Behind-the-Meter Solar Impact to Demand and Operations

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Impacts of DERs on the Bulk Power System Training
NARUC/NASEO/NASUC

Agenda

- CAISO Overview
- Expected growth of Behind-the-Meter Penetration
- Demand Forecast
- Operational Impact

California ISO facts

As a federally regulated nonprofit organization, the ISO manages the high-voltage electric grid California and a portion of Nevada.

50,270 MW record peak demand (July 24, 2006)

233 million megawatt-hours of electricity delivered (2018)

75,747 MW power plant capacity

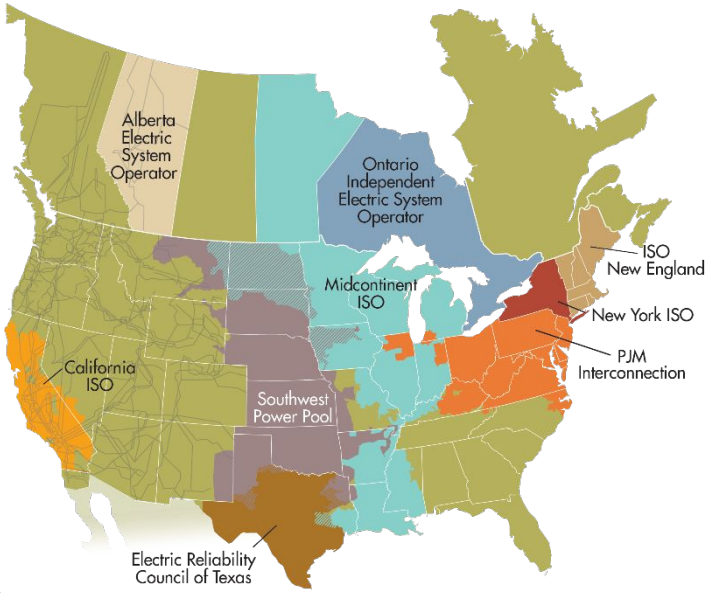
Source: California Energy Commission

1,119 power plants

Source: California Energy Commission

32 million people served

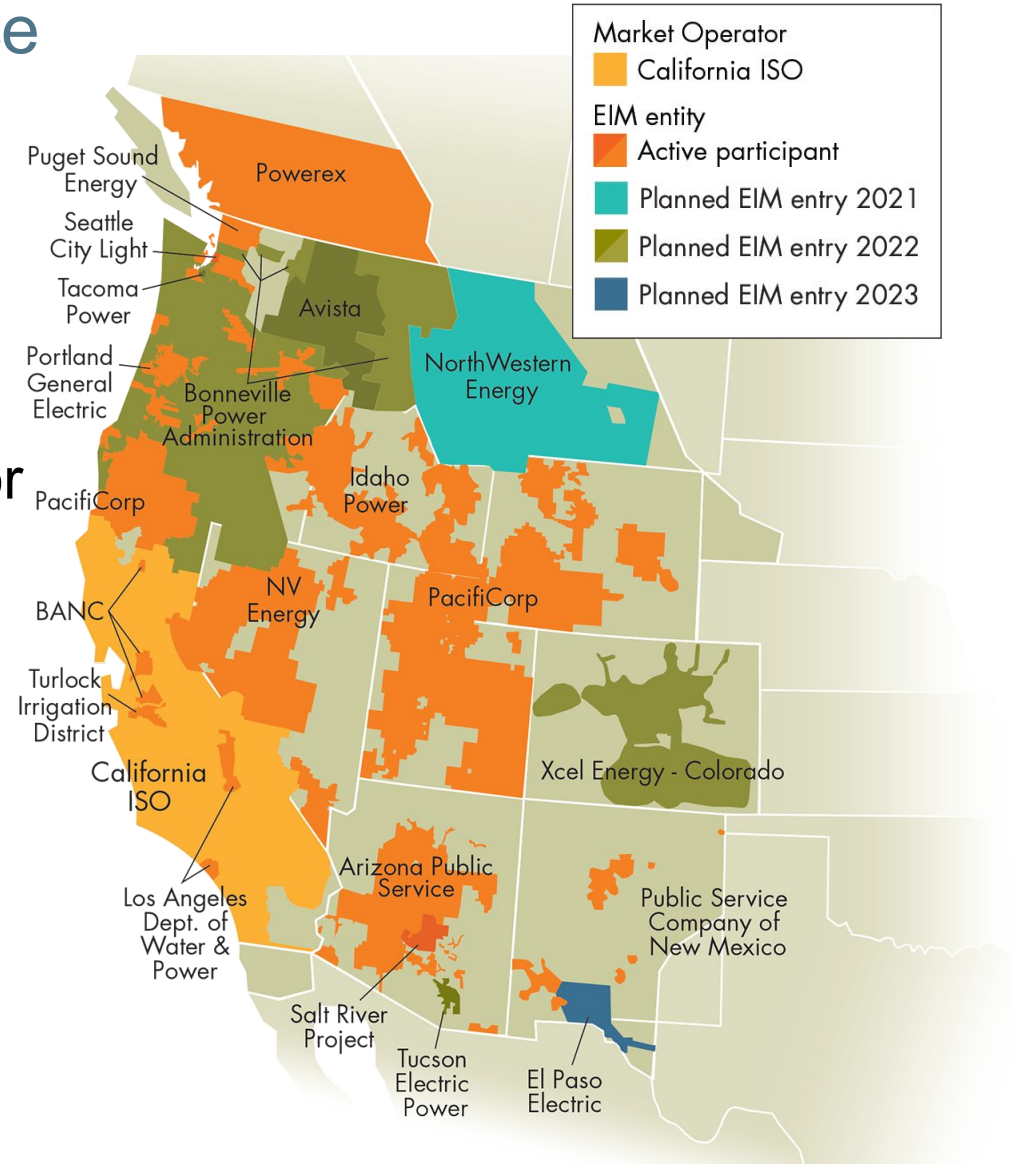
One of **9** ISO/RTOs in North America



Western Energy Imbalance Market (EIM)

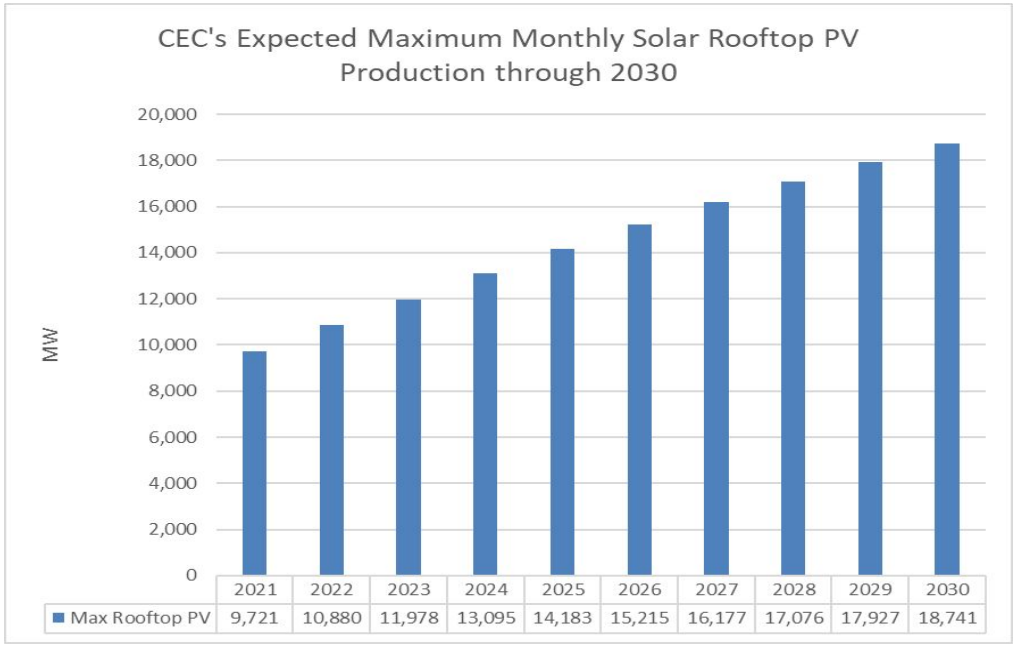
Since its launch in 2014, the Western EIM has enhanced grid reliability, generated millions of dollars in benefits for participants, and improved the integration of renewable energy resources.

- Gross benefits exceeding $1 billion
- Reduced over half a million metric tons of CO_2

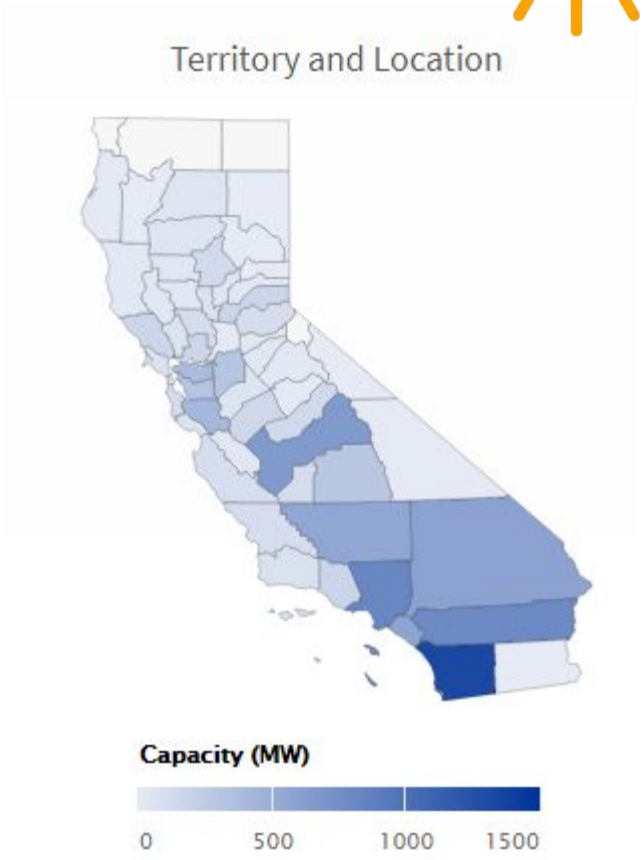


Map boundaries are approximate and for illustrative purposes only

California ISO Behind-the-Meter Solar



CAISO Total Values: https://efiling.energy.ca.gov/GetDocument.aspx?tn=236297-6



https://www.californiadgstats.ca.gov/charts/

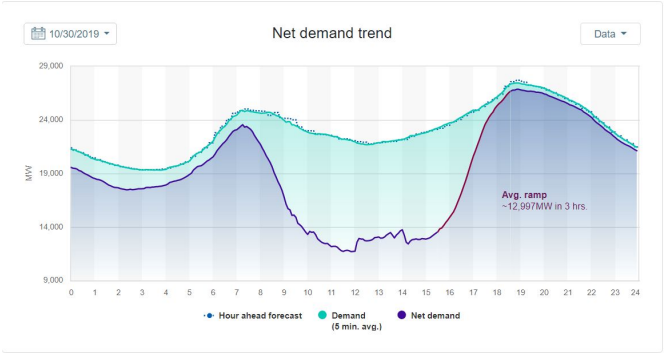
Rooftop solar is not connected to the high-voltage transmission system, but they affect the ISO's markets and grid operation. Rooftop solar is expected to produce up to 19,000 MW by 2030.

Demand Forecasting at CAISO

Forecast Inputs

Weather Contributors:
- BTM Forecast
- 2 Weather Providers
- Meteorological Review

Other Contributors:
- BTM Actuals
- Day Types
- Historical Actuals
- Estimated Gross Load Reduction Information



Day Ahead & Real Time

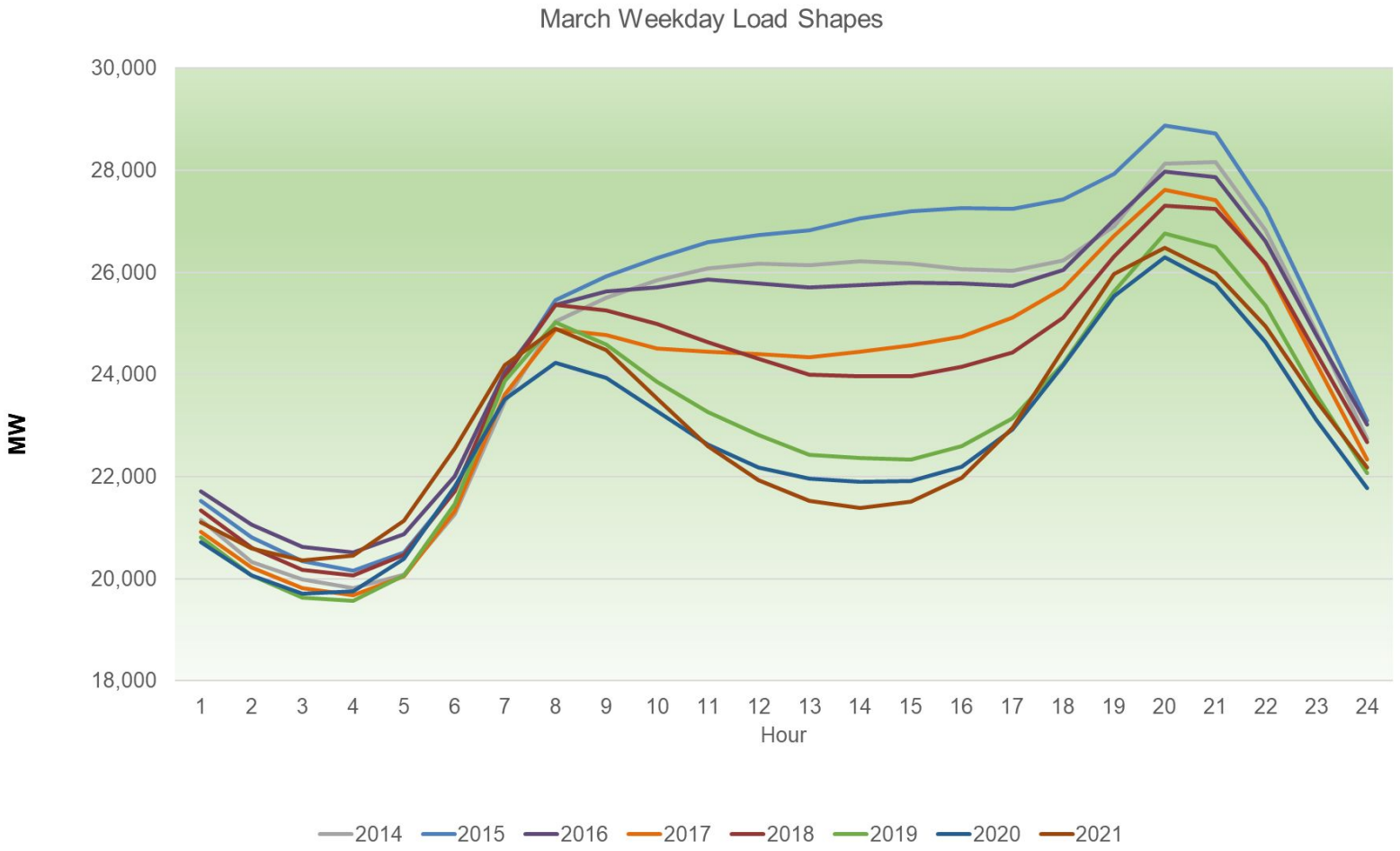
<u>One Configurable Load Forecasting Platform Provides:</u>

- **Hourly Day Ahead Forecasts** out 9 Days; updated at 9am Day Previous
- **Real Time Forecasts** for rolling 24 hours at a 5 minute granularity. Updated every 5 minutes.

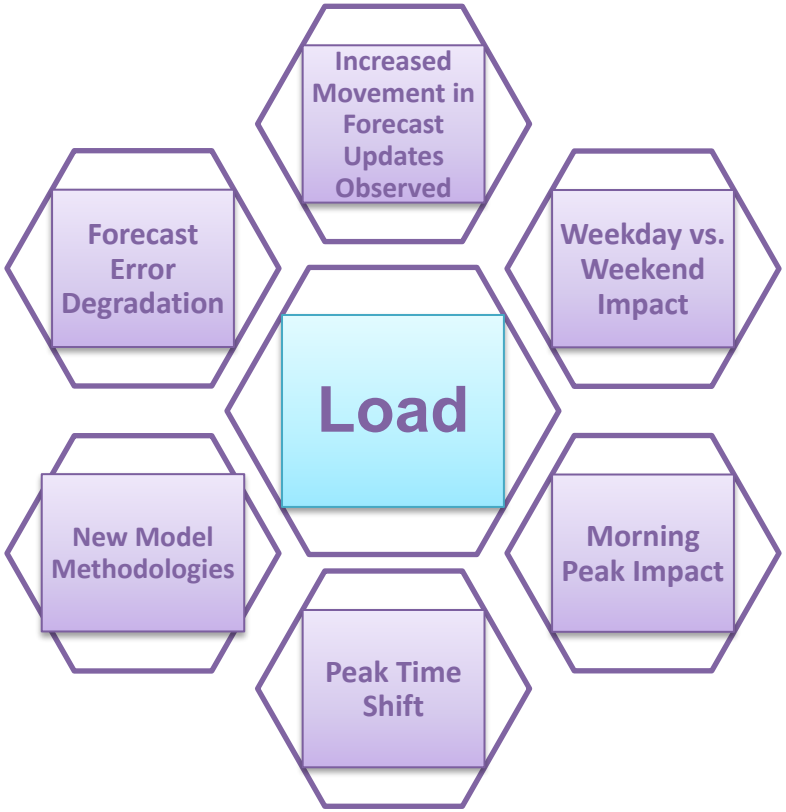
CAISO Systems

- Forecasting Team can select "active" Forecast Provider for DA, RT, and Blend Configurations
- **Hourly Forecast** used in all reliability studies (RUC, Outage Coordination, Next Day Study)
- **Real Time Forecast** used in real time market optimization to form commitment decisions and pricing
- **Internal Confidence Bands** provided to operations to assist in quantifying uncertainty due to BTM resources.

Historical Load Shapes

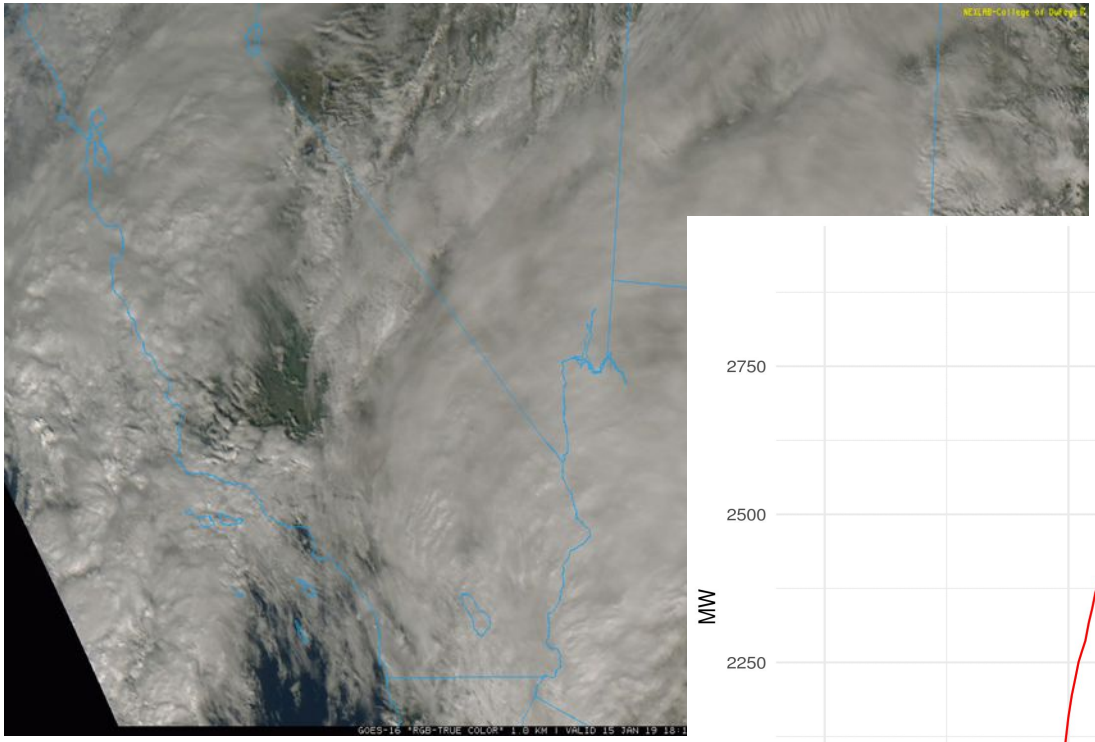


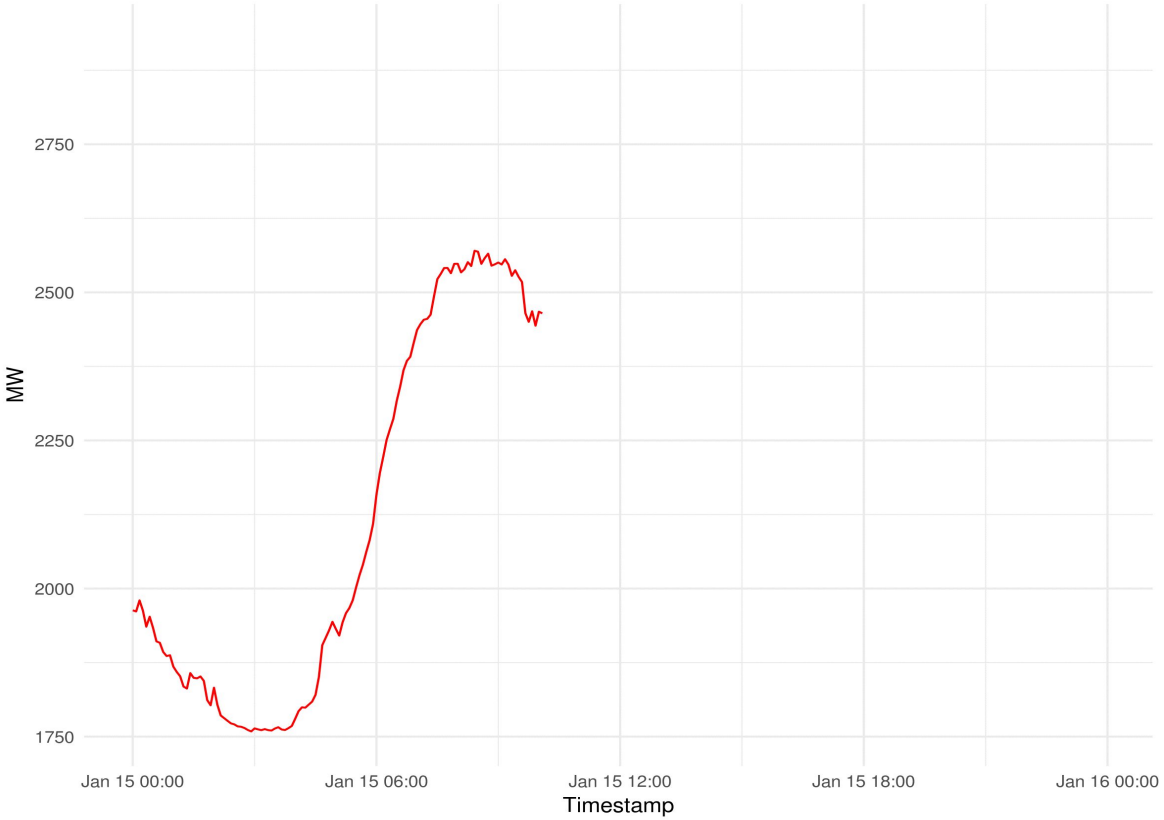
Demand Forecasting with Increased Behind-the-Meter Solar



- Importance of Behind the Meter Solar Forecasting as Input

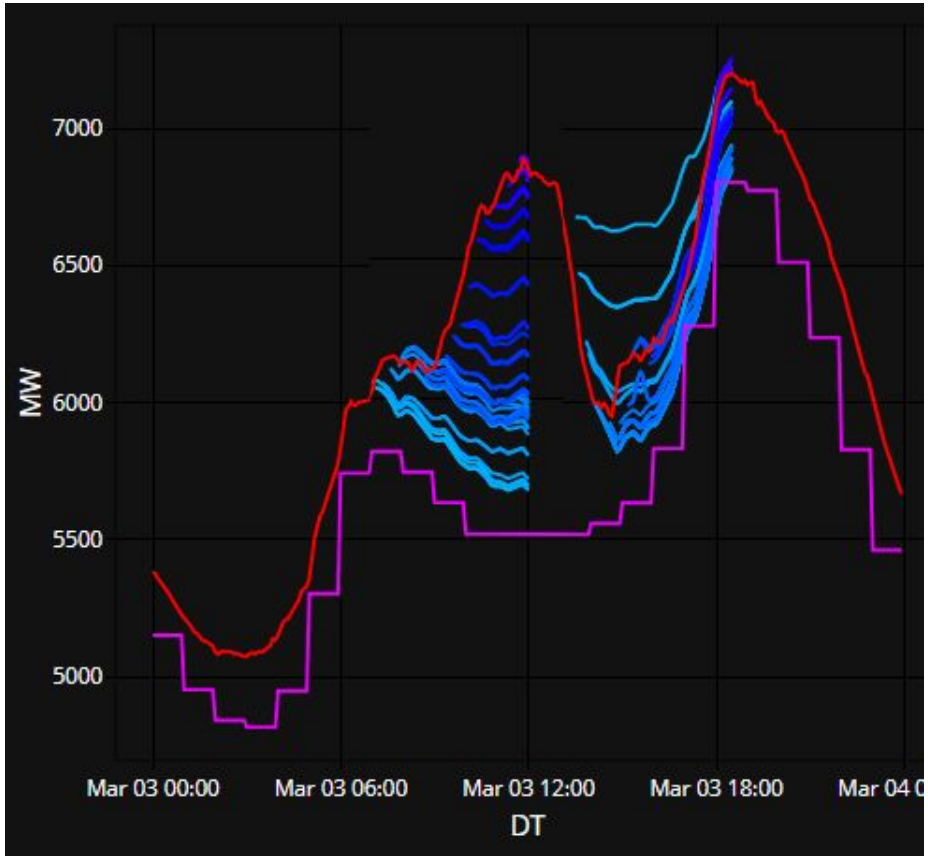
Enhancing Load Forecasting to account for Behind-the-Meter Solar Penetration



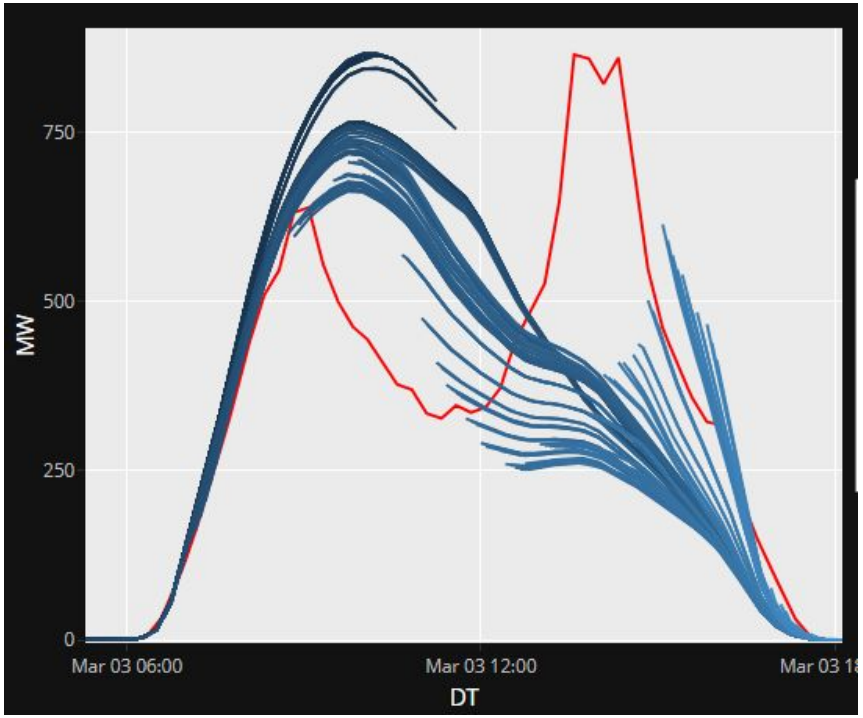


Demand Forecast Movement due to Behind the Meter Solar

Load Forecast Movement due to BTM Solar

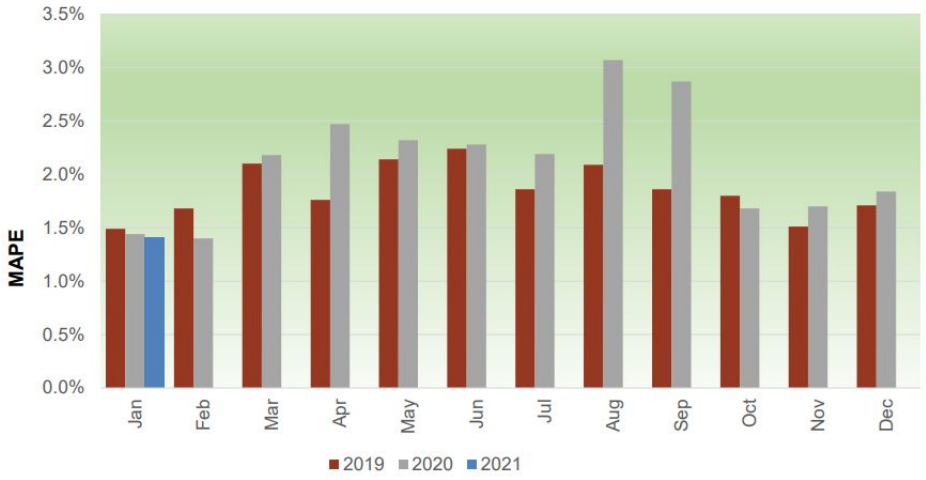


BTM Solar Forecast Updates vs. Actual



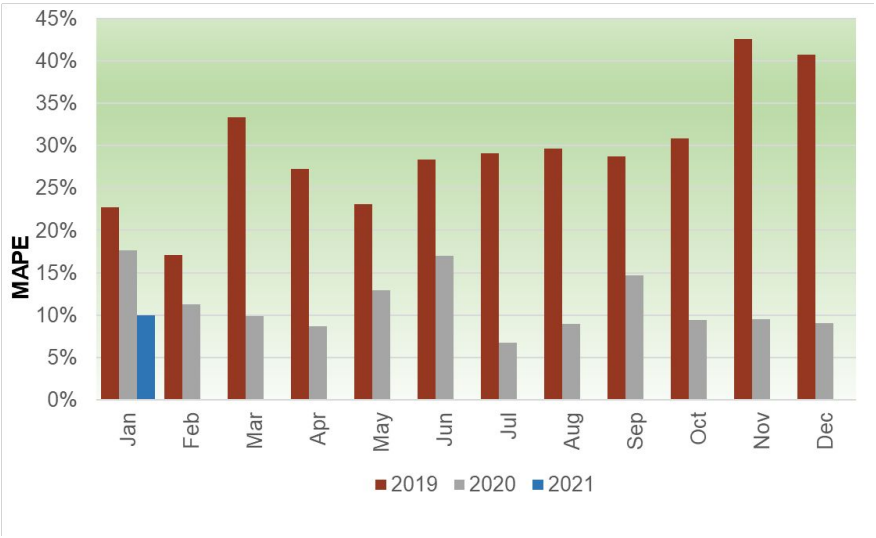
CAISO Forecast Accuracy

Day Ahead Load Forecast



- $MAPE = abs(Forecast - Actual)/Actual$

Day Ahead BTM Forecast



- $MAPE = abs(Forecast - Actual)/MonthlyFullSun$

Operational Impacts

CAISO Forecasting Advancements in Support of High Penetrations of Renewable Resources