Briefing on Forecasting in Western EIM

Michael Stewart

Forecast Model Analyst, Short Term Forecasting

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California ISO

Presentation overview

- Load forecasting

- Wind/Solar forecasting

  – Persistence Forecast

Short-term load forecast importance and use

- Definition of short-term load forecasts
  - Looking at the time frame from intra-hour to 2 weeks out
- Essential to the market optimization and reliability of the Balancing Authority
- Drives basic reliability and dispatch operation functions, such as:
  - Unit commitment
  - Economic dispatch
  - Fuel scheduling
  - Generation and transmission maintenance

How is the load forecast derived?

- Load forecasting is nonlinear and has behavioral impact from the following different areas:
  - Weather Conditions
  - Variations of Social and Economic Environments
  - Previous System Load
  - Emerging Technologies such as behind the meter solar

- Forecasted weather parameters are the most important factors in short-term load forecasts
  - Temperature
  - Humidity
  - Cloud Cover

How is the load forecast derived continued

- Key parameters needed to develop a load forecast
  - Weather
  - Gross actual load information
    - Taking into account day of the week, month, holiday, etc.
  - Estimated gross load reduction information, such as:
    - Behind the meter solar
    - Demand response
    - Battery behavior
    - Hydro pump storage behavior
- It is **important** to have the **best actual information possible**, breaking out the individual effects to train the load forecast model of what future behavior will be. *For example, forecasted & actual temperature information, forecasted & actual demand response information, etc.*

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Load 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

One Configurable Load Forecasting Platform Provides:

- **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.

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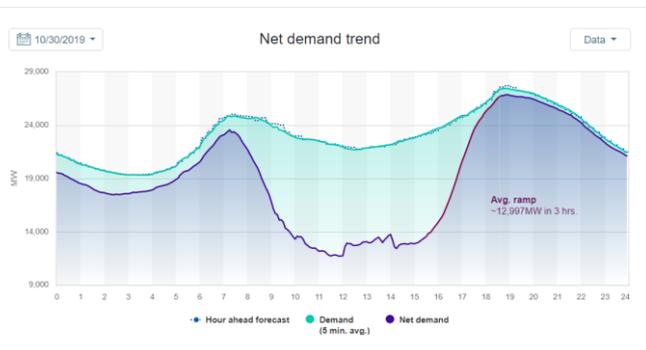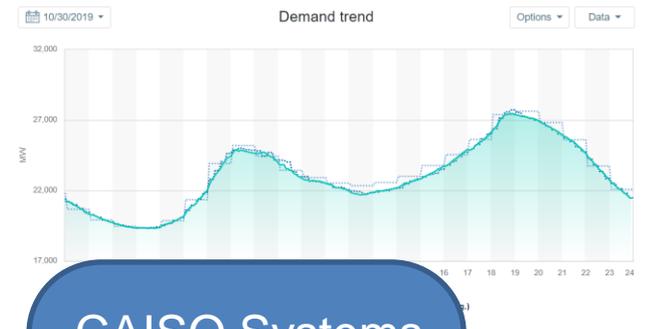
What different models are used within a neural net system?

- ## Persistence Model
  - 0 - 75 min (configurable)
  - Forecasting off recent load and day type
  - Blending into Hour Ahead Model

- ## Hour Ahead Model
  - 40 minutes to 4 hours (configurable)
  - Similar Hours
  - Weather inputs

- ## Day Ahead Model
  - 4 hours – 9 days (configurable)
  - Similar days
  - Weather Inputs

2020 load forecasting accuracy: T-60 minutes

2020 EIM BAA T-60 Forecast Accuracy
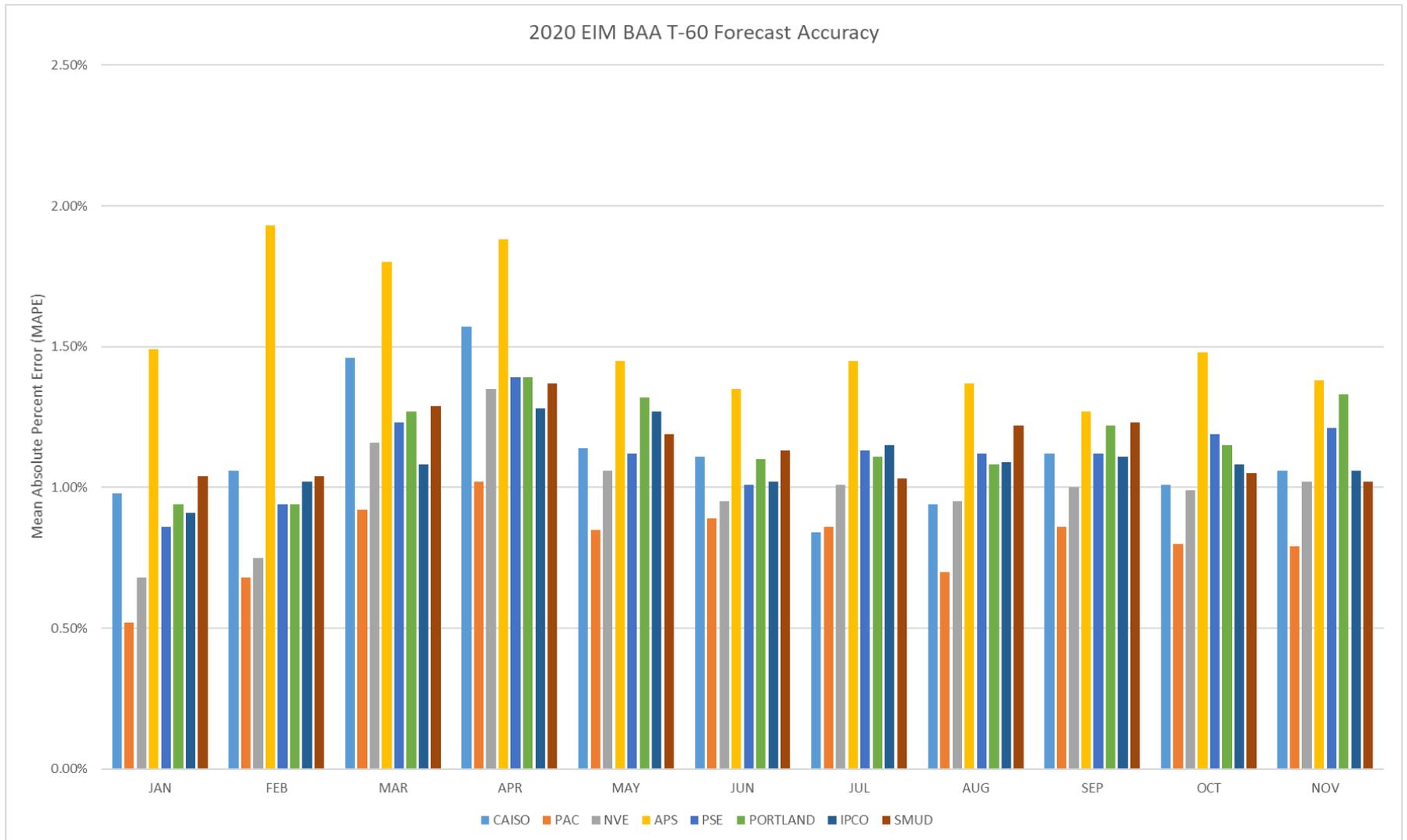
2020 load forecasting accuracy: T-40 minutes

2020 EIM BAA T-40 Forecast Accuracy
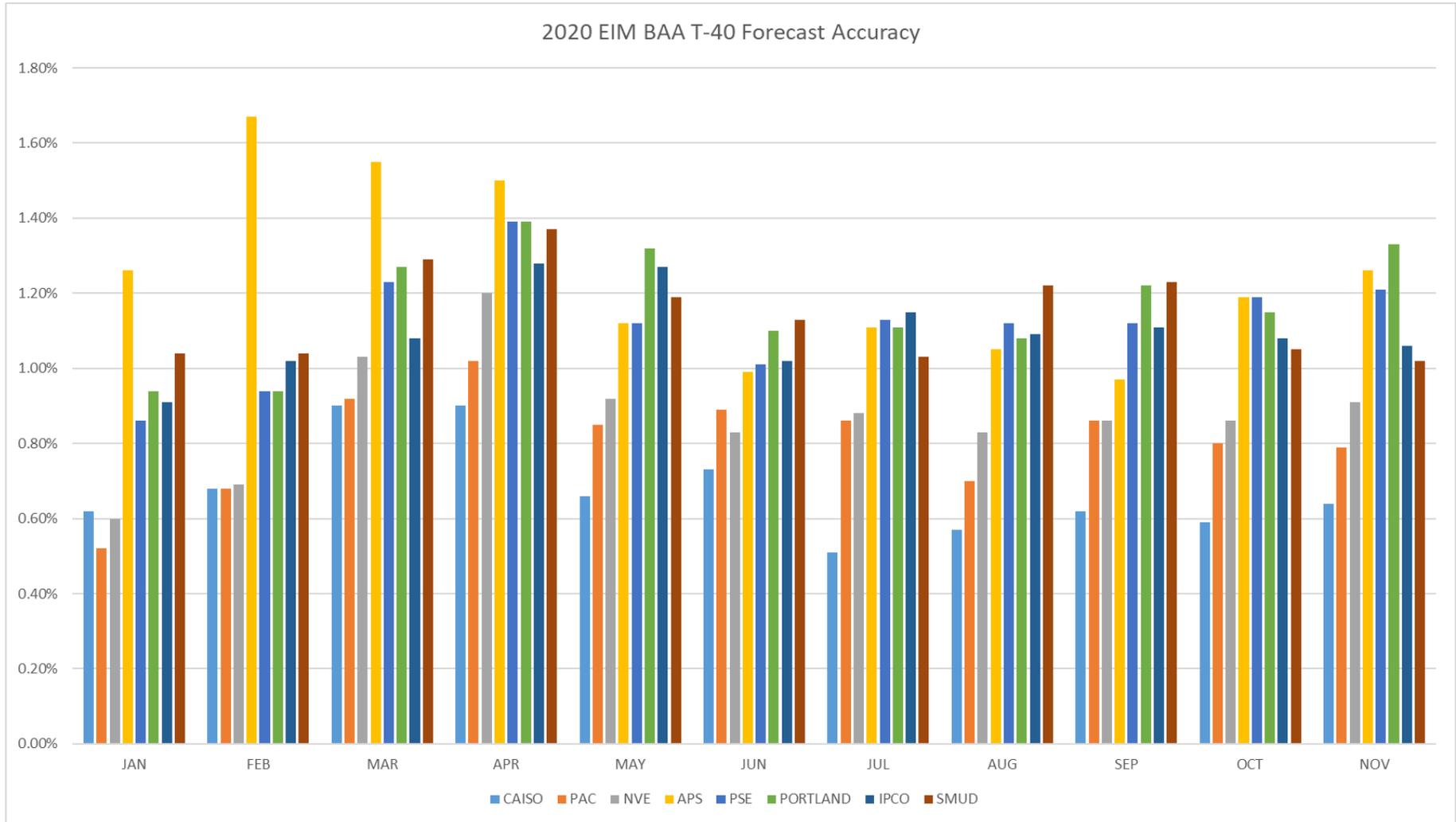
What are the key load forecast intervals used in the market runs?

- **Base schedule balancing**
  - <u>T-80 minute</u> forecast is used for the T-75 minute base schedule balancing
  - <u>T-60 minute</u> forecast is used for the T-55 & T-40 minute base schedule balancing
    - Note: This time period is financially binding
- **Flexible ramping sufficiency test:**
  - 15-minute average used
  - T-75 minute flex sufficiency test uses the 15-minute forecast that went out at <u>T-79 minutes</u>
  - T-55 & T-40 minute flex sufficiency tests use the 15-minute forecast that went out at <u>T-69 minutes</u>

EIM Entities' options for load forecasting

- ## Use their own Demand Forecast, by BAA area
  - *"An EIM Entity Scheduling Coordinator may opt to provide a non-binding EIM Entity Demand Forecast . . .as part of the hourly EIM Base Schedules."*

- ## Use the CAISO Demand Forecast
  - Using the CAISO Demand Forecast allows for the following exemption from under/over scheduling charges under Section 29.11(d)(1) and (2).
    - *"An EIM Entity will be exempt from under-scheduling and over-scheduling charges under Section 29.11(d)(1) and (2) if it uses the Demand Forecast prepared by the CAISO in its EIM Resource Plan and it approves EIM Base Schedules for its resources within +/- 1% of the CAISO Demand Forecast, as determined according to the Business Practice Manual for the Energy Imbalance Market."*

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Future improvements to load forecasting

- EIM Entities have option to provide CAISO their load forecast

- Further coordination on meter validation parameters
  - Good Data In = Good Data Out!

- Incorporate Behind-the-Meter Solar Forecasting into EIM Load Forecasts

- Further monitor and make improvements due to impact of COVID to EIM load shapes

- Continue to monitor and work towards improvement of forecast movement of EIM Load Forecasts
  - Especially as it relates to T-80 to T-60 Forecast Updates

Wind & Solar Forecasting at CAISO

Tehachapi Pass

Eligible Intermittent Resources (EIR)

- Asset Registration Information
- Outage/De-Rate Schedules
- Real Time Generation Telemetry (MW)
- Real Time Telemetry for Meteorological Information

Topaz Solar Farm, San Luis Obispo County, California

Wind & Solar Forecast Service

Two Forecast Service Providers each provide:

- **Hourly Day Ahead Forecasts for each EIR** out 4 Days; updated at 5:30 am and 8:45am Day Previous
- **Real Time Forecasts** for rolling 8 hours at a 5 minute granularity. Updated every 5 minutes
- One Provider Provides Probabilistic Forecasts used for risk assessment

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 dispatch to set DOT for EIR Resources
- **Internal Persistence Forecast** used in RTD to improve accuracy 50% from FSP providers.

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Is there a time delay getting renewable forecasts into the market runs?

- Short answer is yes; below describes some typical transfer time that is needed for the renewable forecasts coming from a 3rd party source
- Example of how the renewable forecasts from an EIM Entity flow through the CAISO systems:

  - EIM Forecast Service Provider (EIM FSP) Submitted @ 10:24:08 AM
    Internal system picked up EIM FSP forecast @ 10:24:35 AM
    Internal system published 5 min VER payload @ 10:27:13 AM
    Market received 5 min VER payload @ 10:27:16 AM

    Following the market receiving the information it would end up in that market run; if it is received after the market run has been kicked off, it is going to be picked up in a successive RTD run.
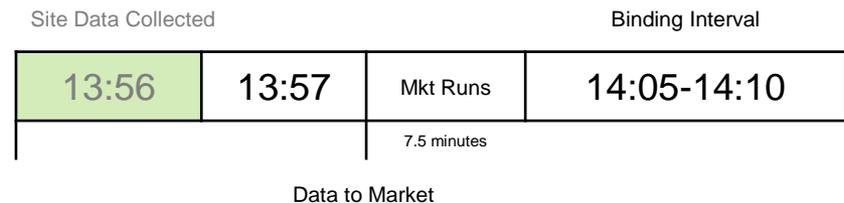
Internal CAISO Persistence-Based Renewable Forecast – Why was an internal RTD forecast needed?

Current:

Site Data Collected	FSP Creates Forecast	ALFS Process Complete		Binding Interval
13:45-13:50	13:51-13:53	13:54-13:57	13:57	Mkt Runs	14:05-14:10
5-10 minutes	up to 3 minutes	3 minutes		7.5 minutes	

PI Data submitted to FSP   Forecast to ALFS   Data to Market

Persistence Method:

- More recent actuals are used in forecast
- 6+ minutes are eliminated from lag

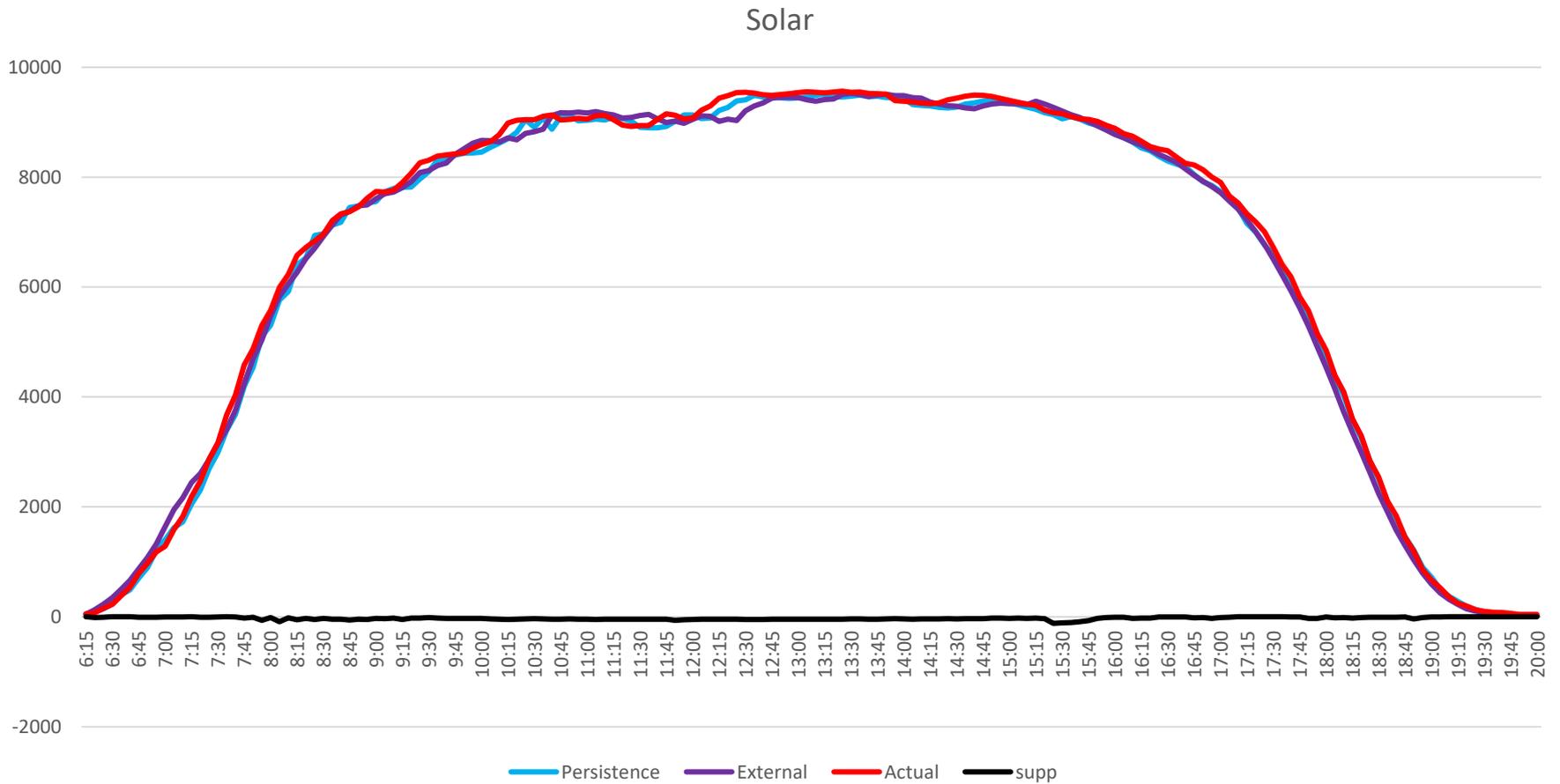| Site Data Collected			Binding Interval
13:56	13:57	Mkt Runs	14:05-14:10
		7.5 minutes	

Data to Market

Forecast calculated in market, eliminating ALFS & processing time needed outside of CAISO

Impact of Shortened Processing Time
for Wind

Simple Persistence Model Works for Wind
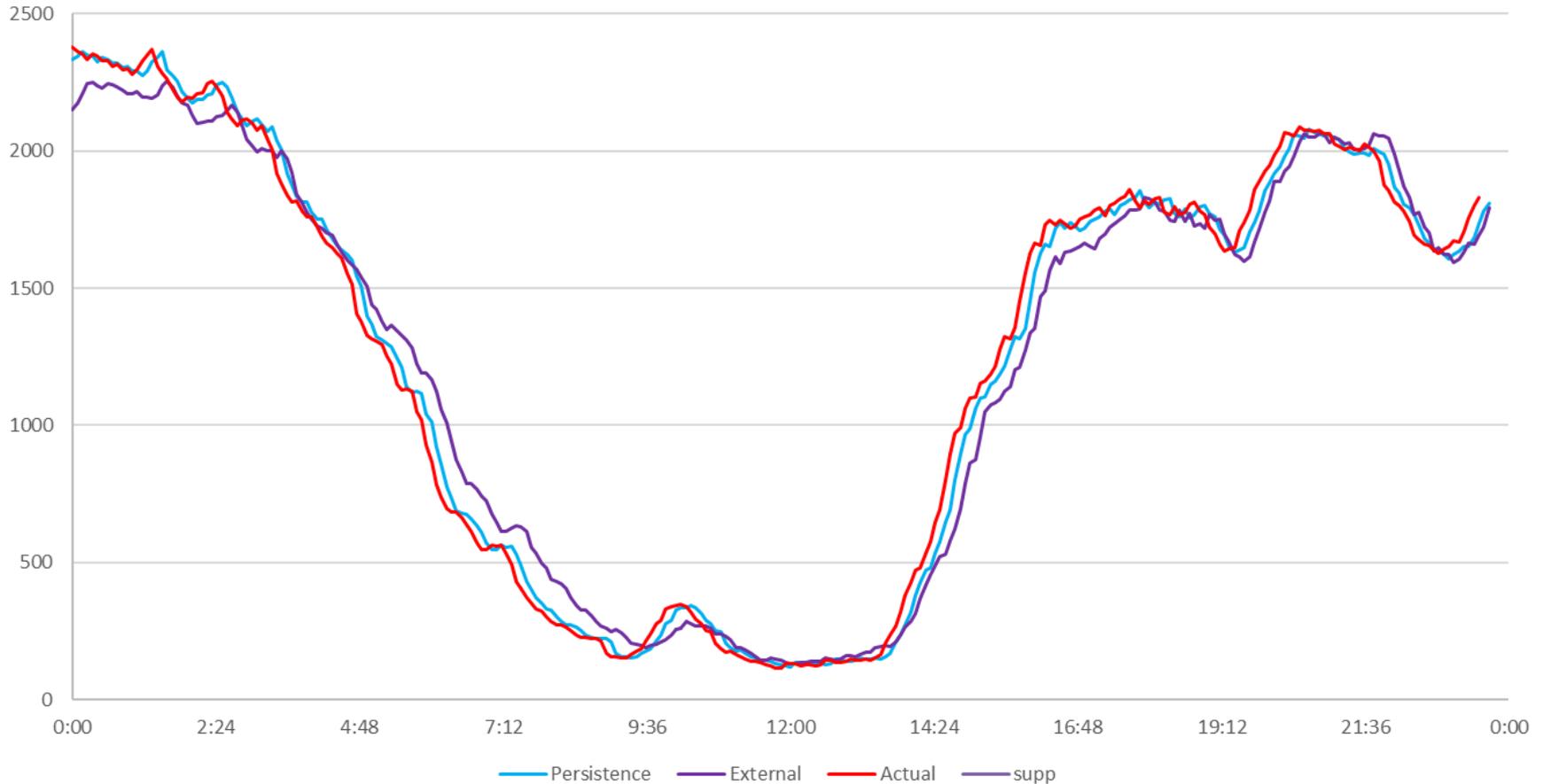
Results: Contour Persistence Works for Solar

Solar

EIM Entities' options for renewable forecasting

- ## Use their own Forecasting Service Provider (FSP)
  - At this time, all EIM Entities are using this option
- ## Use the CAISO Persistence Forecast (RTD Only)
  - The cost of this is covered within the EIM entities GMC rate.
  - Utilizing persistence methodology can assist with time delay and improved accuracy in RTD timeframe.
- ## Use the CAISO Forecasting Service Provider (FSP)
  - CAISO does charge a fee for the variable energy resource forecasting services in accordance with Appendix F, Schedule 4 at a rate of $.10 per MWh

Questions?