

WESTERN ENERGY IMBALANCE MARKET

Briefing on Forecasting in Western Energy Imbalance Market

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EIM Governing Body Meeting

General Session

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Presentation overview

- Load forecasting
- Wind/Solar forecasting

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

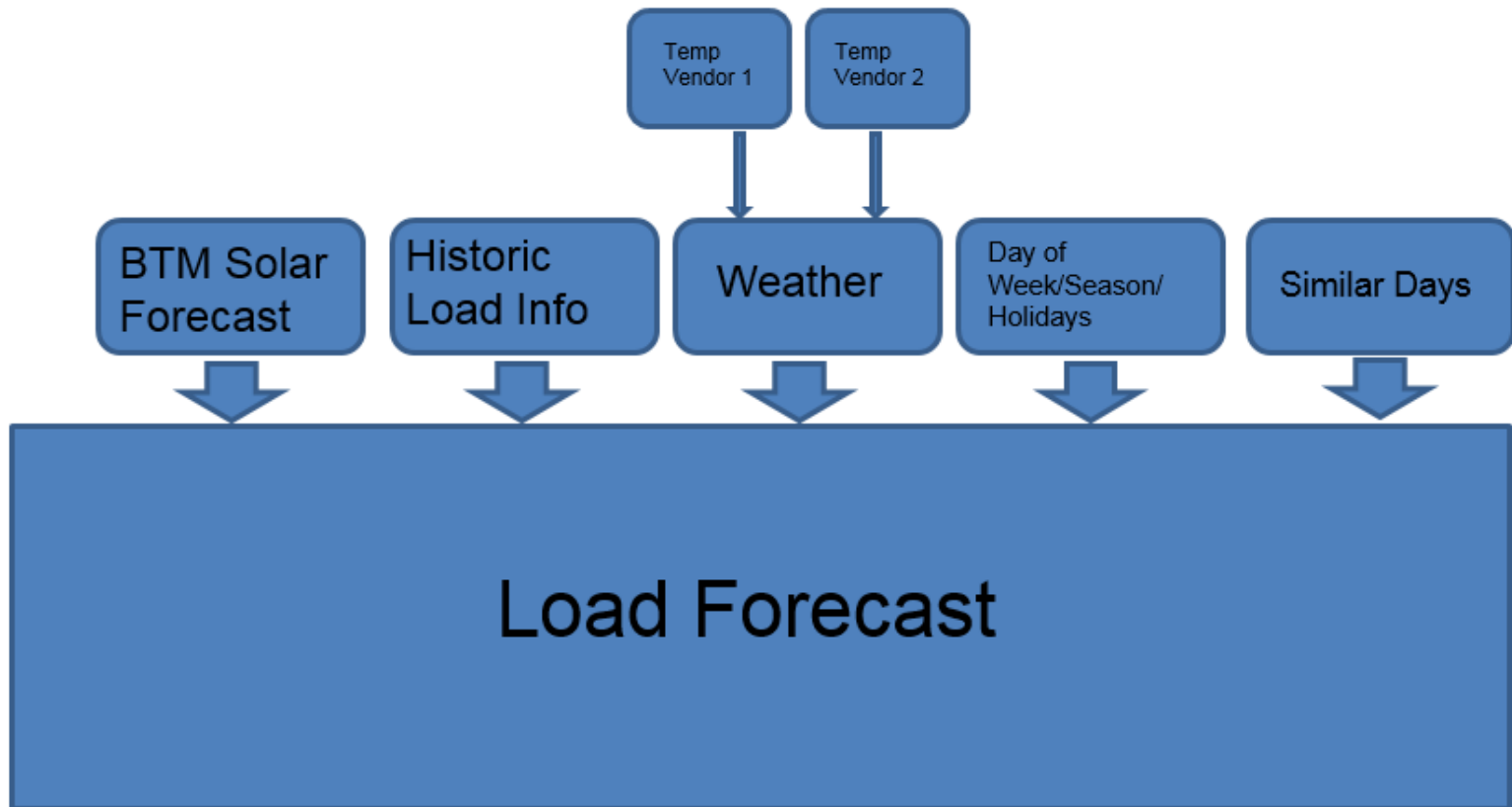
How is the load forecast derived?

- 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

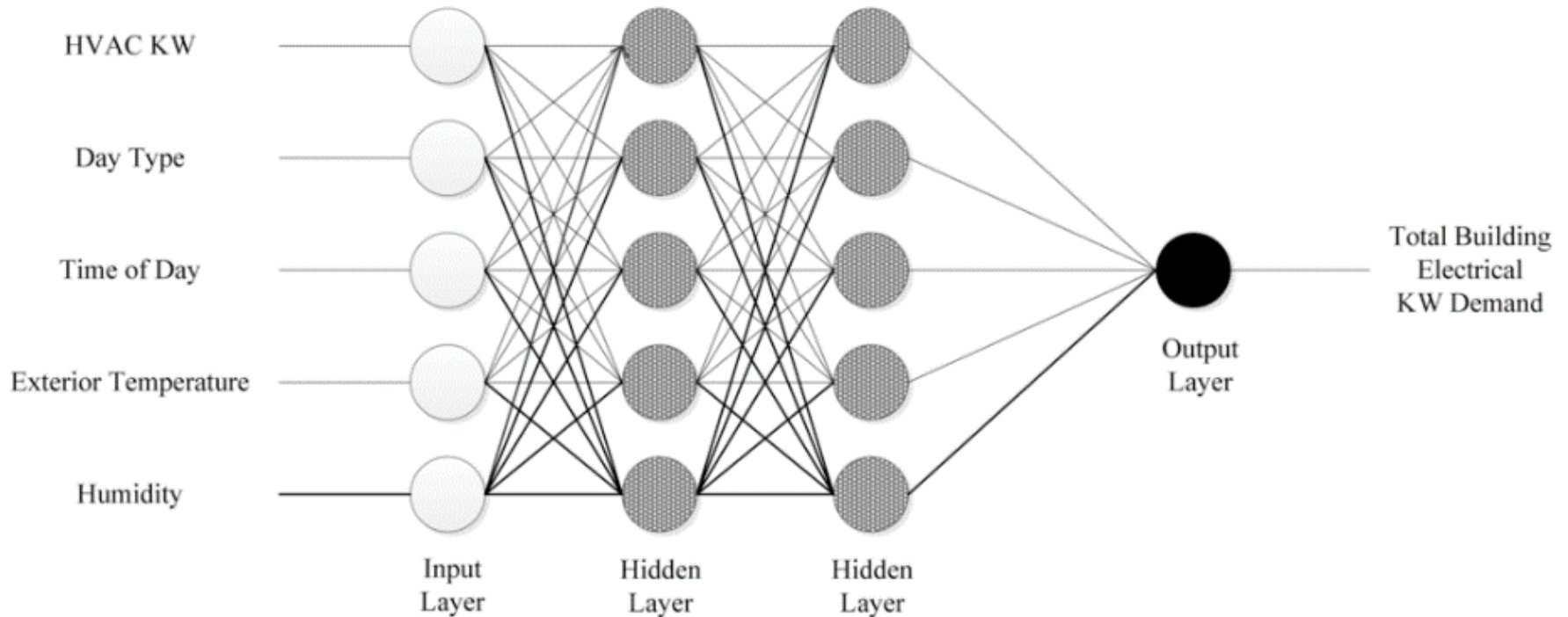
- Key parameters needed to develop a load forecast
 - Weather
 - Gross actual load information
 - Taking into account day of the week, month, holiday, etc.
 - Estimated gross load reduction information, such as:
 - Behind the meter solar
 - Demand response
 - Battery behavior
 - Hydro pump storage behavior
- 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.*

How is load forecasting done for EIM Entities?



What is neural network forecasting?

- “...a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs.” Dr. Robert Hecht-Nielsen



What different models are used within a neural net system?

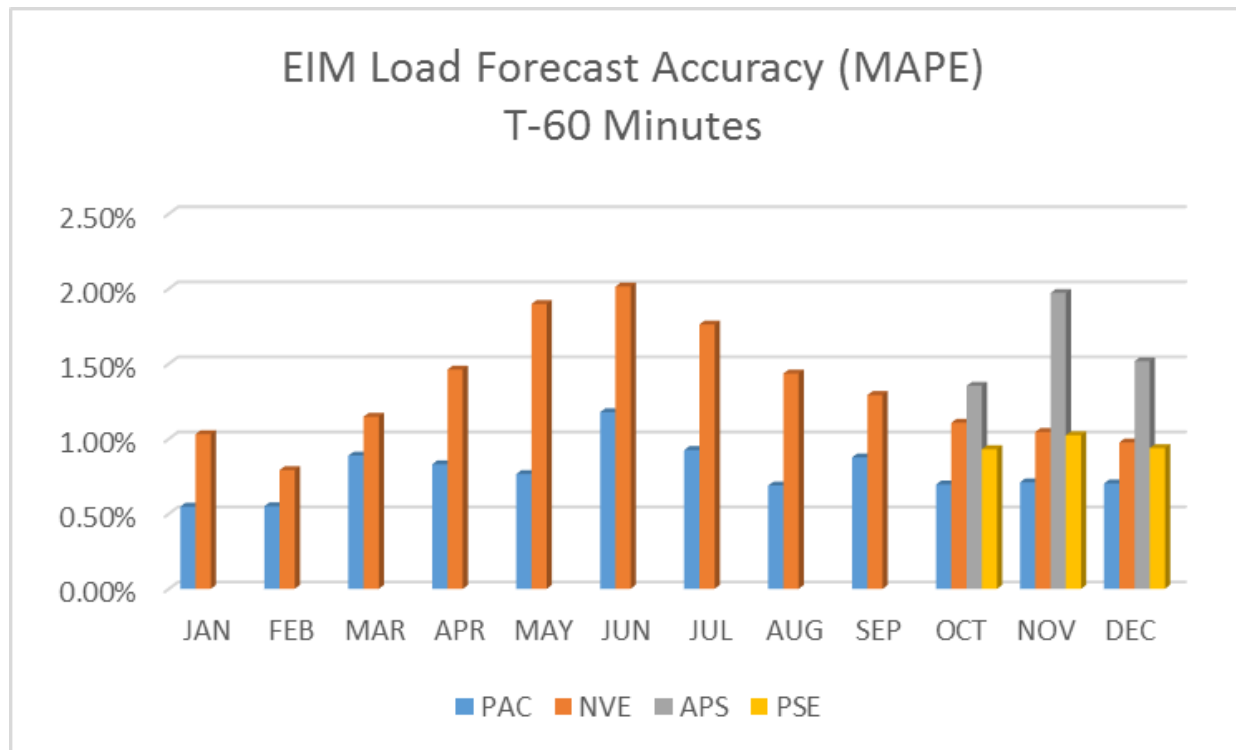
- Persistence model
 - 0 - 75 min (configurable)
 - Forecasting off recent load and day type
 - Blending into hour-ahead model
- Hour-ahead model
 - 40 minutes to 4 hours (configurable)
 - Similar hours
 - Weather inputs
- Day-ahead model
 - 4 hours – 9 days (configurable)
 - Similar days
 - Weather inputs

What is cloud cover's role in load forecasting as behind the meter solar generation increases?

- **Before:**
 - Cloud cover was fully inter-related to temperatures.
 - Example: Clouds come over and drive temperature reduction during summer months
- **Now:**
 - Clouds come over head, the temperatures still reduce; BUT load can increase due to loss of behind the meter solar generation

2016 load forecasting accuracy: T-60 minutes

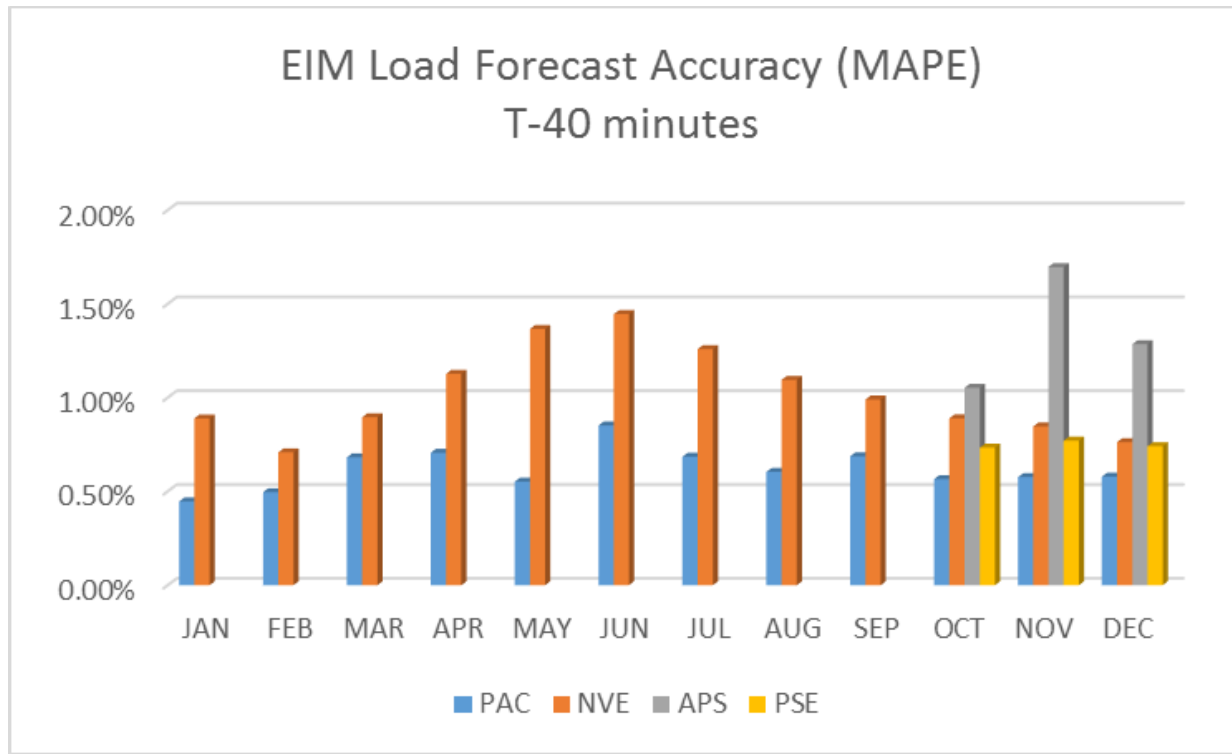
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PAC	0.55%	0.55%	0.89%	0.83%	0.77%	1.18%	0.93%	0.69%	0.88%	0.70%	0.71%	0.70%
NVE	1.03%	0.79%	1.15%	1.46%	1.90%	2.01%	1.76%	1.44%	1.29%	1.11%	1.05%	0.97%
APS										1.35%	1.97%	1.52%
PSE										0.93%	1.02%	0.94%



MAPE = Mean Absolute Percentage Error

2016 load forecasting accuracy: T-40 minutes

T-40	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PAC	0.45%	0.50%	0.68%	0.71%	0.55%	0.85%	0.68%	0.60%	0.69%	0.57%	0.58%	0.58%
NVE	0.89%	0.71%	0.90%	1.13%	1.37%	1.45%	1.26%	1.09%	0.99%	0.89%	0.85%	0.76%
APS										1.05%	1.70%	1.29%
PSE										0.73%	0.77%	0.74%



What are the key load forecast intervals used in the market runs?

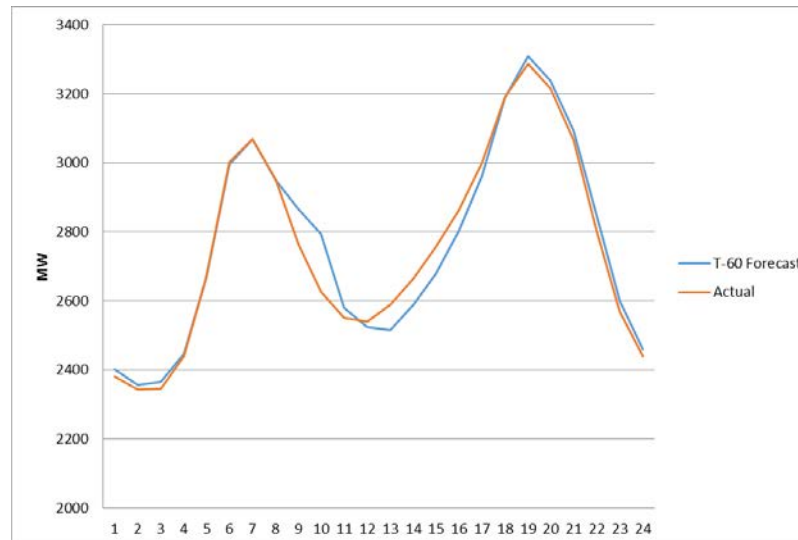
- Base schedule balancing
 - T-80 minute forecast is used for the T-75 minute base schedule balancing
 - T-60 minute forecast is used for the T-55 & T-40 minute base schedule balancing
 - Note: This time period is financially binding
- Flexible ramping sufficiency test:
 - 15-minute average used
 - T-75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

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.”*

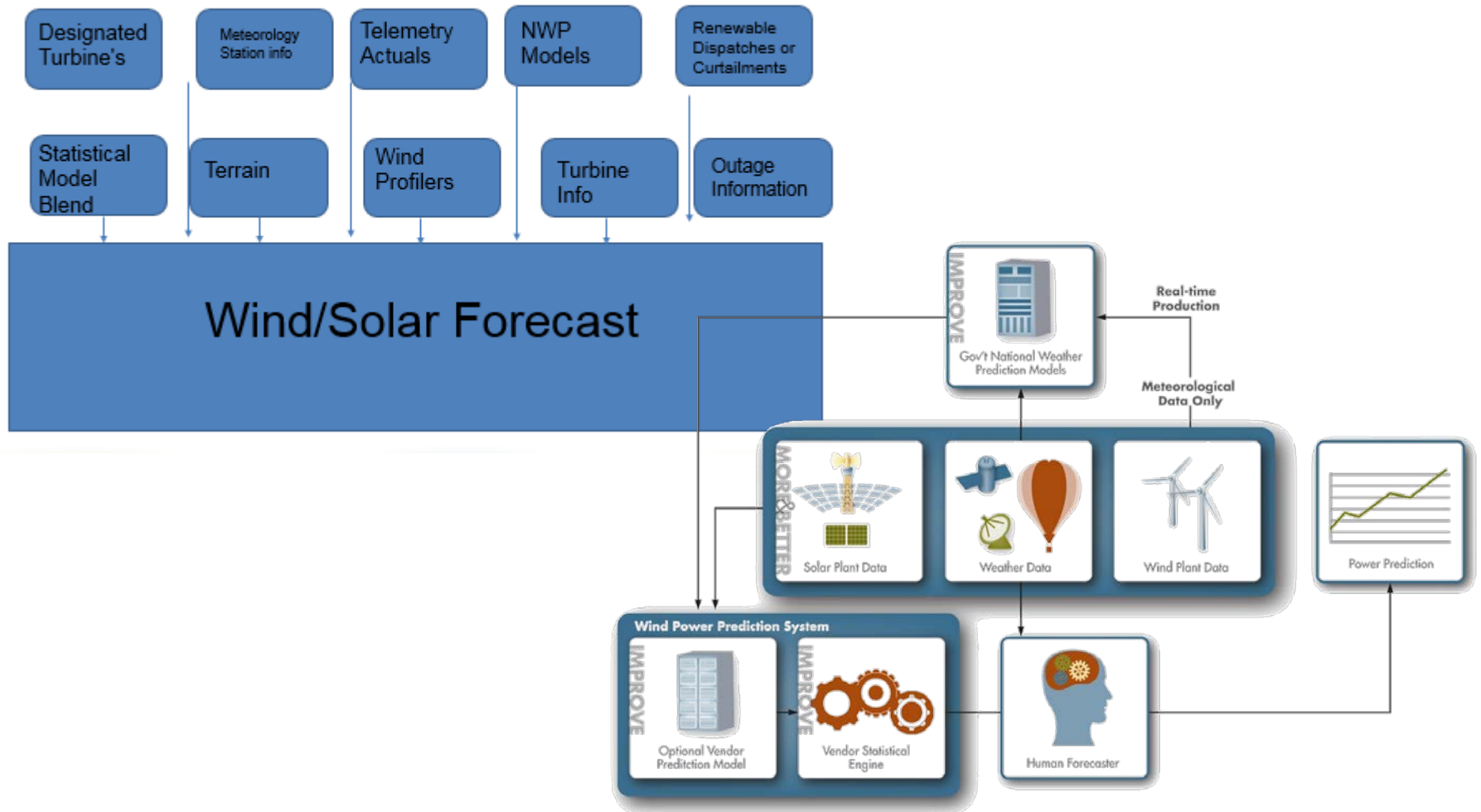
Future improvements to load forecasting

- EIM Entities to provide CAISO their BAA load forecast
- Get further actual information from entities as it relates to:
 - Demand response
 - Hydro behaviors where applicable to load
 - Roof-top solar
 - Irrigation
- Improve ramp load forecasting

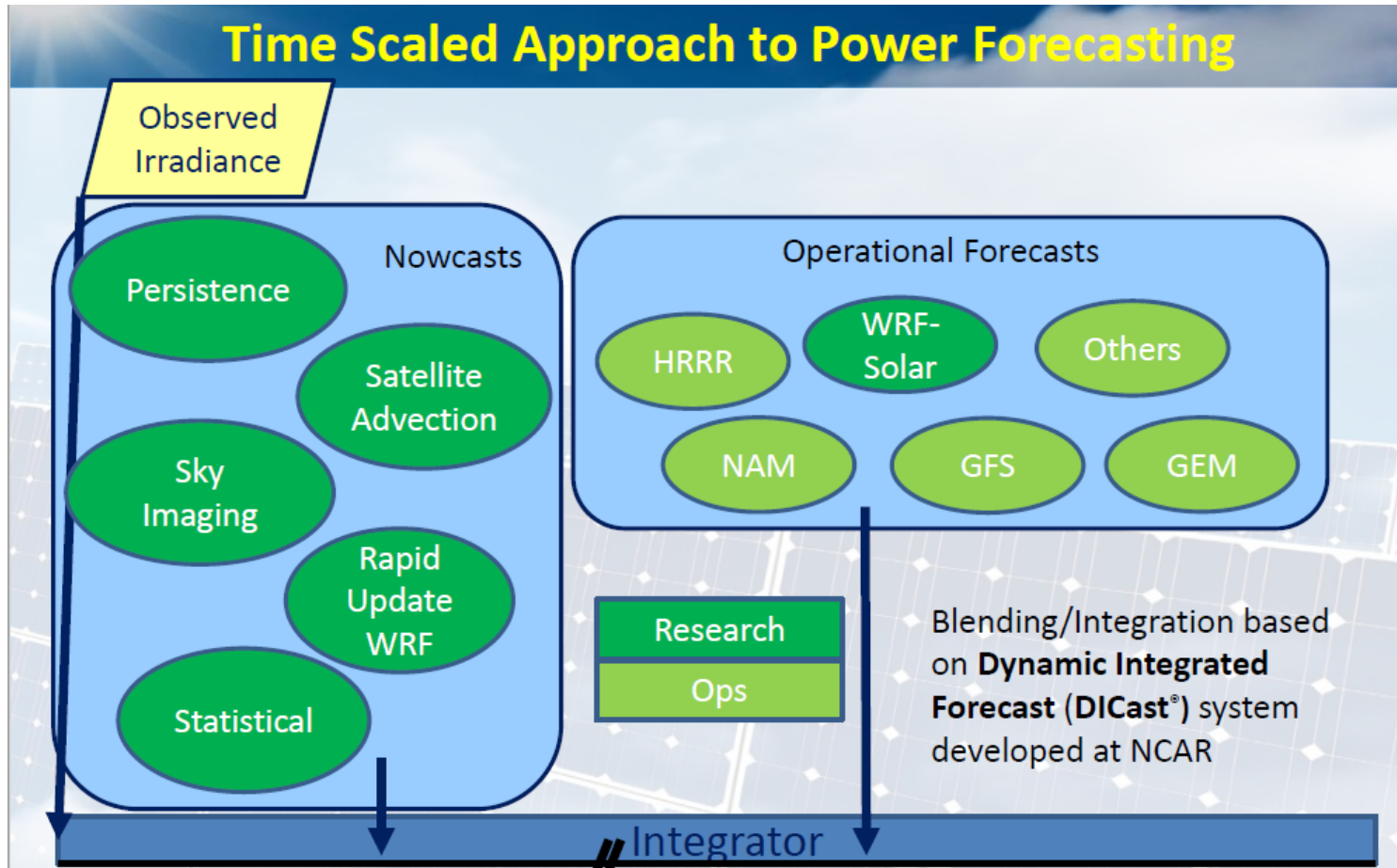


What is behind renewable forecasting?

Data Required for Renewable Forecasting



What are the different renewable forecasting methods based on time periods?



Picture from NCAR Research:

https://energy.gov/sites/prod/files/2016/08/f33/2.Tara_Jensen_DOE_SolarWorkshop_final.pdf

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.

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 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
 - Potential benefit in the future when in-house persistence forecast methodology is developed/delivered this may assist with time delay



Questions?

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Appendix



Where can I find that forecast information?

- OASIS
 - System Demand Tab
 - Sufficiency Evaluation Demand Forecast

Sufficiency Evaluation Demand Forecast - OASISUI Prod - PUBLIC - 0 - Internet Explorer

California ISO OASIS

ATLAS REFERENCE REPORT DEFINITION PRICES TRANSMISSION SYSTEM DEMAND ENERGY ANCILLARY SERVICES CONGESTION REVENUE RIGHTS PUBLIC BIDS

Date: 02/22/2017 Granularity: 15MIN BAA ID: AZPS Apply Reset

Download XML Download CSV

Sufficiency Evaluation Demand Forecast

1 - 20 of 3456

BAA	Granularity	Publication Timestamp	Interval Timestamp	Forecast(MW)
AZPS	15MIN	02/21/2017 23:51	02/22/2017 00:00	2408.918
AZPS	15MIN	02/21/2017 23:51	02/22/2017 00:15	2366.081
AZPS	15MIN	02/21/2017 23:51	02/22/2017 00:30	2382.896
AZPS	15MIN	02/21/2017 23:51	02/22/2017 00:45	2372.73
AZPS	15MIN	02/21/2017 23:51	02/22/2017 01:00	2369.058
AZPS	15MIN	02/21/2017 23:51	02/22/2017 01:15	2361.103
AZPS	15MIN	02/21/2017 23:51	02/22/2017 01:30	2355.947
AZPS	15MIN	02/21/2017 23:51	02/22/2017 01:45	2368.246
AZPS	15MIN	02/21/2017 23:51	02/22/2017 02:00	2368.502
AZPS	15MIN	02/21/2017 23:51	02/22/2017 02:15	2379.366
AZPS	15MIN	02/21/2017 23:51	02/22/2017 02:30	2391.16
AZPS	15MIN	02/21/2017 23:51	02/22/2017 02:45	2414.204
AZPS	15MIN	02/21/2017 23:51	02/22/2017 03:00	2441.485
AZPS	15MIN	02/21/2017 23:51	02/22/2017 03:15	2468.322
AZPS	15MIN	02/21/2017 23:51	02/22/2017 03:30	2462.96
AZPS	15MIN	02/21/2017 23:51	02/22/2017 03:45	2555.311
AZPS	15MIN	02/21/2017 23:51	02/22/2017 04:00	2617.663
AZPS	15MIN	02/21/2017 23:51	02/22/2017 04:15	2680.014
AZPS	15MIN	02/21/2017 23:51	02/22/2017 04:30	2742.365
AZPS	15MIN	02/21/2017 23:51	02/22/2017 04:45	2823.868

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