



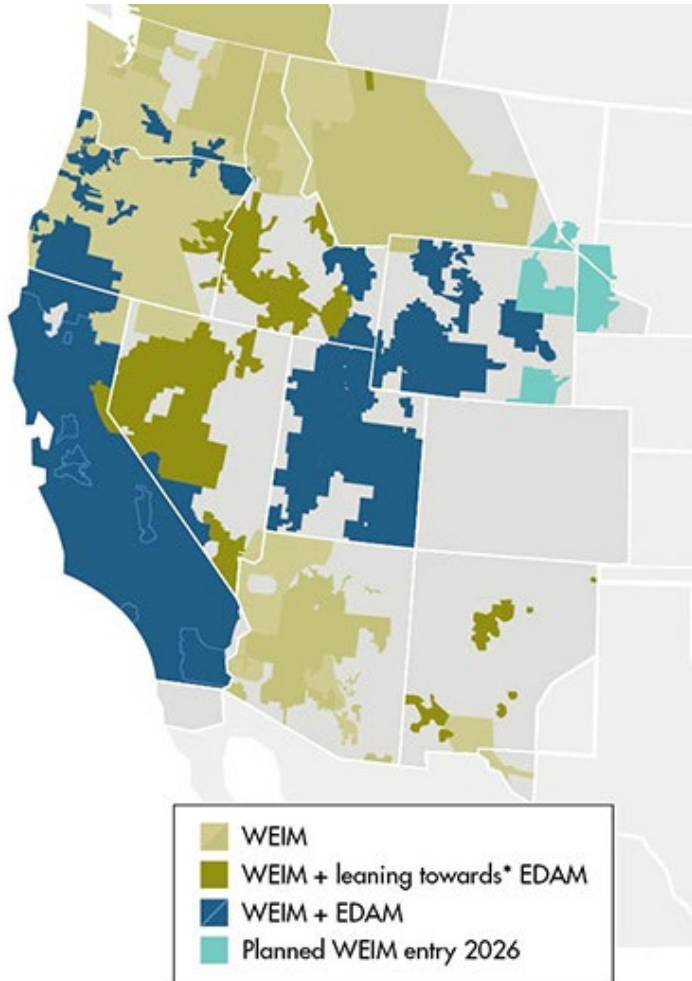
Uses of Probabilistic Renewable Forecasting

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ESIG Forecasting & Markets Workshop – Nashville, TN

California ISO



**These entities have publicly indicated a leaning towards EDAM as their preferred day-ahead market.*

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

52,061 MW record peak demand
(Sept. 6, 2022)

22 participating WEIM entities

Peak WEIM demand above
134,000 MW (July 10, 2024)

5 entities committed to join EDAM

4 entities signal intent to join

Over **1 million** metric tons
of CO₂ avoided

Renewable Penetration Facts for CAISO BAA

PEAK DEMAND

52,061 MW

Sept. 6, 2022 at 4:57 p.m.

Second highest:

50,270 MW, July 24, 2006

New record

SOLAR PEAK

21,370 MW

May 2, 2025 at 12:13 p.m.

Previous record:

21,062 MW, April 24, 2025

WIND PEAK

6,465 MW

May 28, 2022 at 5:39 p.m.

Previous record:

6,265 MW, Mar. 4, 2022

PEAK NET IMPORTS

11,894 MW

Sept. 21, 2019 at 6:53 p.m.

STEEPEST 3-HOUR AVERAGE RAMP

23,400 MWh

Mar. 7, 2025 starting at 3:05 p.m.

Second highest:

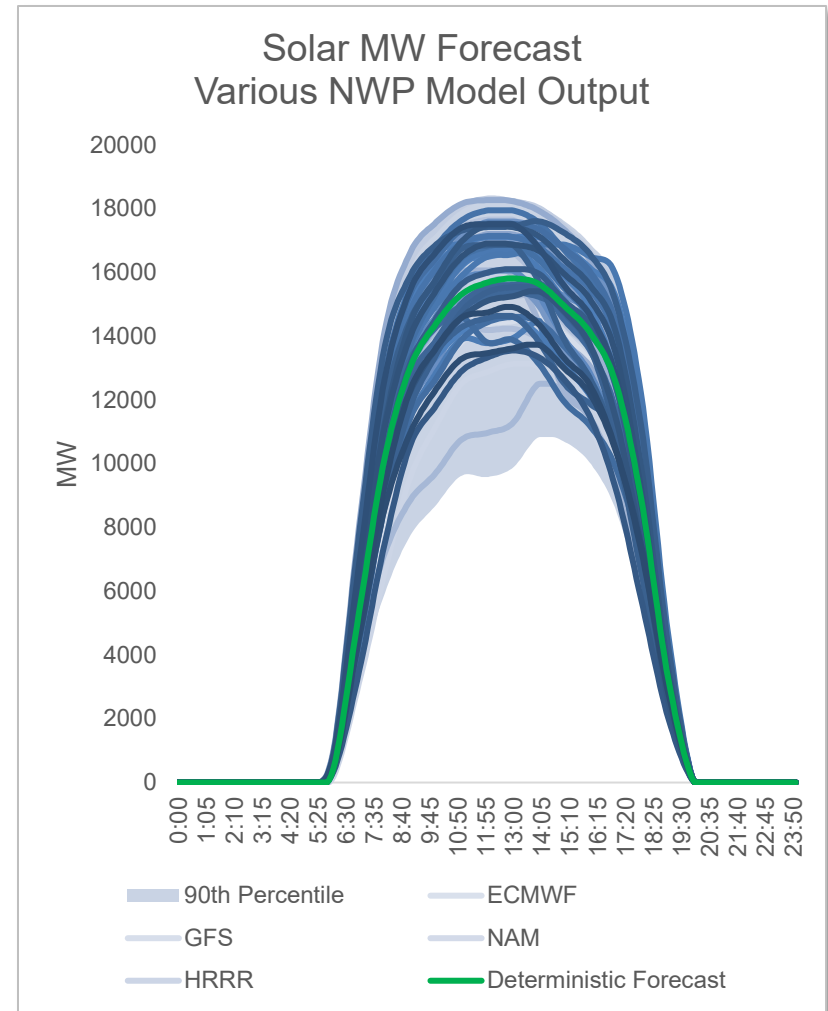
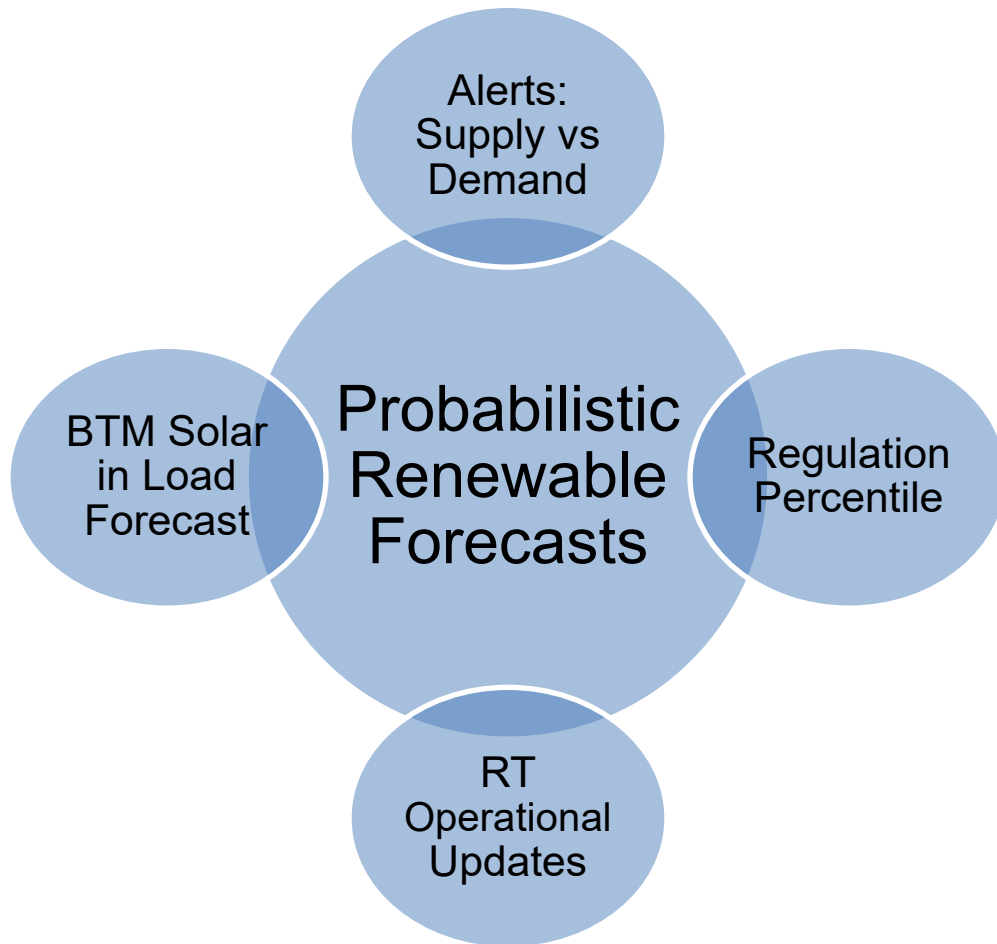
23,228 MWh, Jan. 20, 2025

Currently Installed	Capacity
Number of Renewable Resources	541
MW Capacity Large Scale Renewables	29,071 MWs
MW Capacity Behind-the-Meter Solar	17,900 MWs

*Values are approximate as of January 2025

Probabilistic forecasts help us **manage uncertainty**. Adapting for **conditions** helps us balance cost with risk.

Probabilistic forecasting for renewables are utilized throughout the CAISO processes



Creating an advanced warning system looking at key indicators of system health



The CAISO is monitoring and alerting on the following key elements in the 1-8 day horizon.

- Load
- Renewables
- RA Resource Supply
 - Transmission Outages Impacting Resource Supply



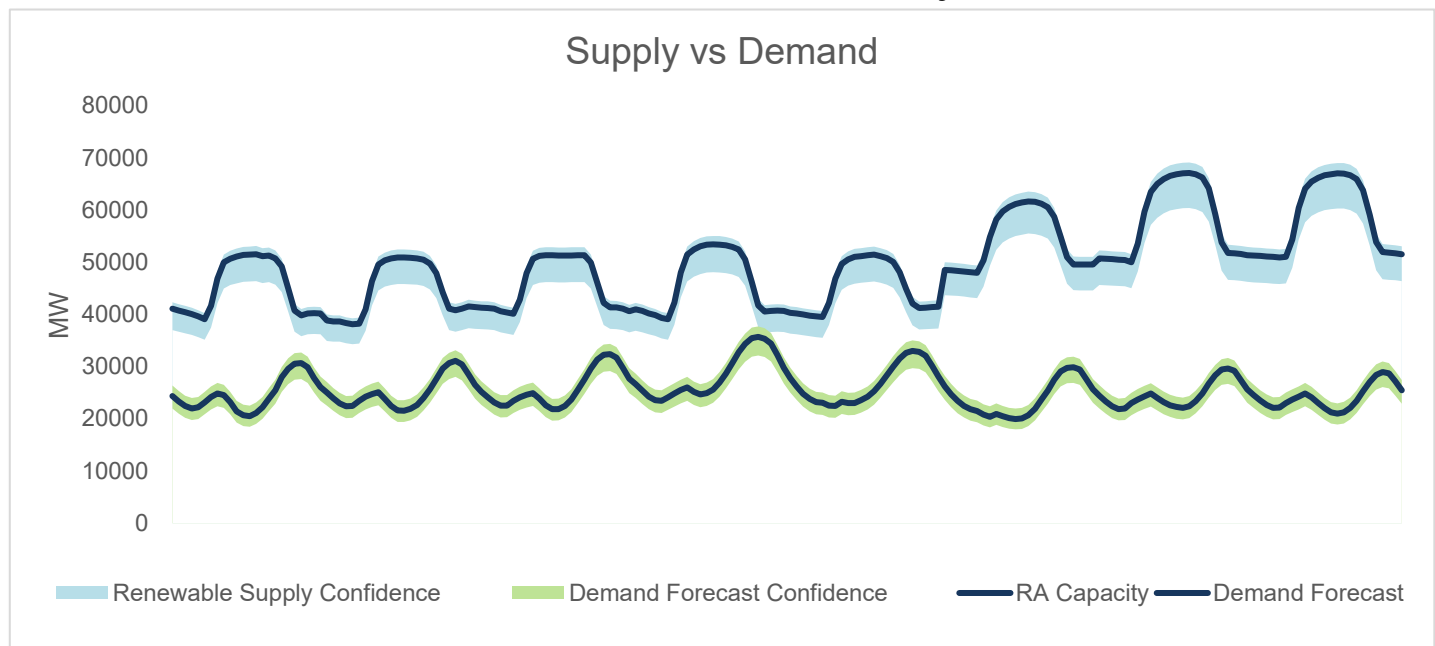
Alerts:
Supply vs
Demand

Daily outlooks are utilized to:

- Forecast resource adequacy supply margins and flag potential supply shortfalls.
- Inform playbook actions
 - [extreme-weather-event-process-and-communications.pdf \(caiso.com\)](https://www.caiso.com/documents/10183/101832022/extreme-weather-event-process-and-communications.pdf)

Accounting for renewable uncertainty in forward alerting

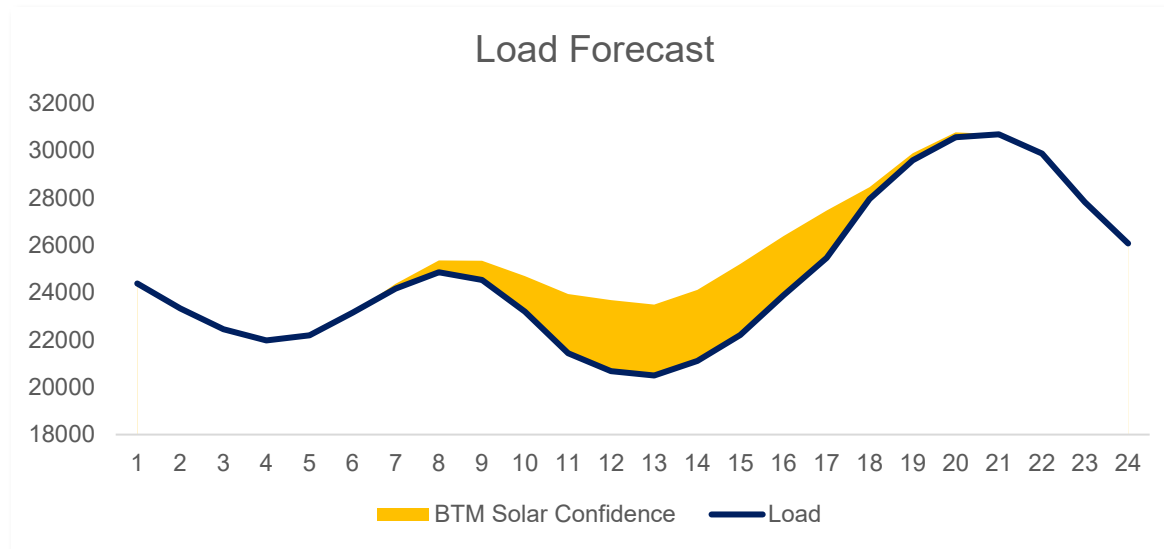
- Outlooks include load, wind, and solar uncertainty in addition to outage risk in forward days, based on historical data:
 - Weather risk leads to forecasted uncertainty



Alerts:
Supply vs
Demand

Rooftop Solar

- Worst-case production is provided during events with heavy impact to BTM solar production, such as fog, smoke, and marine layer.
- Understanding MW risk and timing assist in Load Forecast creation and evaluation.

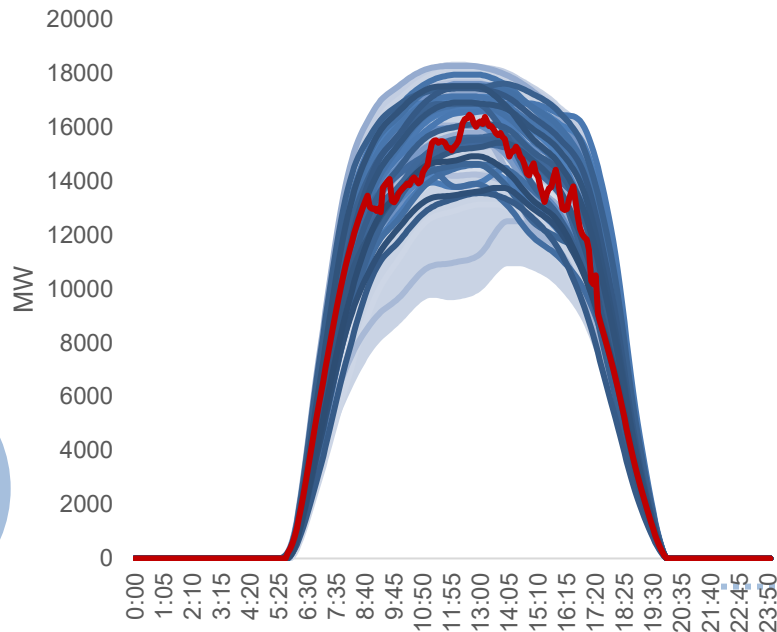


BTM Solar
in Load
Forecast

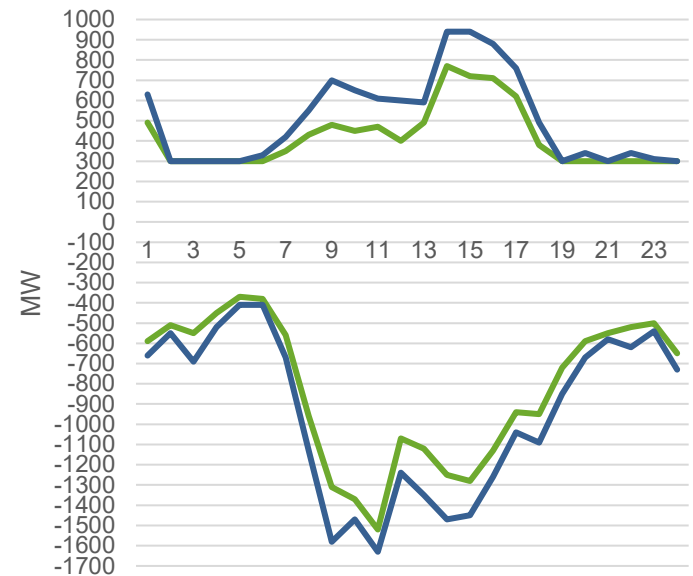
Regulation

Methodology	Pros	Cons
<p>Hourly Regulation values are calculated at multiple percentiles based on historic Regulation needed.</p> <p>Increased variability seen in confidence bands results in a higher percentile recommendation.</p>	<ul style="list-style-type: none"> Coverage: 95th vs 98th provides additional MW on variable/risky days Stability using minimum of monthly updates and only 2 percentiles, more predictability in market optimization 	<ul style="list-style-type: none"> The percentile is chosen by whole day, not hour Potential for too much regulation during hours that don't need it

Renewable Variability



Reg Recommendations (95th & 98th)

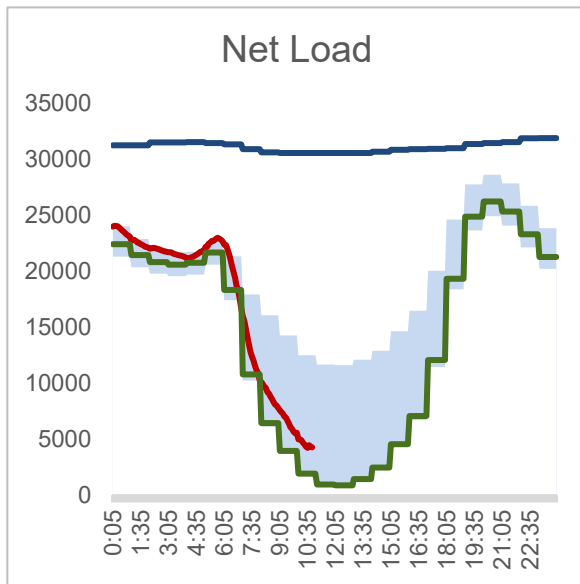


Regulation
Percentile

In stressed system conditions, every MW counts in planning

Risk to RT renewable production is communicated based on range of confidence bands.

- Is there enough supply?
- How should batteries be dispatched?



Solar and wind forecast uncertainty through net load peak (HE)				
SOLR	DA	Low	Current RT	High
16	16,041	14,827	15,615	16,791
17	15,123	13,852	14,801	15,904
18	12,956	11,493	12,805	13,677
19	7,769	6,386	6,963	7,742
20	1,961	475	852	1,035
21	18	2	1	6

WIND	DA	Low	Current RT	High
16	1,197	489	1,044	1,209
17	1,356	616	1,358	1,757
18	1,549	1,083	1,539	1,974
19	1,720	1,224	1,748	2,457
20	1,950	1,412	2,187	2,905
21	2,279	1,667	2,538	3,252

- Net RA Capacity
- Day Ahead Net Load Forecast
- Net Demand
- Renewable Uncertainty

