Adapting probabilistic forecasts based on conditions

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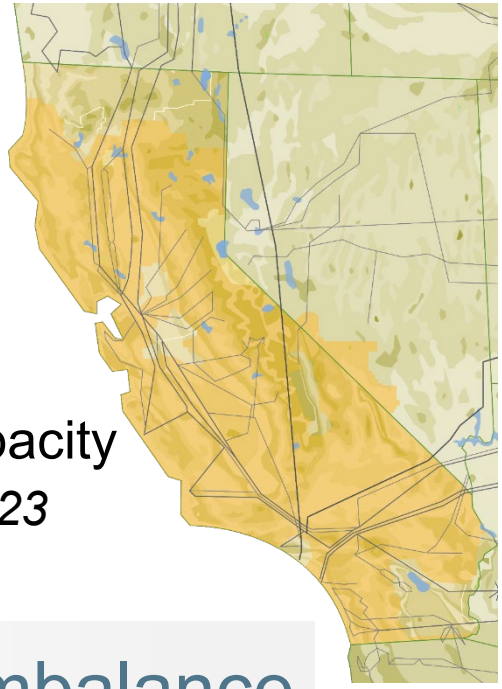
Probabilistic forecasts help us **manage uncertainty**. Adapting for **conditions** helps us balance cost with risk.

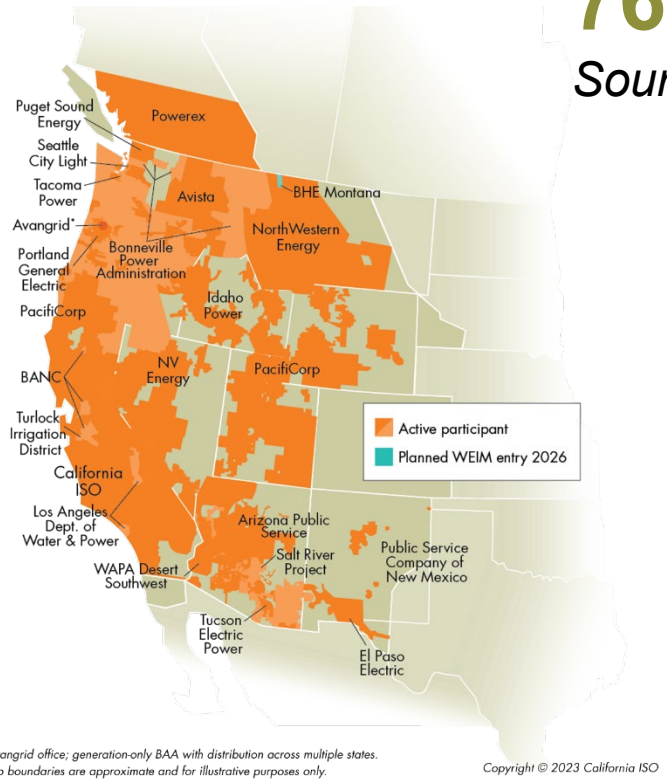
California ISO

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



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

76,184 MW power plant capacity
Source: ISO's Masterfile, August 2023



*Avangrid office; generation-only BAA with distribution across multiple states.
Map boundaries are approximate and for illustrative purposes only.

Western Energy Imbalance Market (WEIM)

22 participating entities

925,568 metric tons of CO_2 avoided

CAISO Renewables

Historical statistics and record (as of May 30, 2024)

Solar peak **NEW!**

18,933 MW

May 13, 2024 at 11:55 am

Previous record:
18,770 MW, May 9, 2024

Wind peak

6,465 MW

May 28, 2022 at 5:39 pm

Previous record:
6,265 MW, March 4, 2022

Peak percentage of renewables compared to demand

117.3%

April 20, 2024

Previous record:
107%, June 2023

Number of Renewable Resources: **529**

MW Forecasted Large Scale Renewables: **27,872 MWs**

MW Capacity Behind-the-Meter Solar: **16,200 MWs**

Values are approximate as of May 2024

Renewables increase net load uncertainty and drive the need for probabilistic forecasts.

Uncertainty driven by renewables and electrification

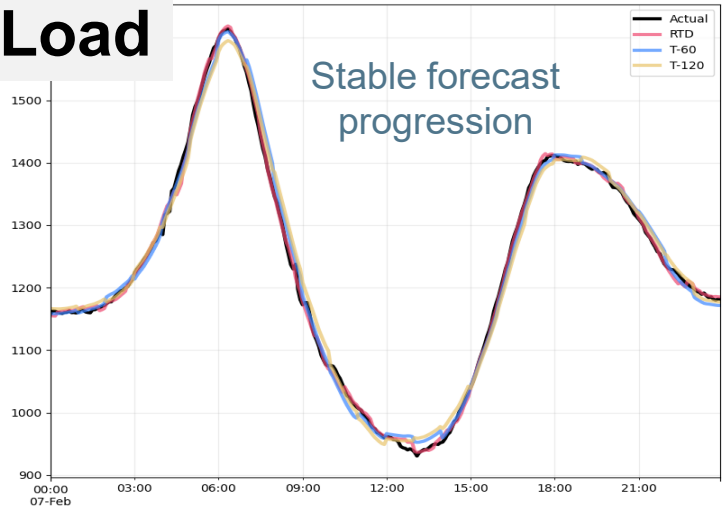
Solar

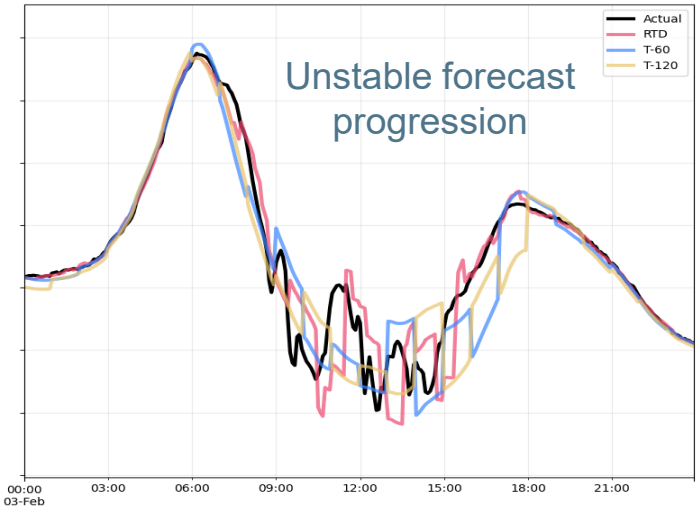
Topaz Solar Farm, San Luis Obispo County, California

Wind

Tehachapi Pass

Load

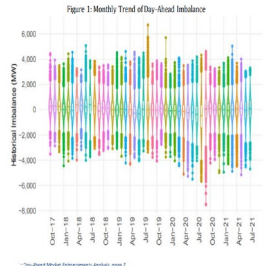


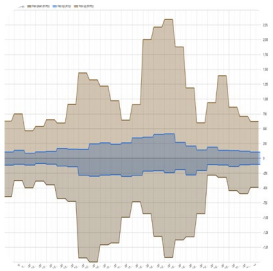


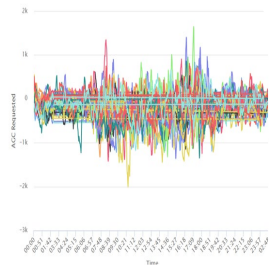
Net-Load Uncertainty Requirements

These requirement products employ target percentiles to help cover forecast uncertainty.

Day-ahead







Real-time

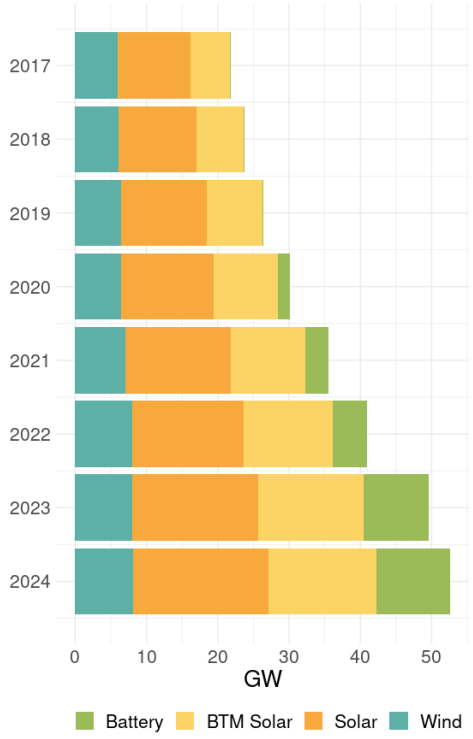
Requirement	Time frame	Method
Imbalance Reserve (IBR)	DA to FMM	Quantile Regression (Mosaic)
Flexible Ramp Product (FRP)	FMM to RTD	Quantile Regression (Mosaic)
Regulation	RTD to actual	Combination

Focusing on RUC

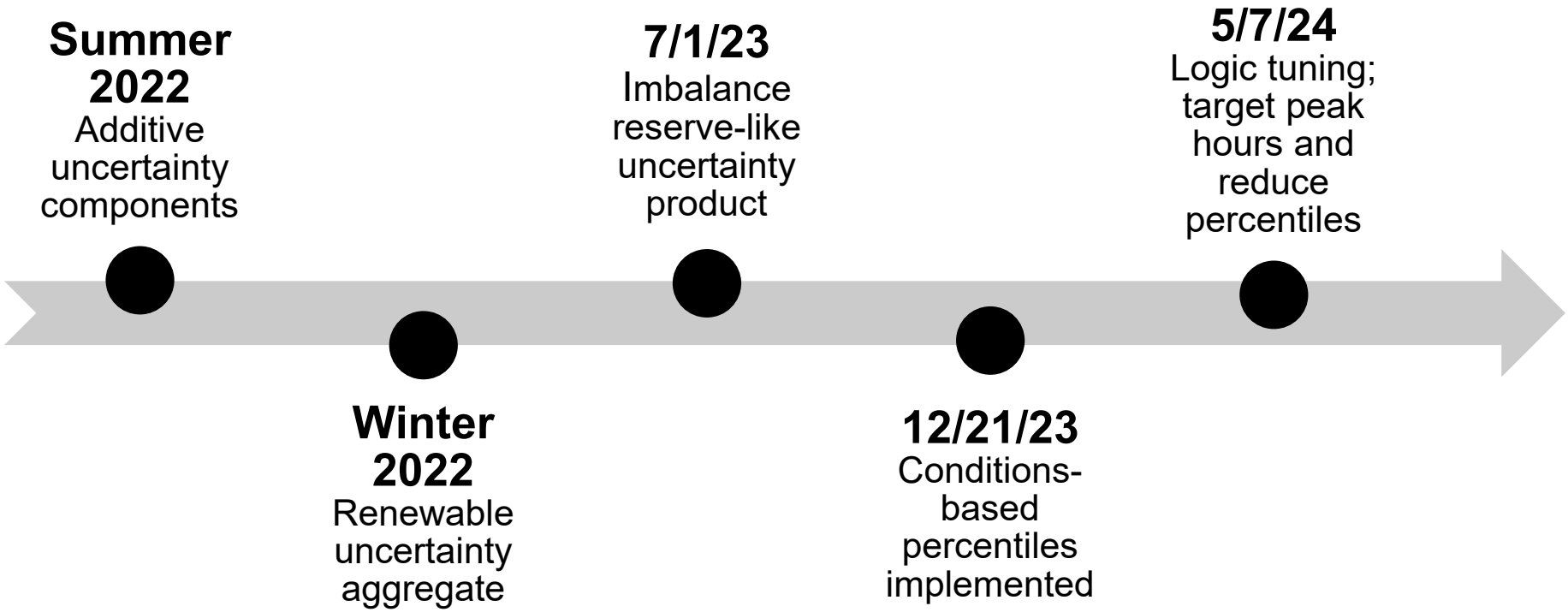
Requirement	Time frame	Method
Imbalance Reserve (IBR)	DA to FMM	Quantile Regression

Frequency and magnitude of RUC adjustments have grown over time, along with evolution of the resource mix.

IBR ~ RUC adjustments

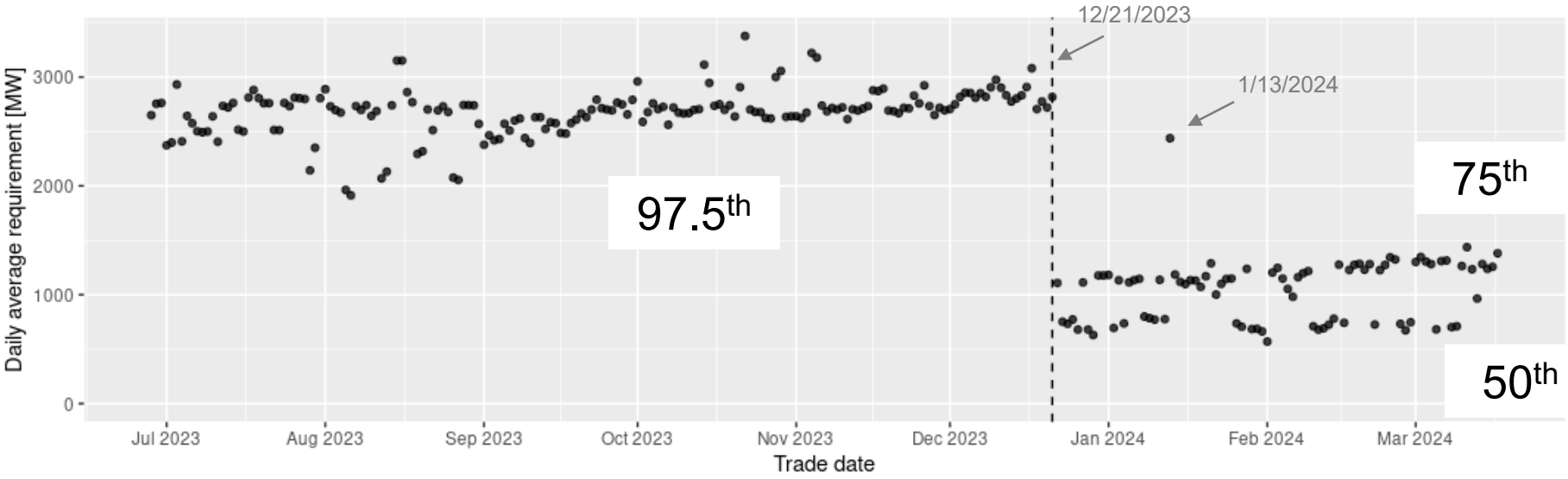


Guidance for RUC adjustments have increasingly incorporated conditional signals in conjunction with probabilistic forecasts



Recent tuning has reduced target percentiles and focuses on adjustments in morning and evening peak hours.

Conditions are used to inform target percentiles



List of conditions are outlined in Operating Procedure 1210.

Examples of conditions:

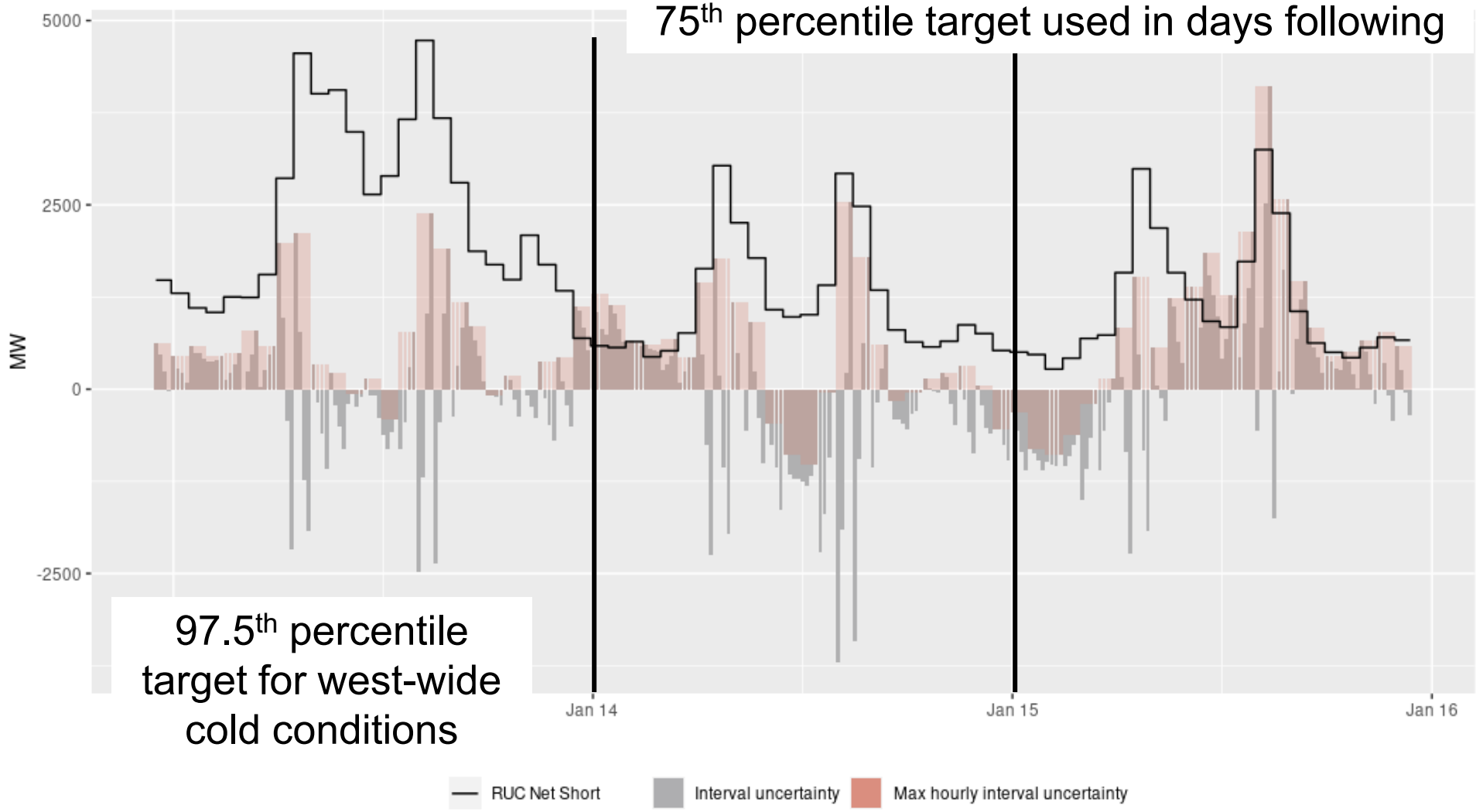
- Weather
- West-wide grid impacts
- Operational RA supply

Image from NYTimes

Example case

$$\text{uncertainty} = \max(NL_{\text{FMM}} - NL_{\text{DA}})$$

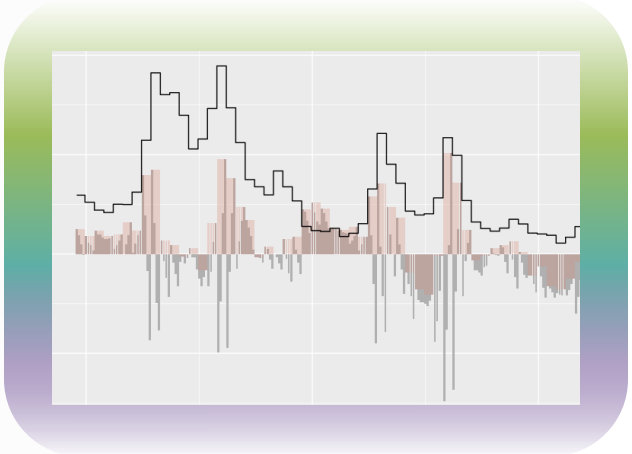
75th percentile target used in days following



97.5th percentile target for west-wide cold conditions

Summary

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



Next Steps

Enhancements to mosaic methodology

- Day-type change – Completed
- Revise historical sample data utilized – Expected late 2024 for FRP, under review for IBR

Ongoing exploration, development, and review of data quality tracking, conditional triggers, and historical sample sets to improve probabilistic forecasts of uncertainty.