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Details on the Use of the Solar Photovoltaic Forecast to Modify the Long-term New England Load Forecast

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Objective

- ISO would like to use available data to support the concept of its use of the BTM PV forecast to modify the load forecast

Background

- ISO began forecasting BTM PV in 2014 in anticipation that the load impacts of its rapid growth would not be captured within ISO's long-term load forecast which relies on historical load trends
- Over the past few years, increasing BTM PV has had a growing impact on system loads
- ISO's first discussions about using the BTM PV forecast as a load reduction in the net load forecast include (links provided):
  - September 15, 2014 DGFWG
  - February 17, 2015 Reliability Committee
  - April 14, 2015 DGFWG (slides 15-27)
- In 2015, as part of determining how to include BTM PV in the 2015 CELT load forecast, ISO estimated the impact of already-existing BTM PV on the load forecast
  - This was referred to as the "embedded" BTM PV

Gross and Net Load Forecasts in CELT

- ISO first develops "gross" load forecasts that reflect a forecast of load without reductions from behind-the-meter PV (BTM PV)
  - BTM PV is reconstituted into historical hourly loads used to estimate gross load forecast models
  - This ensures the proper accounting of BTM PV, which is forecast separately
  - Passive demand resources (PDR) are also reconstituted into historical loads, but are not the focus of this presentation
- "Net" load forecasts are in turn developed by subtracting the BTM PV forecast from the gross forecasts
  - Estimates of BTM PV's summer peak load reduction are used, which reflect expected shift of the summer peak timing as BTM PV penetrations increase
  - More information on ISO's methodology is available in the Appendix of 2016 PV Forecast slides: https://www.iso-ne.com/static-assets/documents/2016/09/2016_solar_forecast_details_final.pdf

BTM PV Profiles Used for Reconstitution

Methodology

- ISO develops hourly state PV profiles for the period 1/1/2012 –1/31/2016 using historical production data
  - Data are aggregated into normalized PV profiles for each state, which represent a per-MW-of-nameplate production profile for PV
- Total state PV production is estimated by scaling the profiles up to the total PV installed over the period according to distribution utility data
  - (Normalized Hrly Profile) x (Total installed PV Capacity) = Hourly PV production
- Subtracting the hourly PV settlements energy (where applicable) yields the total BTM PV energy for each state

BTM PV Profiles Used for Reconstitution

Data Source

- ISO has contracted with a third-party vendor for PV production data services
  - Includes data from more than 9,000 PV installations
  - Data are 5-minutely and at the town level
  - Broad geographic coverage
  - Data provided begins in 2014
- An example snapshot of regional data is plotted to the right
  - Data are from February 2, 2017 at 12:10pm
  - Yellow/red coloring shows level of PV production
  - No data available in towns colored gray
  - Data not requested in towns colored black
- Using these data, state PV profiles are developed as described on the previous slide

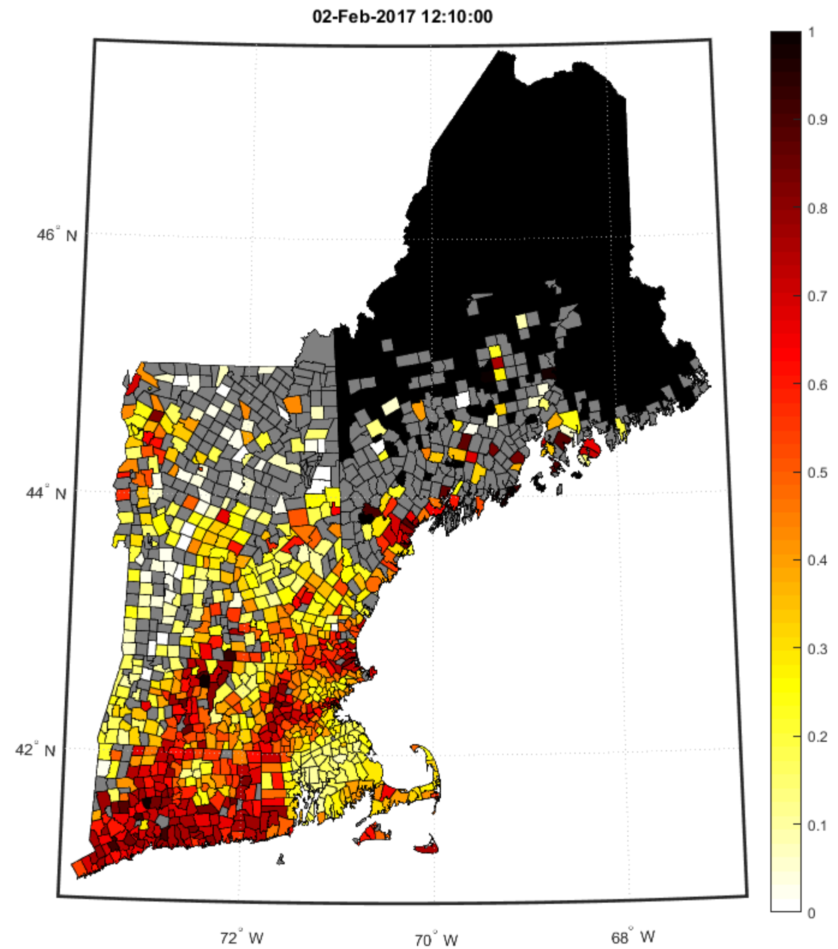
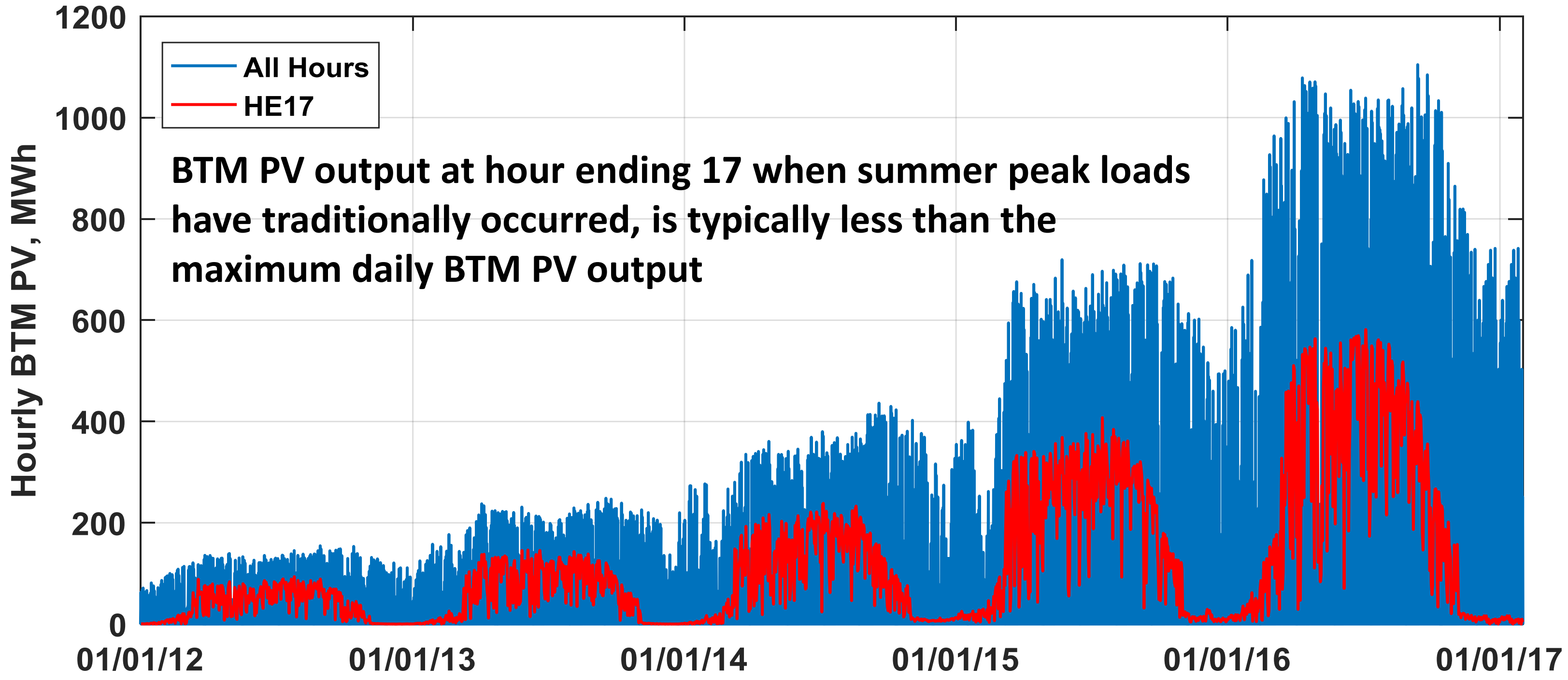


Figure notes:

1. Graphic developed by ISO New England
2. Data source: Quantitative Business Analytics, Inc.

BTM PV Profiles Used for Reconstitution

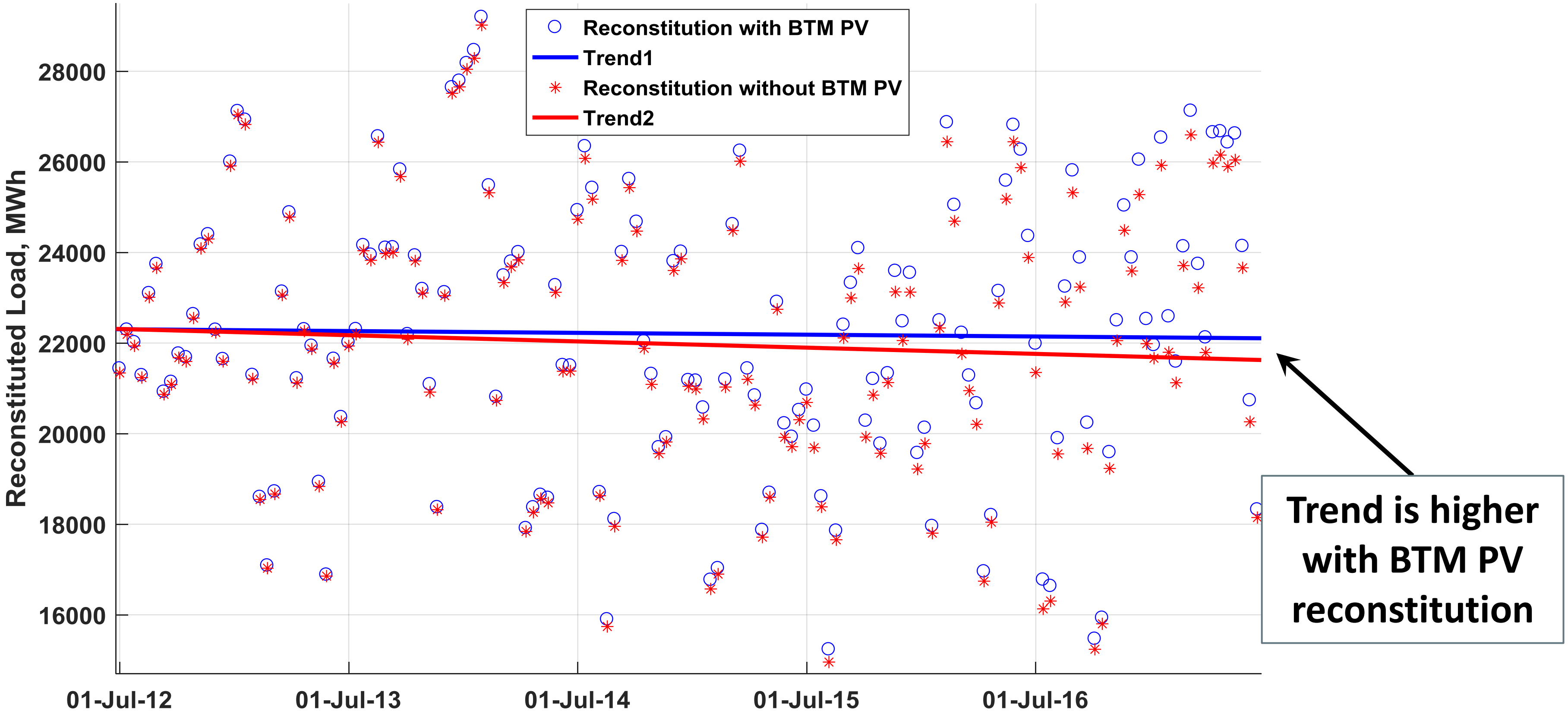
Results for ISO-NE



ISO-NE July Daily Peak Trends, 2012-2016

With and Without BTM PV Reconstitution

- A simplified linear trend analysis using historical July load data serves as an example of the effect of BTM PV reconstitution on summer gross load forecast
  - Limited daily peak load data from a recent period (2012-2016) used to emphasize effect
  - Trend lines represent example gross load forecast equations with and without BTM PV reconstitution



Gross Summer 50/50 Peak Forecast Comparison

- ISO has separately estimated gross summer load forecast models without BTM PV reconstitution and compared the resulting forecasts to the 2017 CELT gross forecast
- The difference in these forecasts reveals the amount of BTM PV that would be "embedded" in the load forecast without separately forecasting and reconstituting BTM PV

Gross Summer 50/50 Peak Forecast Comparison

Forecasts With and Without BTM PV Reconstitution

Forecast Year	50/50 Gross Load: 2017 CELT With BTM PV Reconstitution (MW)	50/50 Gross Load: Without BTM PV Reconstitution (MW)	Difference Embedded BTM PV (MW)	Final 2017 BTM PV Forecast (MW)	Without BTM PV Reconstitution Not Embedded BTM PV (MW)	Without BTM PV Reconstitution Embedded BTM PV (%)
2017	29,146	28,667	479	575	96	83%
2018	29,454	28,926	528	690	162	76%
2019	29,753	29,178	575	783	208	73%
2020	30,039	29,418	621	848	227	73%
2021	30,327	29,660	667	891	224	75%
2022	30,623	29,910	713	929	216	77%
2023	30,923	30,162	761	963	202	79%
2024	31,223	30,414	809	992	183	82%
2025	31,521	30,665	856	1014	158	84%
2026	31,820	30,916	904	1035	131	87%

Conclusions

- The amount of BTM PV that would be embedded in the load forecast without a separate BTM PV forecast and its reconstitution is approaching equivalence with the ISO's load modifications from the BTM PV forecast
  – Results show that 73% or more of the BTM PV forecast would be embedded in the 2017 CELT load forecast
- Separately forecasting and accounting for BTM PV as ISO currently does will shield against a tendency to under-forecast load if:
  – Rapid BTM PV growth continues, and the timing of the summer peak shifts later in the day as PV output diminishes
  – Growth in BTM PV slows down out of step with the recent trend

Questions