



Forecasting Hybrid and Co-Located, Resources

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Agenda

- CAISO Overview
- Resource Evolution
- What is a “Hybrid” Resource?
 - Hybrid
 - Co-Located
- Renewable Forecasting Products
- Forecasting New Resource Types
- Enhanced Data Requirements
 - High Sustainable Limit (HSL)



California ISO

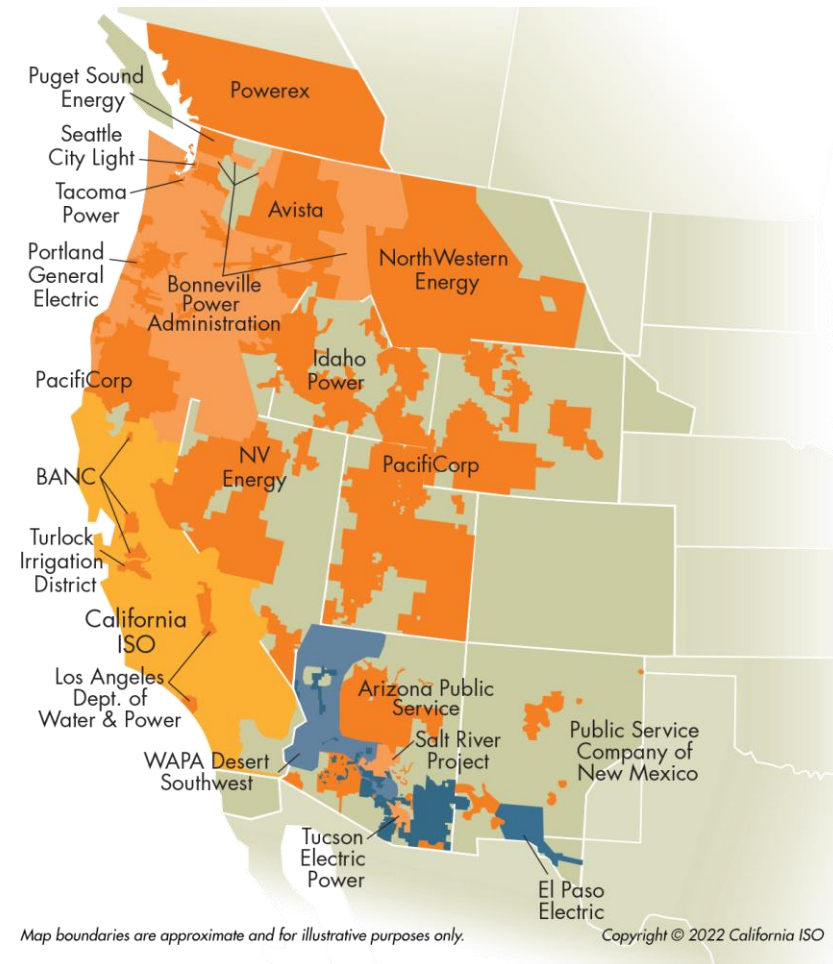
As a federally regulated nonprofit organization, the ISO manages the high-voltage electric grid.

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

224.8 million megawatt-hours of electricity delivered
(2020)

75,747 MW power plant capacity
Source: California Energy Commission

1,119 power plants
Source: California Energy Commission



Current Renewable Penetration Facts

Historical statistics and records *(as of 04/01/2022)*



Solar peak NEW!

13,456 MW

Mar 24, 2022 at 2:32 p.m.

Previous record:

13,205 MW, May 27, 2021



Wind peak NEW!

6,265 MW

Mar 4, 2022 at 2:50 p.m.

Previous record:

6,178 MW, Feb 15, 2022



Peak renewables NEW!

serving load

96.4%

Mar 27, 2022 at 1:52 p.m.

Previous record:

94.5%, Apr 24, 2021



**Peak
net imports**

11,894 MW

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



**Peak
demand**

50,270 MW

Jul 24, 2006 at 2:44 p.m.

Second highest:

50,116 MW, Sep 1, 2017



**Steepest ramp
over 3-hour period**

17,660 MW

Mar 11, 2022 starting at 2:59 p.m.

Second highest:

17,259 MW, Feb 28, 2021

¹ Based on 1-minute averages, and includes dynamic transfers. Values are subject to revision as data is refined.

² Indicates the highest amount of renewables serving peak electricity demand on any given day.

Currently Installed	Capacity
Number of Renewable Resources	500
MW Capacity Large Scale Renewables	21,500 MWs
MW Capacity Behind-the-Meter Solar	13,000 MWs

*Values are approximate as of November 2021

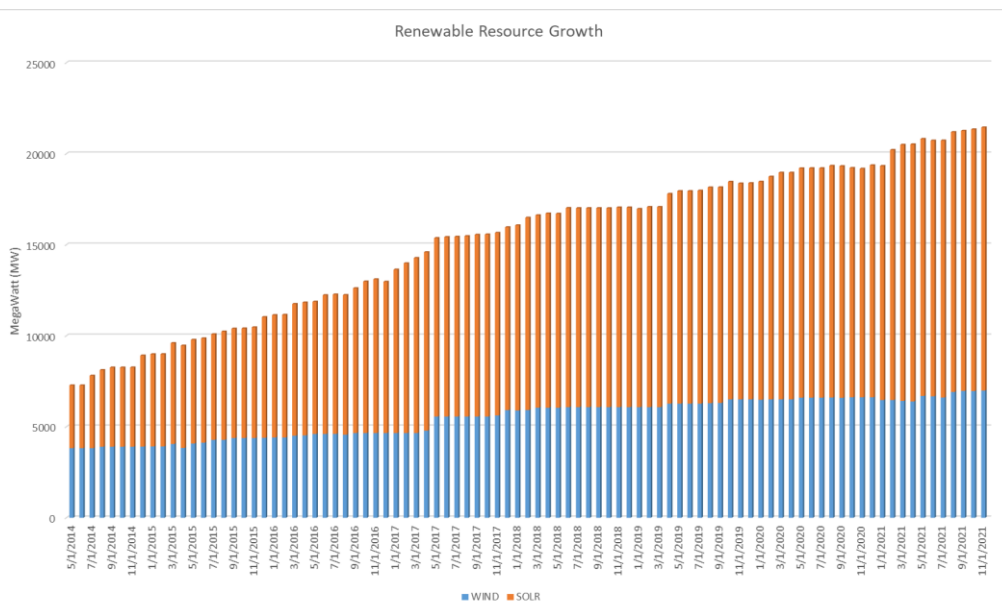
RESOURCE EVOLUTION

Renewable Portfolio Standard (RPS) goals

California requires all utilities to purchase energy that meets the state's aggressive renewable energy goal mandate.

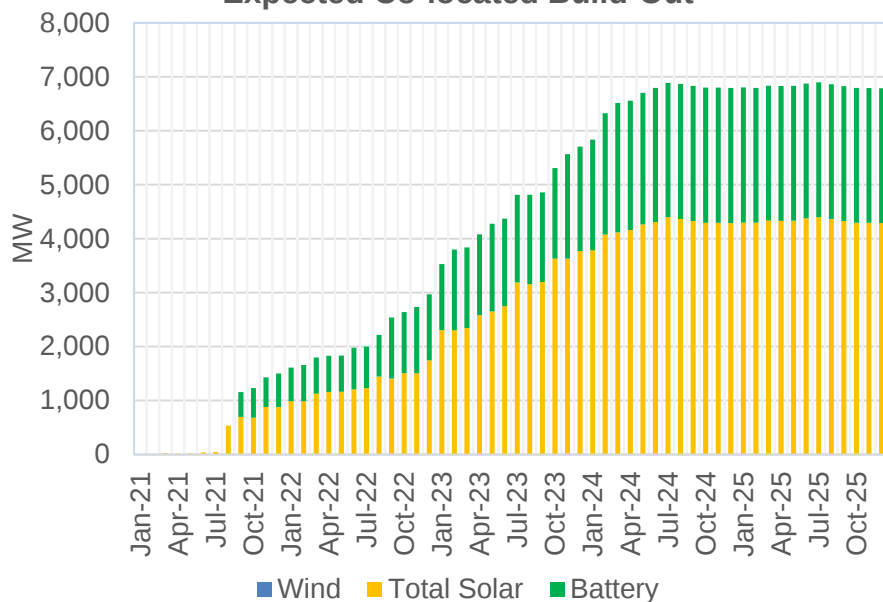


- In 2030, the state's RPS requires 60 percent of the energy provided by utilities to be from a qualified renewable source
- By 2045, 100 percent of all energy provided to consumers must be from zero carbon resources

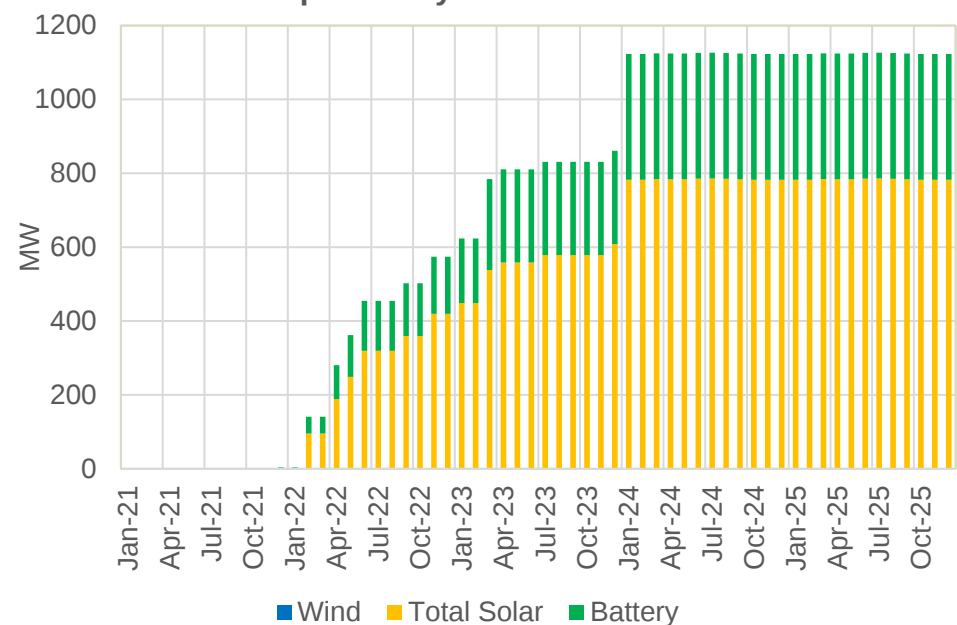


Expected co-located and hybrid renewable buildout through December 2025 based on LSE's submittal

Expected Co-located Build-Out



Expected Hybrid Build-out

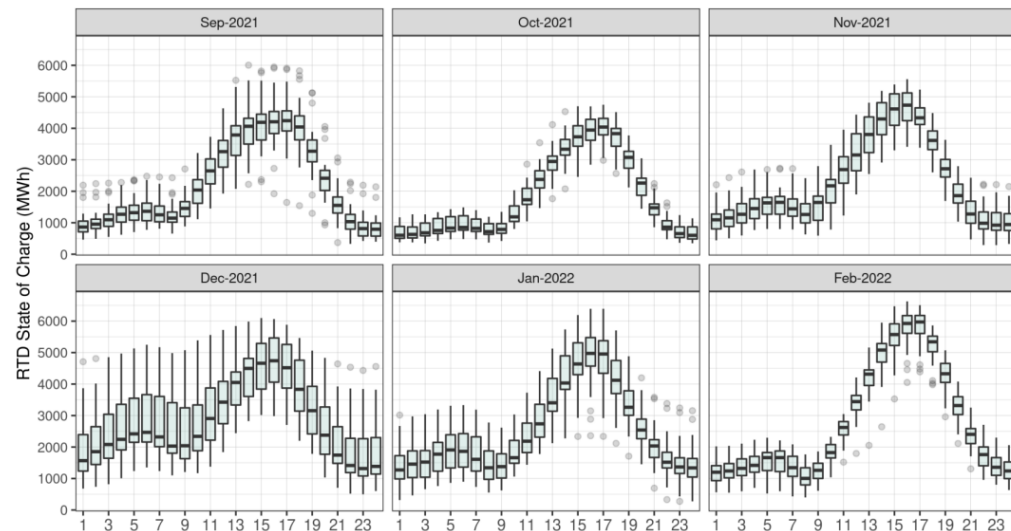
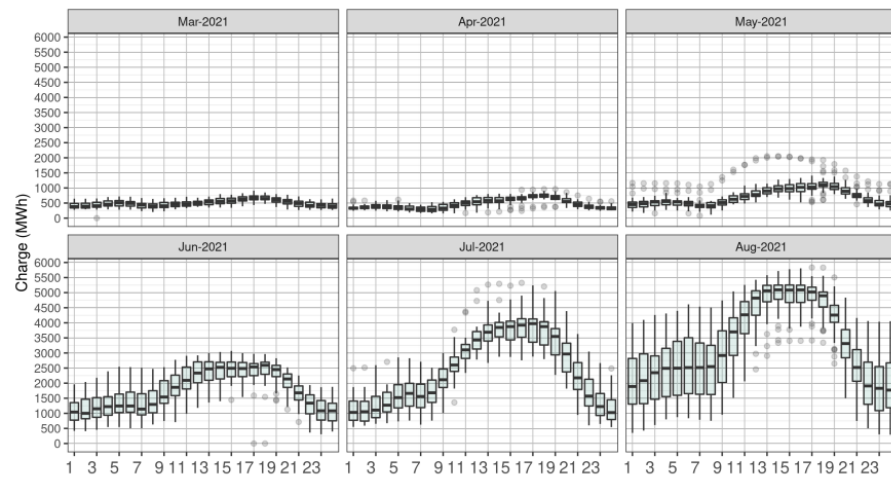


For more details on hybrid and co-located resources, visit the stakeholder page: <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Hybrid-resources>

Storage



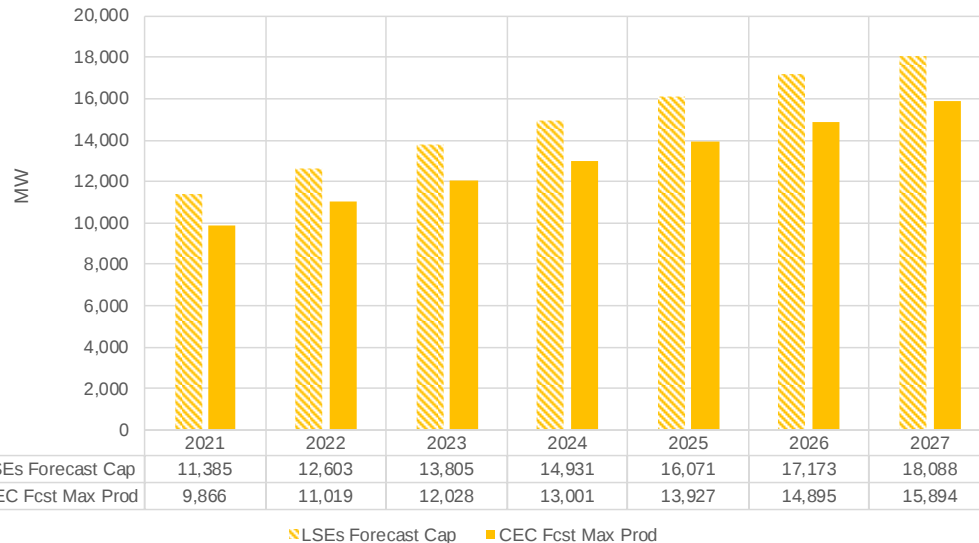
The energy storage industry is developing short- and long-duration storage options to serve both distribution and transmission systems.



California ISO Behind-the-Meter Solar



LSEs Expected Capacity vs. CEC's Forecast Production



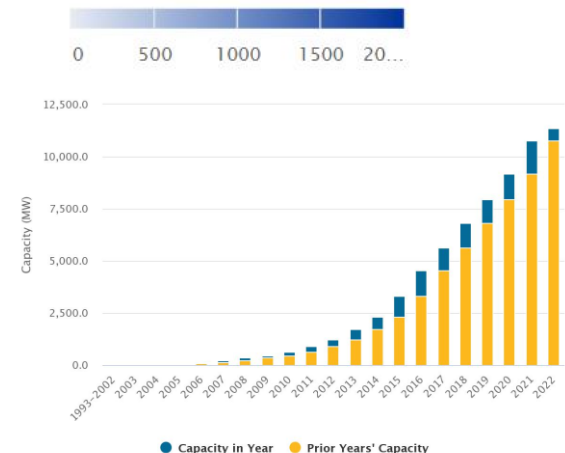
CAISO Total Values: <https://efiling.energy.ca.gov/GetDocument.aspx?tn=236297-6>
<http://www.caiso.com/InitiativeDocuments/Final2023FlexibleCapacityNeedsAssessment.pdf>

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.

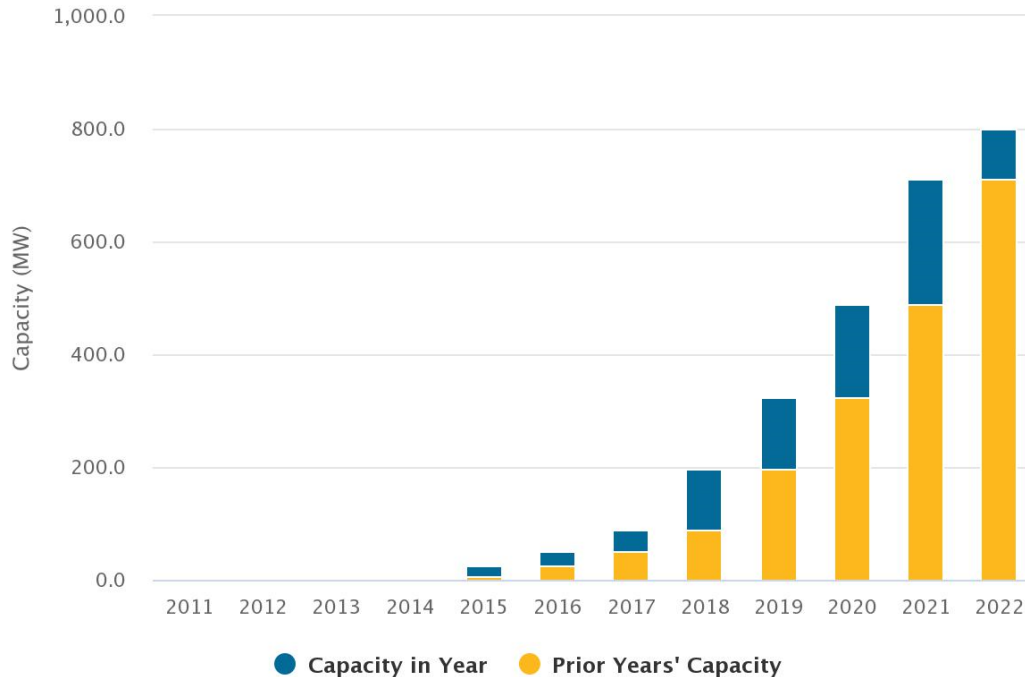
Territory and Location



Capacity (MW)



California ISO Behind-the-Meter Energy Storage



- DER Battery Storage has seen significant growth since 2018

Territory and Location



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

WHAT IS A “HYBRID”?

What is a “Hybrid” Resource?

- **Hybrid Resource:** A Generating Unit, with a unique Resource ID at a single Point of Interconnection, with components that use different fuel sources or technologies
 - Solar and a battery with one resource ID in the market
 - CAISO will receive separate telemetries for the battery and solar components
- **Co-Located Resource:** A Generating Unit with a unique Resource ID that is part of a Generating Facility with other Generating Units. Solar and a battery each with their own resource ID in the market

Rapid growth in storage technologies will require new forecasting techniques and market design to support market participation

- [Hybrid Resource Initiative](#)

Phase 2 go-live Winter 2021 & Fall 2022

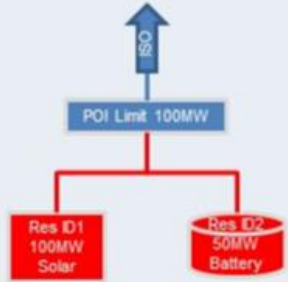
- Phase 1 go-live was Dec 2020

- Expected to have 6,000 MW of renewable + storage by 2024

- Based on Jan 2022 LSE survey

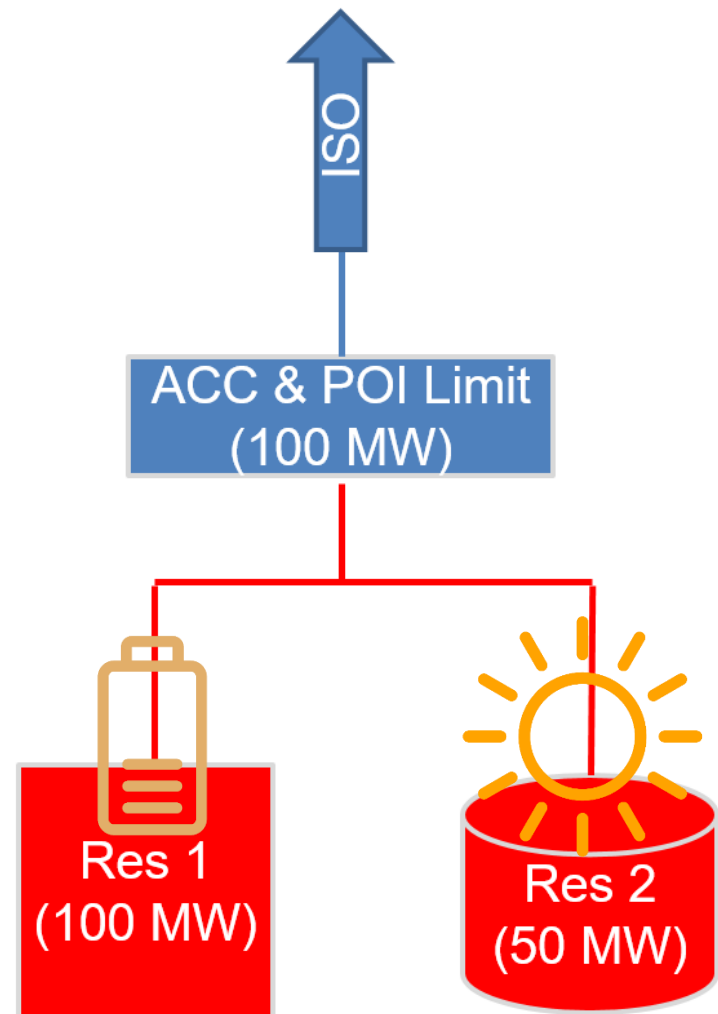
- CAISO will provide wind and solar forecasting services:

- Optional for hybrid renewables
- Required for co-located

Hybrid vs. Co-located	Definition	Forecasting / Dispatch
Hybrid 	A Generating Unit, with a unique Resource ID at a single Point of Interconnection, with components that use different fuel sources or technologies.	• No aggregate forecast for hybrid • Hybrid expected to follow dispatch
Co-located 	A Generating Unit with a unique Resource ID that is part of a Generating Facility with other Generating	• VER component will be forecast • VER dispatched rules • Battery will be dispatched and state of charge managed

Co-Located Resources and the Aggregated Capability Constraint (ACC)

- The ACC prevents dispatch of co-located resources from exceeding the Point-of-interconnect (POI) limits
 - Example: Solar + Storage Resources
- Effective 12/15/2021, each resource behind the ACC and POI is required to follow their DOT when any resource behind the ACC gets any market instruction



FORECASTING

Analysis shows higher error for co-located resources prior to HSL data point versus traditional solar

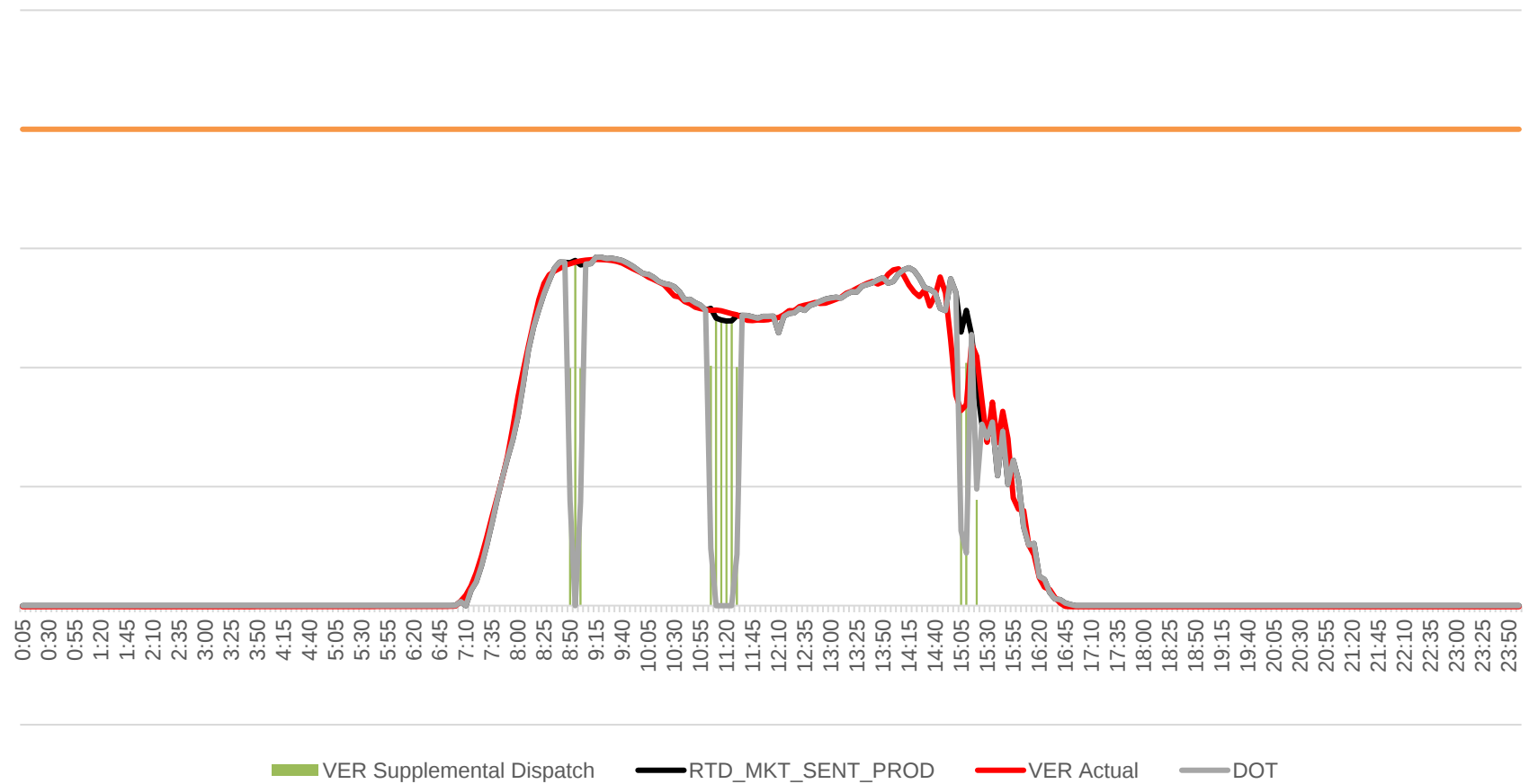
RTD

Fuel Type	Co-Located	2021 MAPE (18 resources)	2020 MAPE (12 resources)
SOLR	Y	2.54%	2.52%
SOLR	N	.92%	1.01%
WIND	N	.86%	.92%

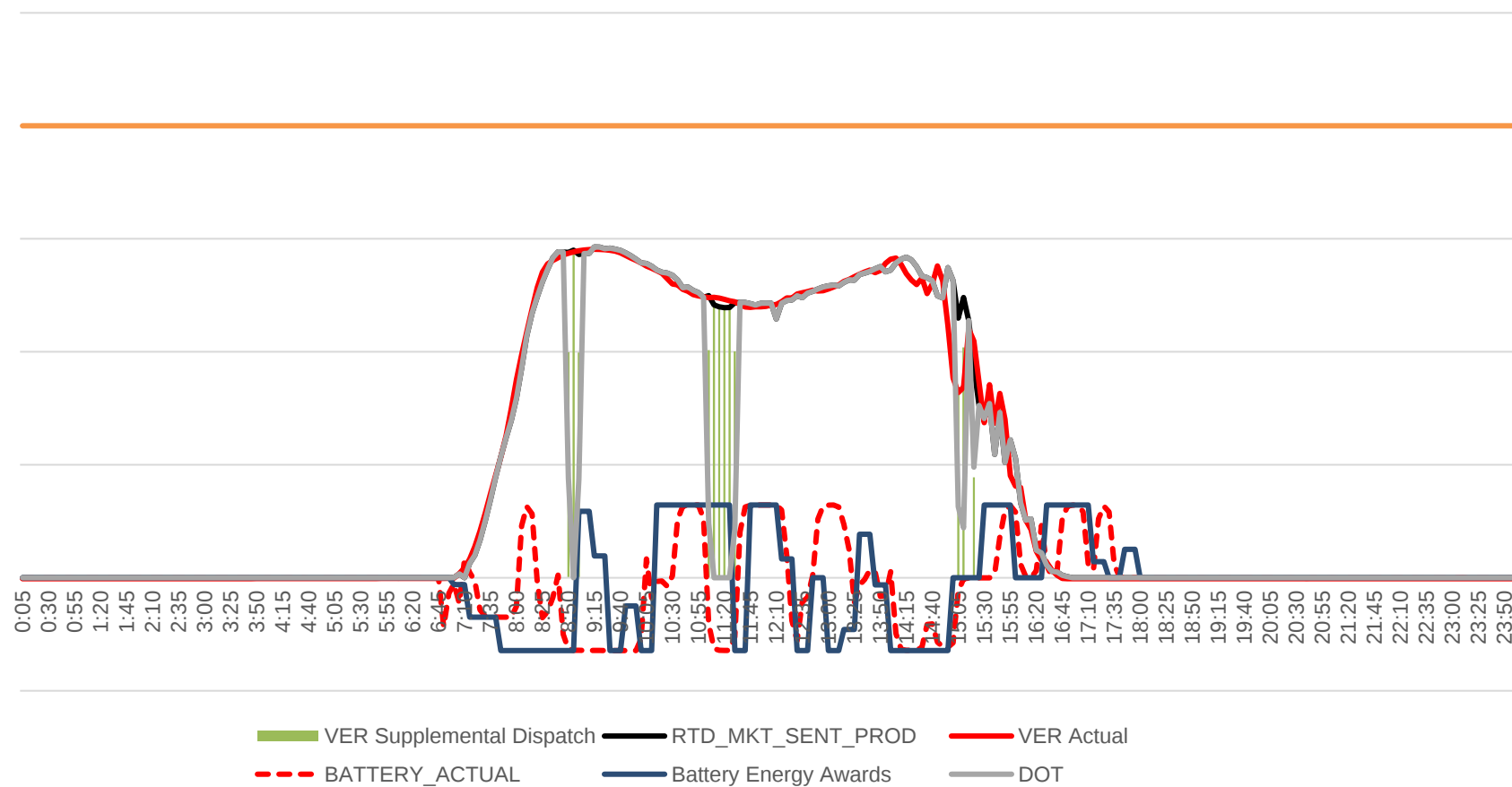
- Co-located solar resources error is 2.5x higher than traditional solar
- Forecast Service Provider (FSP) accuracy (excluding Persistence):

Fuel Type	Co-Located	MAPE
SOLR	Y	4.35%
SOLR	N	2.36%

Co-Located Battery and VER Behavior

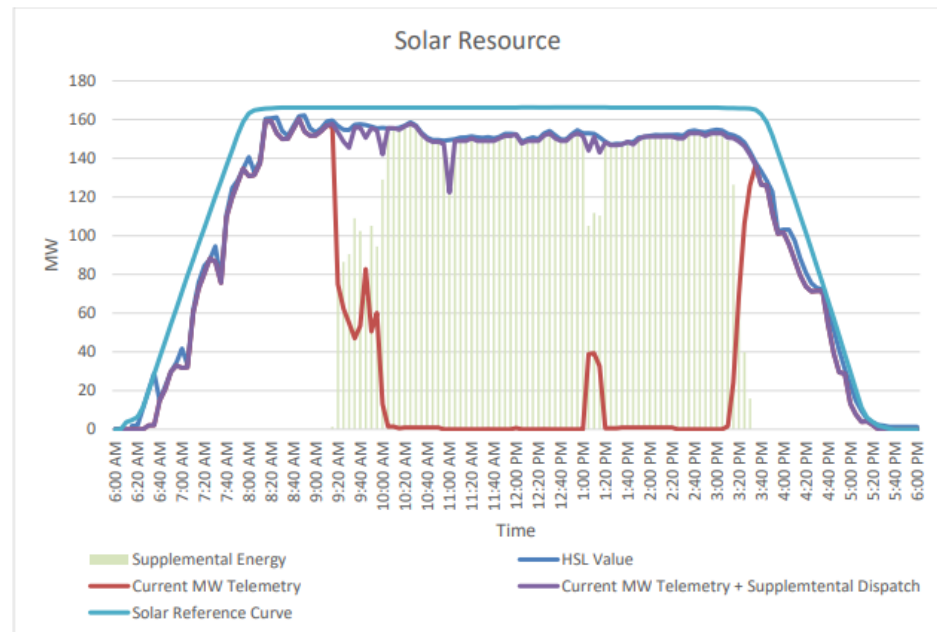


Co-Located Battery and VER Behavior

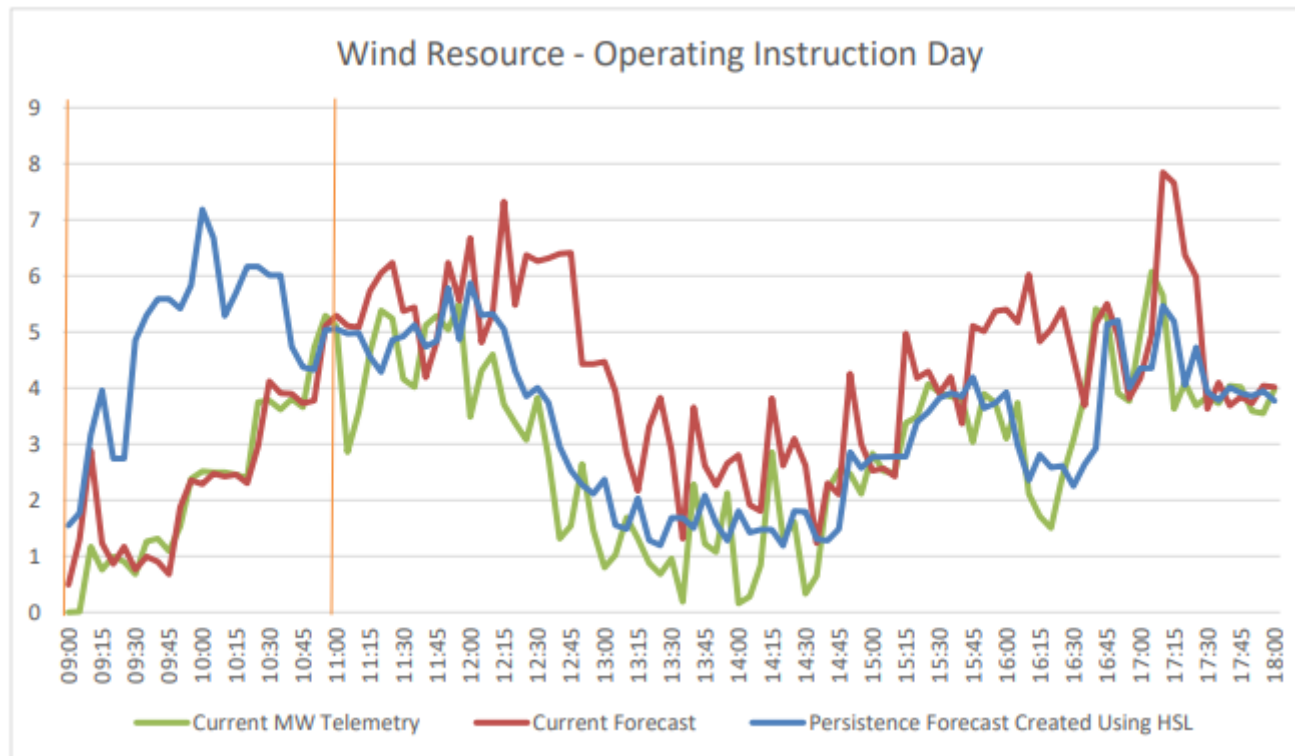


High Sustainable Limit (HSL)

- New *telemetry* required from all renewable Hybrid and Co-Located resource types
- HSL is the value the renewable resource can produce given the current weather conditions and inverters available.
 - No market dispatches or battery impacts in this value
- Can be used in Persistence for Co-Located & traditional renewable resources
- Provided to FSPs to improve forecast



Use of HSL in Wind Resource Forecast



CAISO Forecasting Advancements in Support of High Penetrations of Renewable Resources

