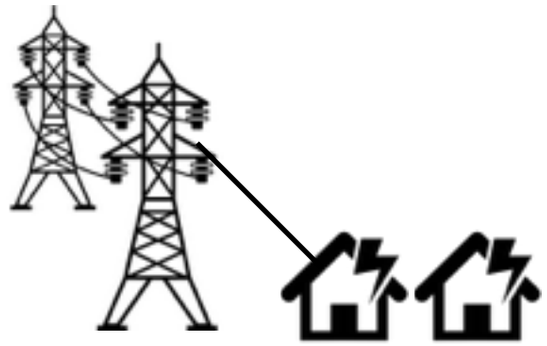
- Improving forecasting can:

  1) help utilities save money

  2) inform investments in the energy market

## the “day-ahead market”

power plants



utility companies

**offers**

**bids**

*electricity market*

“We can generate up to 200MW at 2pm.

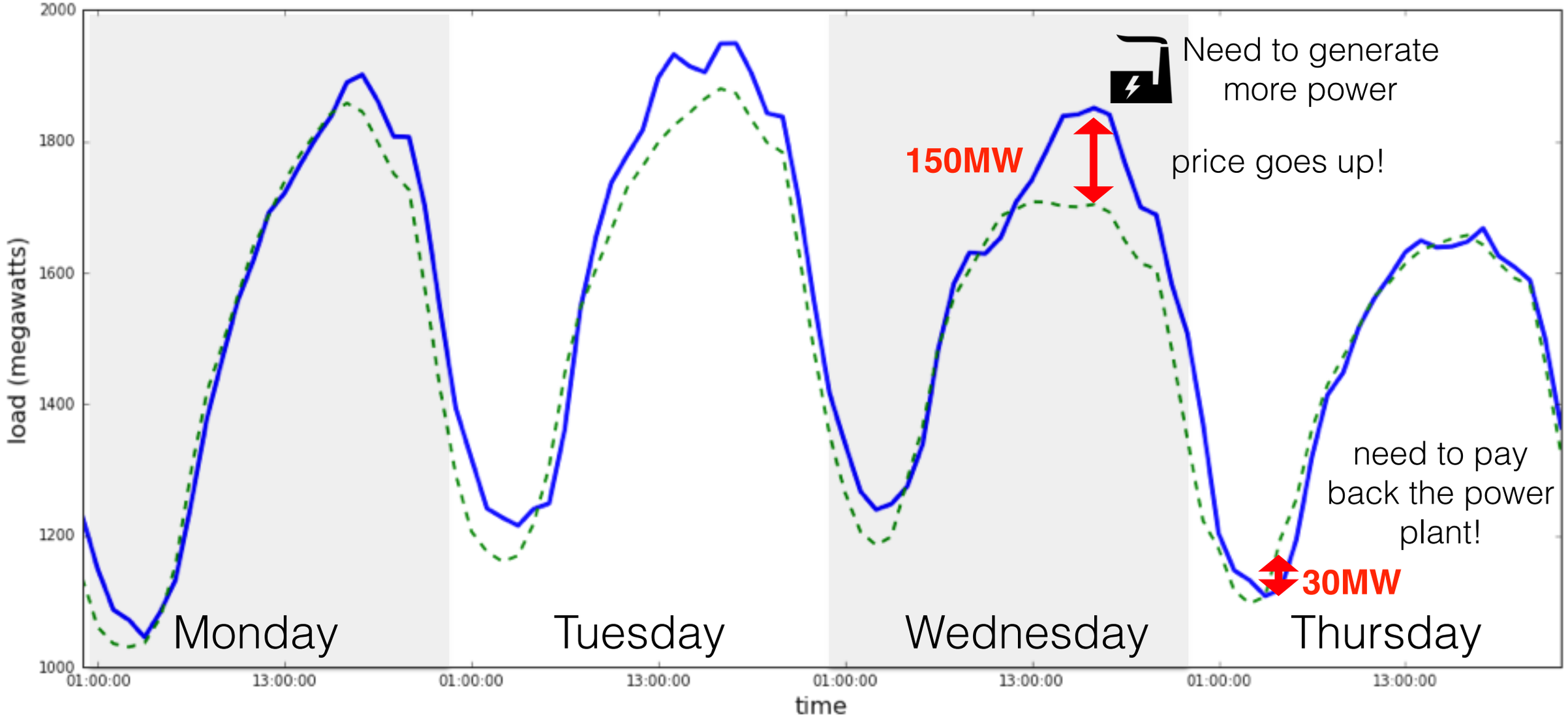
We’ll charge you $25/MW”

“We’ll need 100MW at 2pm!”

Sets the price of energy

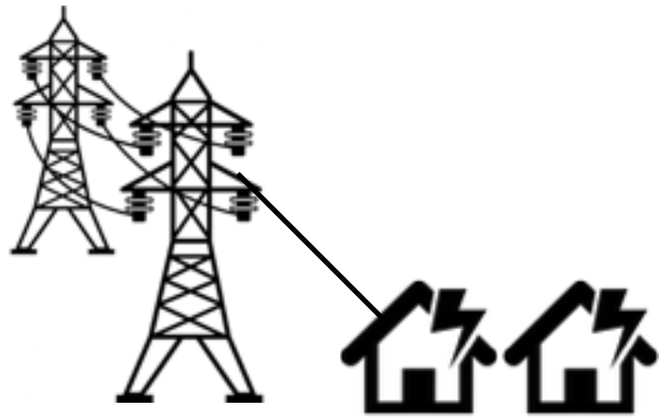
Over/underestimations are settled in the real-time market

# Example: Week of July 6, 2015




Actual demand

NYISO Day-Ahead Forecast



utility companies

**over-forecasting demand** ⋯⋯⋯⋯⋯▸ utilities pay more the day before

**under-forecasting demand** ⋯⋯⋯⋯⋯▸ utilities pay more the day of

**CREATE A MODEL TO IMPROVE FORECASTING**


**NEW MODEL**

- Past demand data (aggregated)
- Weather data
- High-resolution demand from utility companies


- Past demand data (aggregated)
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**NEW MODEL**

- Past demand data (aggregated)
- Weather data
- ~~High-resolution demand from utility companies~~


**NEW MODEL**

## Neural network regressor

Trained on the last 4 years of data

## Gradient-boosted regressor

Trained on historical load 2001-2013

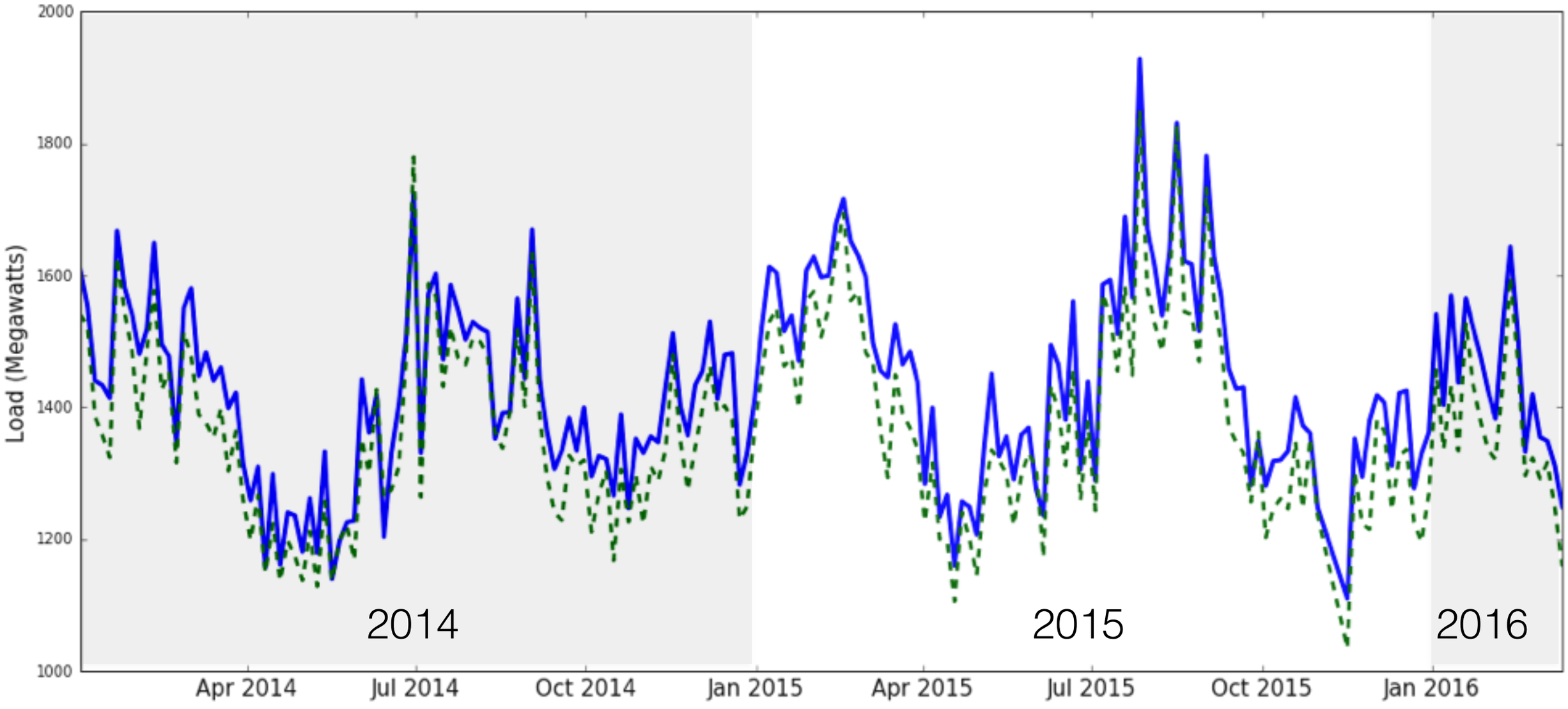
Features:

- Local weather conditions
- Time of day
- Day of year
- Day of week
- Load 48/72 hours earlier

Parameters

- 100 estimators
- Tree-depth = 4
- Minimum sample split = 2

# Comparing Historical Forecasts

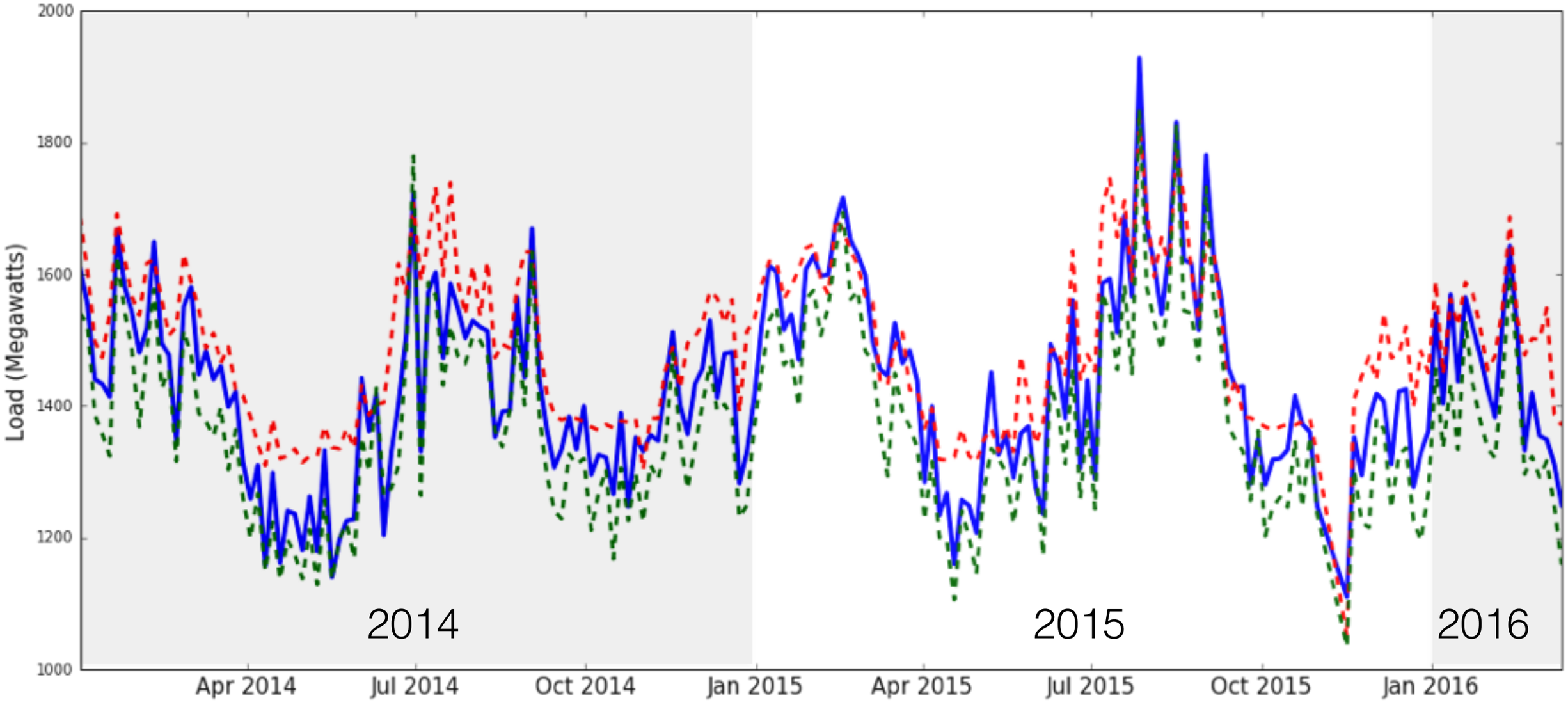



Actual demand

NYISO Day-Ahead Forecast

My model

# Comparing Historical Forecasts




Actual demand

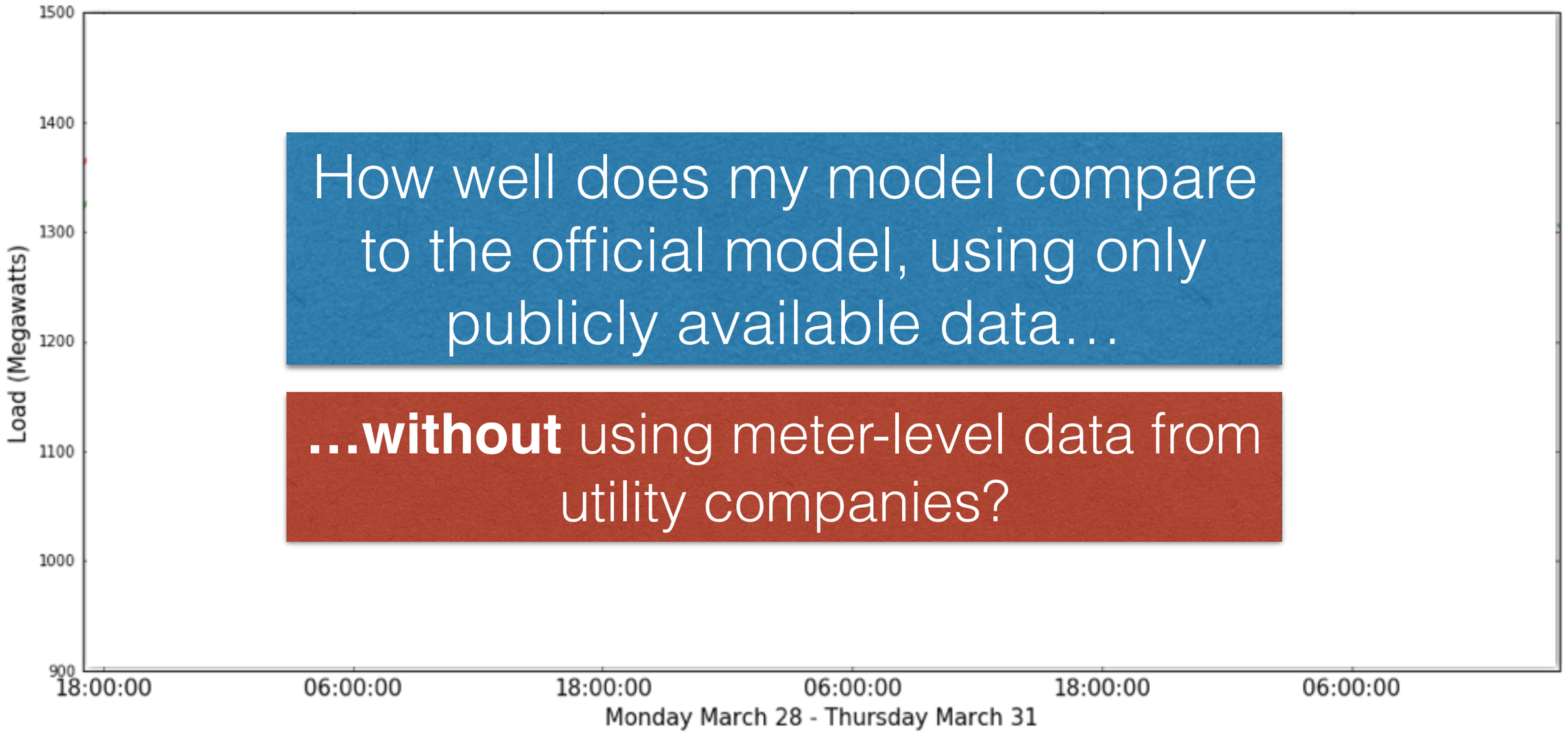
NYISO Day-Ahead Forecast

My model

$R^2$ = 0.882, mean % error = 4.67%

$R^2$ = 0.884, mean % error = 4.79%

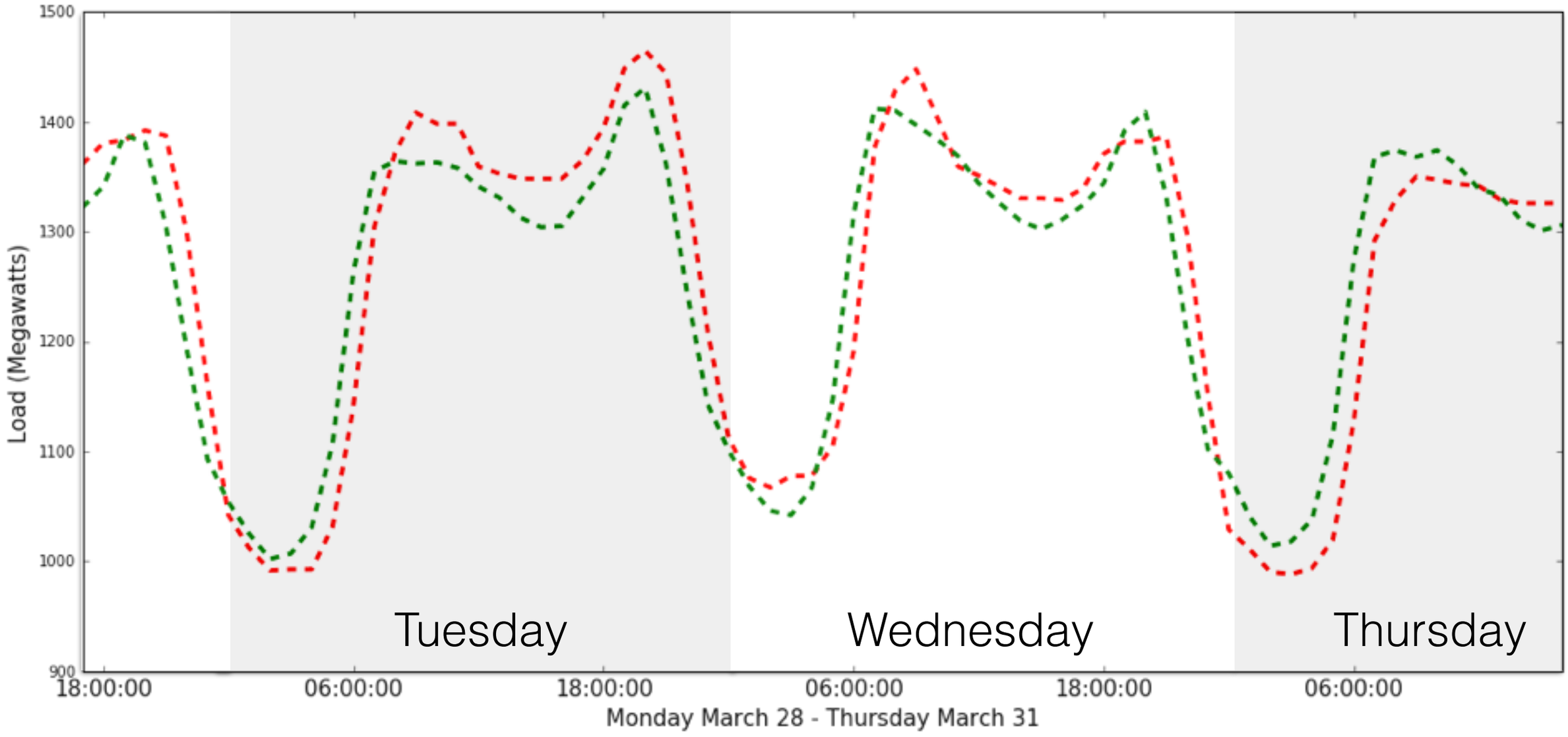
# **Live Model Run:** Monday, March 28, 5pm




How well does my model compare to the official model, using only publicly available data…

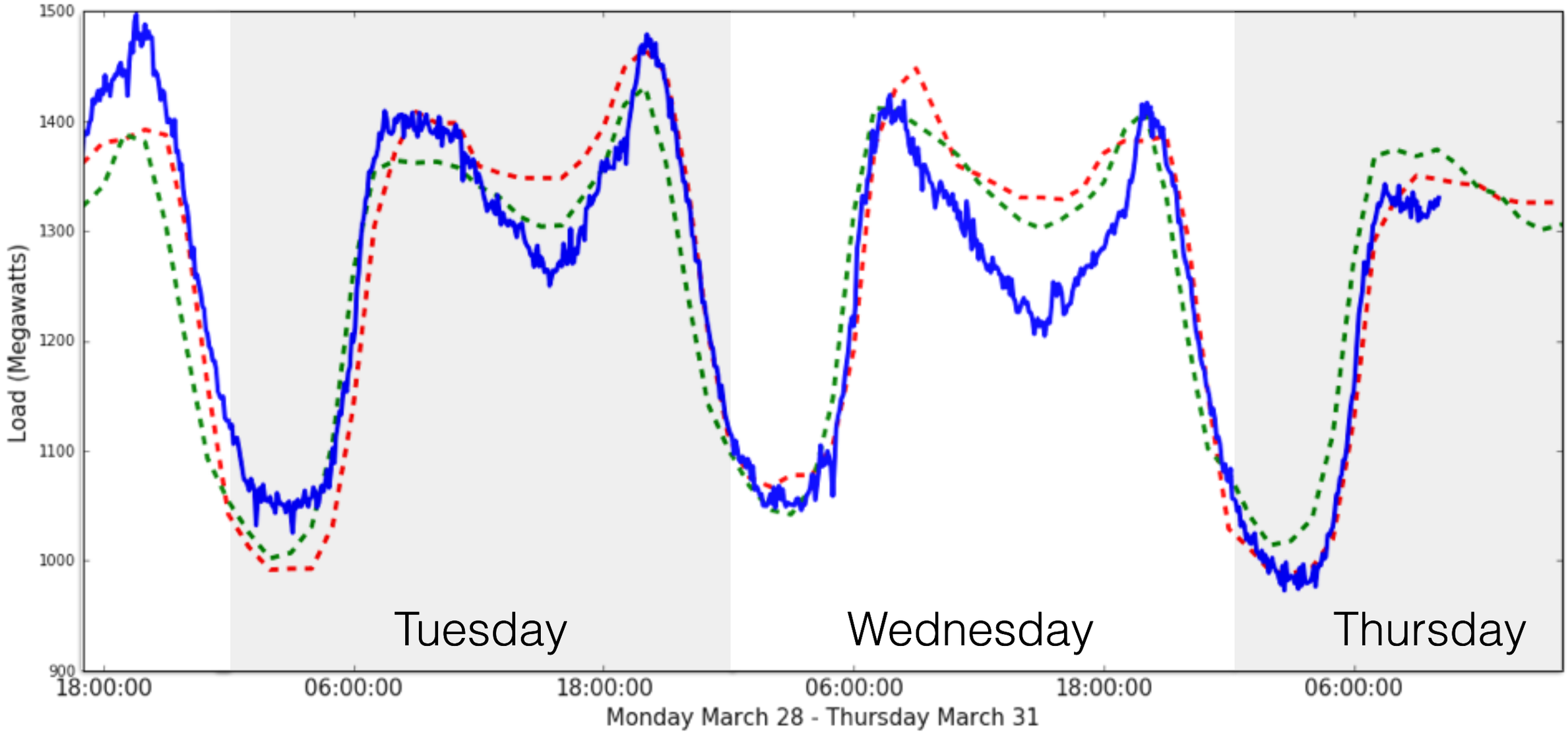
**…without** using meter-level data from utility companies?

# **Live Model Run:** Monday, March 28, 5pm




- NYISO Day-Ahead Forecast
- My model

# **Live Model Run:** Monday, March 28, 5pm




Actual demand

NYISO Day-Ahead Forecast

My model

$R^2$ =0.52, mean % error = 12.5%

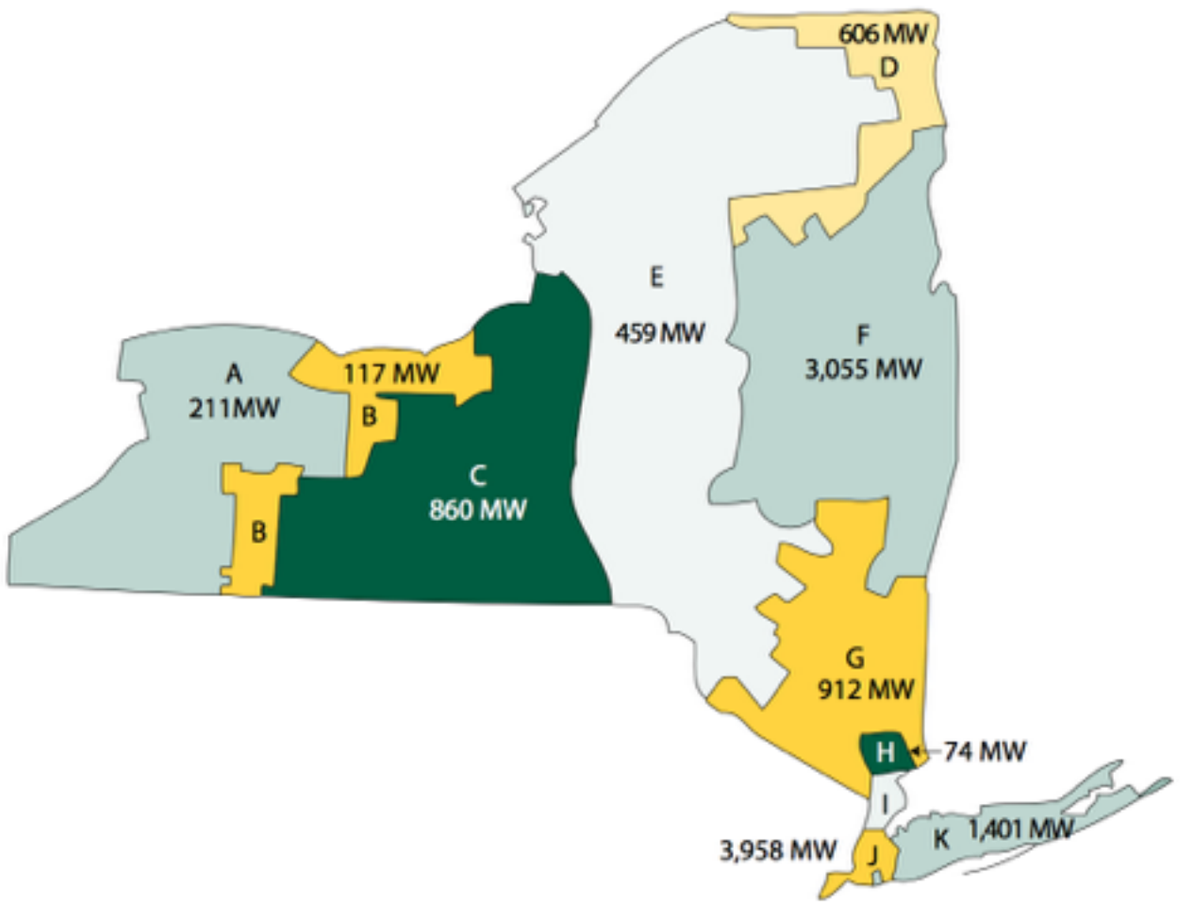
$R^2$ = 0.62, mean % error = 12.9%

## Next steps

- Utilize high resolution features
- Keep refining over/under predictions
- Energy Forecasting Competition 2016

## Applications

- Create more stable prices for electricity
- Promote energy efficiency
- Invest in the virtual electricity market

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