

UVIG Forecasting Workshop

Session 7: Renewable Energy, Energy Trading, Market Evolution and the Role of Forecasting

FTRs and Virtual Energy Trading

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FTRs and Virtual Energy Trading

- ✓ **FTRs**
 - ✓ **Definition**
 - ✓ **Example**
- ✓ **Virtual Energy Trading**
 - ✓ **Definition**
 - ✓ **Example**
- ✓ **Impact of Wind and Solar Generation Forecasts**
- ✓ **Information Gaps and Where Forecasts Can Fill Them**

FTR definitions

“FTR is a financial swap on congestion difference between two locations”

“Right to congestion credits or charges along a path during a given time frame for a certain MW quantity” --- MISO

FTRs are “part of the ISO’s Congestion Management/ Multisettlement System. An FTR provides a forward congestion hedge in the Day-Ahead Energy Market.” --- ISO-NE

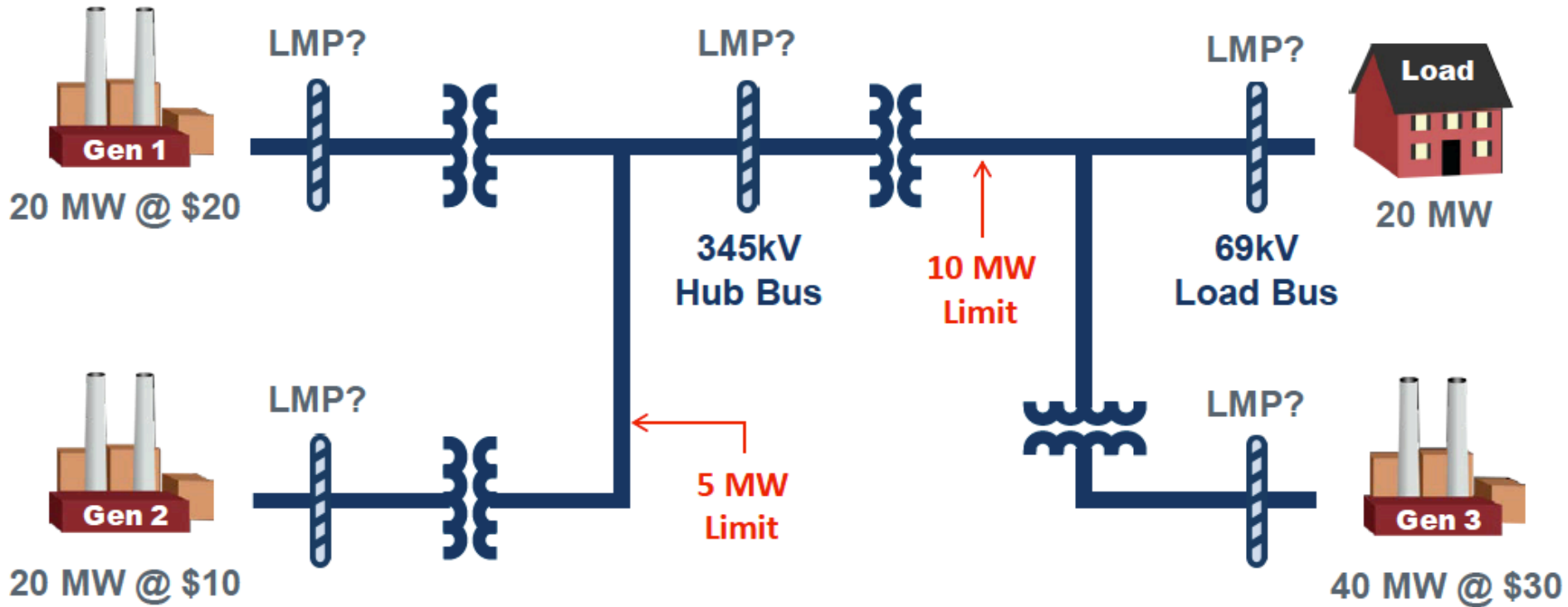
“Financial Transmission Rights or FTRs allow market participants to offset potential losses (hedge) related to the price risk of delivering energy to the grid. FTRs are a financial contract entitling the FTR holder to a stream of revenues (or charges) based on the day-ahead hourly congestion price difference across an energy path.” --- PJM

FTR 101

- 1. Financial Instrument within electricity market with location based electricity prices.**
- 2. A payment or charge to owner when transmission grid is congested and spatial price differentials exist**
--- FTRs are not rights to deliver physical energy! ---
- 3. Usually determined by day-ahead LMPs time- and spatially-weighted (e.g., node, bus, or zone)**
- 4. Are for a yearly or monthly period with monthly auctions**
- 5. Different granularity depending on market (e.g., peak/off-peak, 5X16 (days/week X hours/day))**

FTR - Example


Congestion → LMP Price Differential

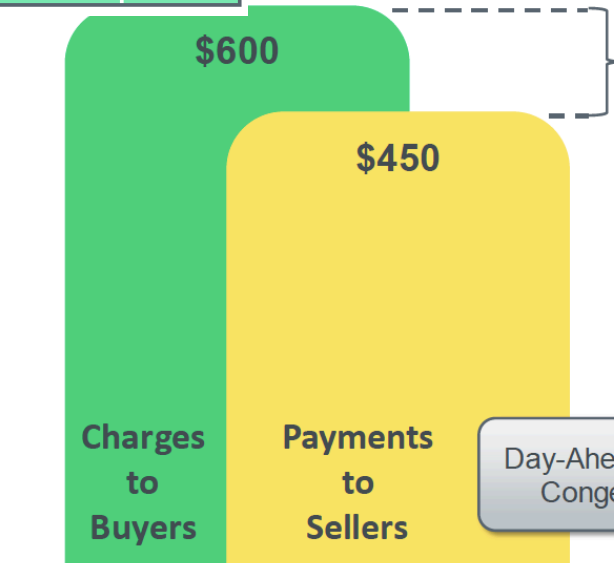
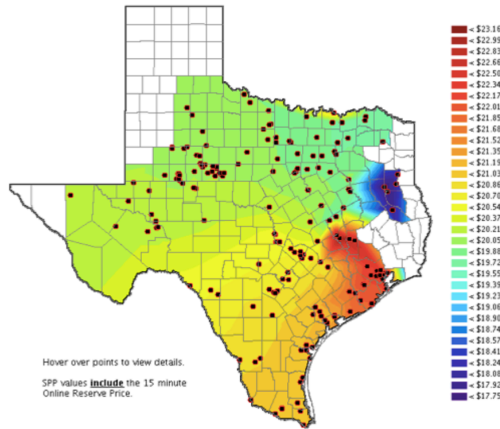


* From http://ercot.com/content/wcm/training_courses/109553/CRR_2017_May.pdf

FTR 101 (continued)

Payments to Sellers			
	LMP	MW	
Gen 1	\$20	5	\$100
Gen 2	\$10	5	\$50
Gen 3	\$30	10	\$300
Total			\$450

Charges to Buyers			
	LMP	MW	
	\$30	20	\$600
Total			\$600



Day-Ahead Market Congestion Rent funds Congestion Revenue Rights (CRRs)

* From http://ercot.com/content/wcm/training_courses/109553/CRR_2017_May.pdf

Virtual Trading Definitions

“Bids and offers submitted to take financial positions in the Day-Ahead Market without the intent of delivering or consuming physical power in the Real-Time Market” --- PJM

“Virtual transactions used to arbitrage price differences between day-ahead and real-time energy markets” --- RTO Insider

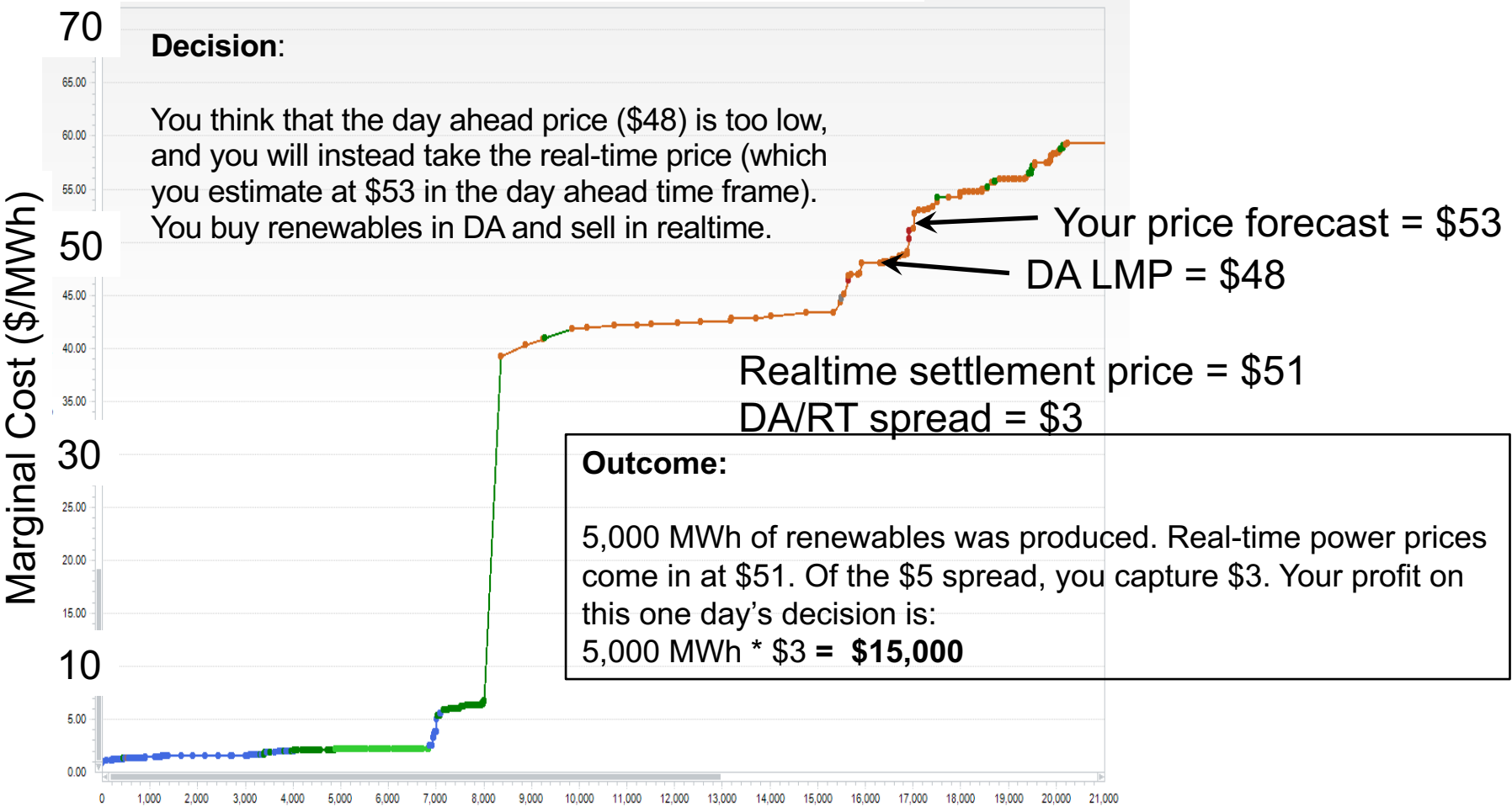
“Financial contracts awarded at day-ahead prices and settled at real-time prices” --- Harvard Business School

Virtual Energy Trading 101

- 1. INC offers (long in DA): sell higher at day-ahead, buy lower in real-time**
- 2. DEC bids (long in RT): buy at specified price or lower in day-ahead market (opposite of INC)**
- 3. UTC (Up-to-Congestion): Day-Ahead Market bid to purchase congestion and losses between two points. Profitable when real-time congestion price spread $>$ day-ahead congestion price spread for prevailing flow**
- 4. Virtual transactions compete with physical resources. Thus, can impact dispatch and day-ahead unit commitment.**

Virtual Energy Trading DEC Example – Supply Stack Curve

CAISO SP-15 Supply Stack Curve



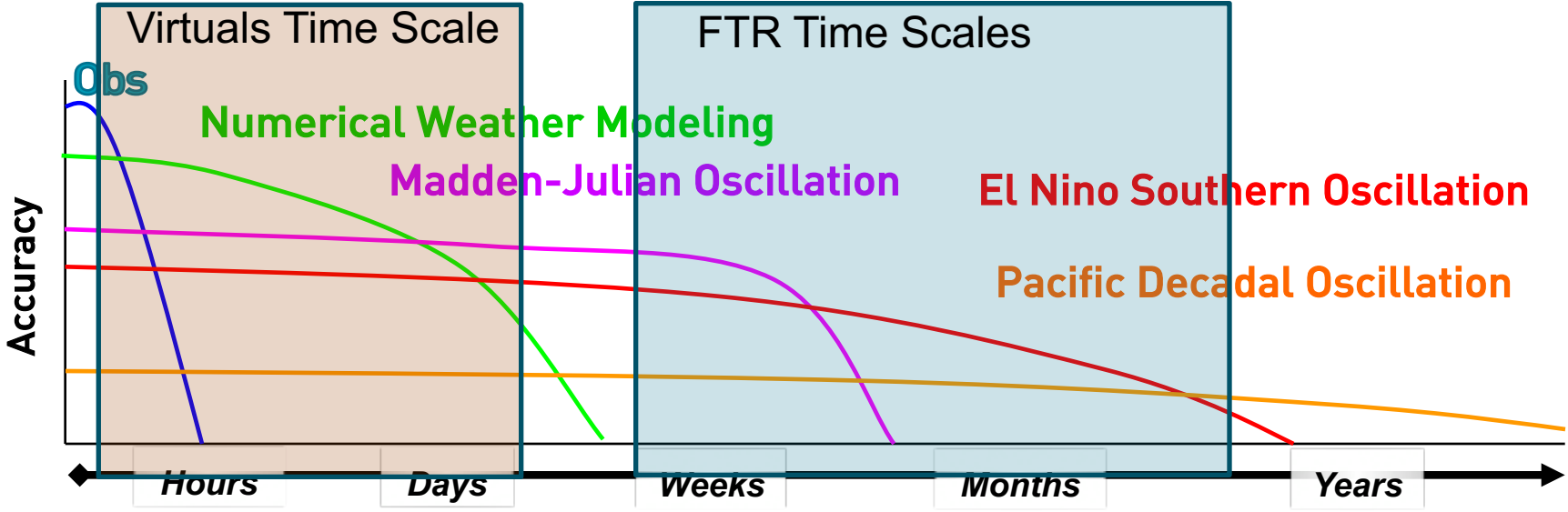
Electricity demand – Electricity supply

Impact of Wind and Solar Forecasts

- FTRs:
 - Minimal impact (currently)
 - For longer horizons, transmission and generator build-out often has larger impact on auction pricing than forecast of generation/load
 - Shortest forecast horizons are 2-6 weeks ahead (sub-seasonal) – too long for most deterministic and ensemble NWP models
 - Spatial differences important and granularity of current wind/solar forecast systems may not be enough
- Virtual Trading:
 - In many markets with locational pricing, renewables (and their forecasts) often move energy prices (e.g., ERCOT, CAISO, SPP)
 - Independent forecast solutions provide informational edge to market participants
 - Spatial and temporal information sufficient for INC, DEC, and UTC trading day ahead down to node level
 - Can hedge (arbitrage) against DA price that incorporates prevailing centralized ISO forecast

FTR forecast horizons going out further (years!) – bigger forecast challenges
Biggest virtual trading opportunities occur when forecast solutions diverge!

Trading Information Gaps and Where Forecasts Can Fill Them



- Spot market
- Day ahead market
- Futures market
- Hedging
- Volumetric risk

Short-range Medium-range Long-range Resource Assessment

Information Gaps and Where Forecasts Can Fill Them - FTRs

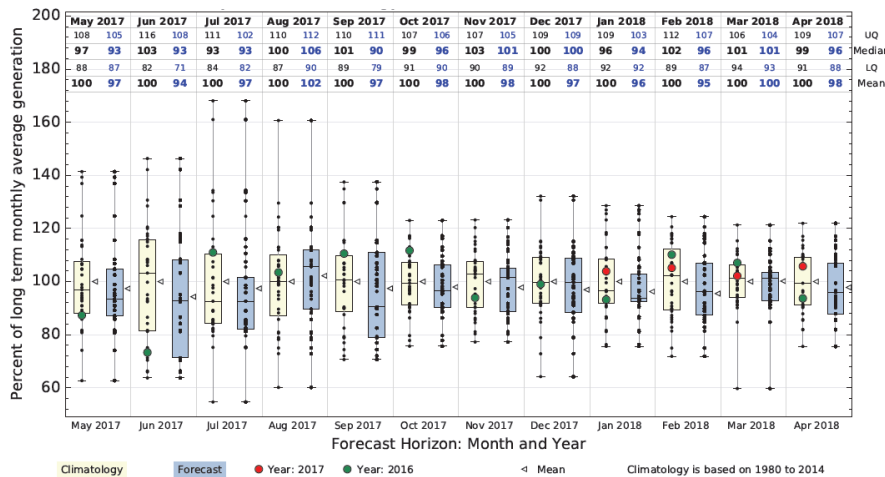
- Need realistic baseline wind and solar generation climatology
 - “If you can’t get the baseline right, the forecast is meaningless”*
- Shortest forecast horizons are 2-6 weeks ahead (sub-seasonal)
 - Too long for most deterministic and ensemble NWP models (typical range is now 10-16 days ahead)
- Climate Forecast System (CFSv2) model covers sub-seasonal at large time steps, but maybe this is sufficient
- Different forecast predictors required for sub-seasonal including:
 - Madden-Julian Oscillation (MJO)
 - Ocean SST anomalies
 - Arctic Oscillation
 - Soil moisture and snow cover

Difficult to ascribe value to the sub-seasonal forecast without a proper baseline for forecast context

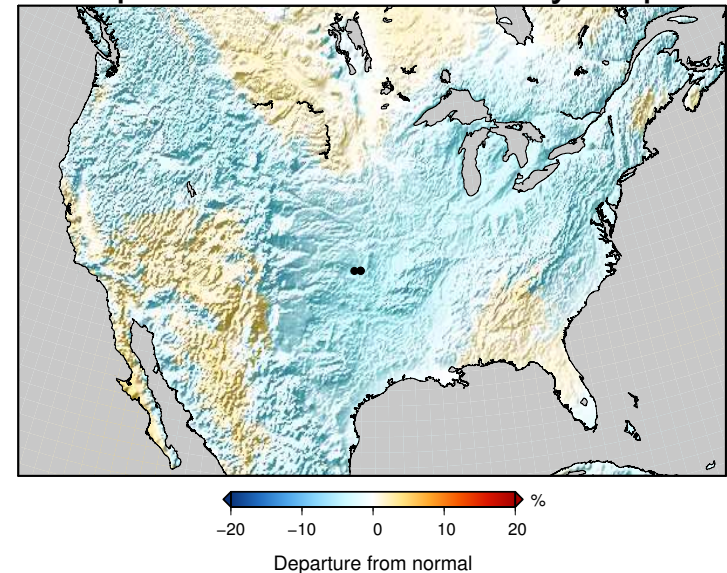
Forecast Data That Can Assist Traders

- Spatial maps depicting gradients in the deviation from climatology
- Point anomaly year-ahead guidance
- Analog historical guidance

Point Anomaly Year-Ahead Guidance



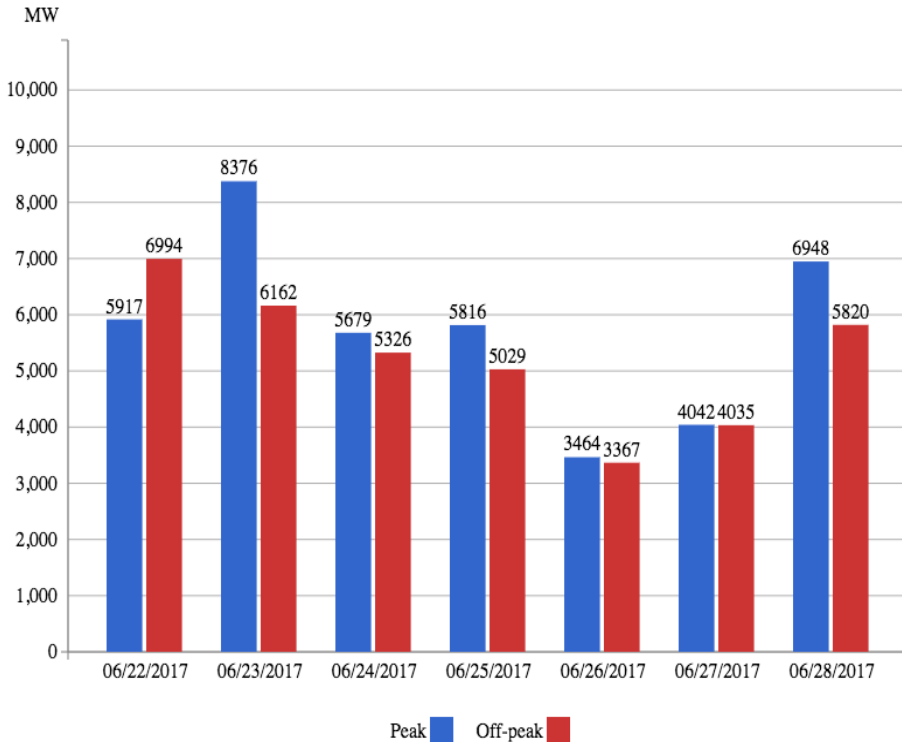
Spatial Forecast Anomaly Maps



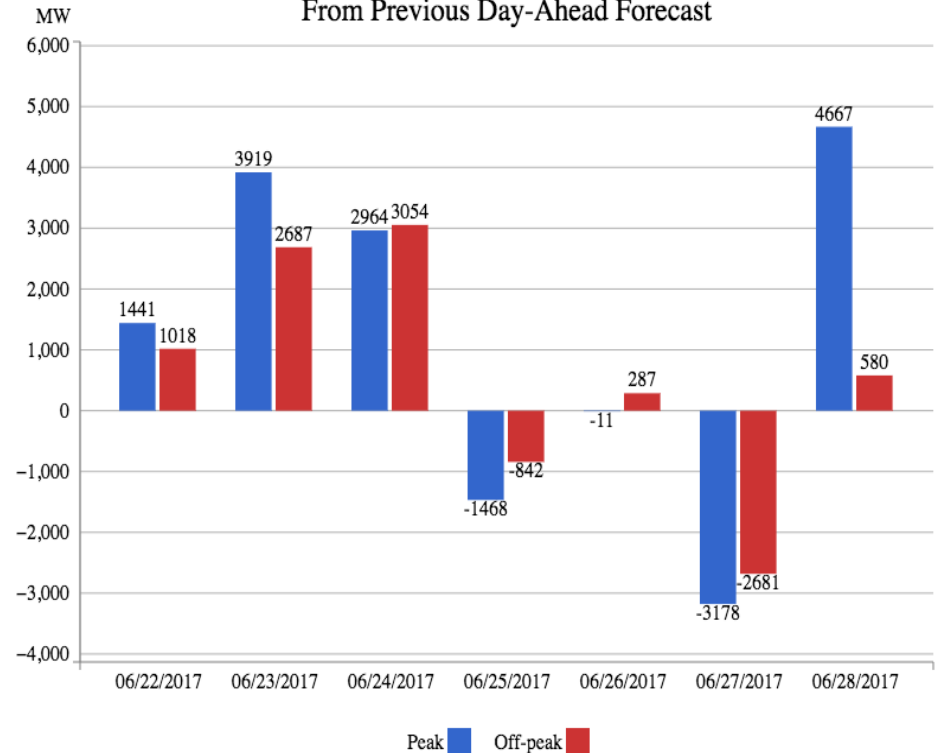
Forecasts of wind and solar anomalies must be accompanied by historical context at these long time scales

Forecast Data That Can Assist Traders

MISO 3TIER Blend Wind Generation Forecast



MISO Wind Generation Forecast Change From Previous Day-Ahead Forecast



Peak/Off-peak generation important as well as how forecast has changed since previous day

Thank You

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