



Hybrid Resource Forecasting

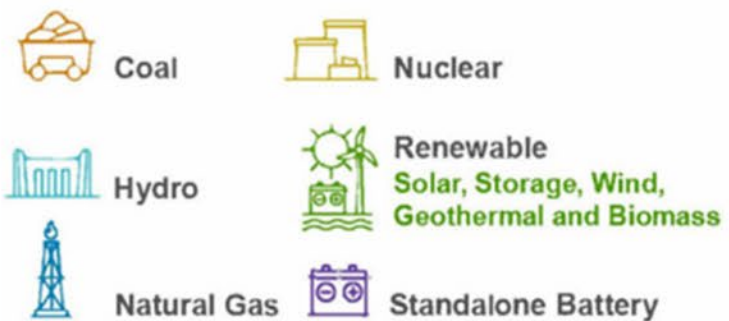
ESIG: Forecasting and Markets Workshop

June 13, 2024

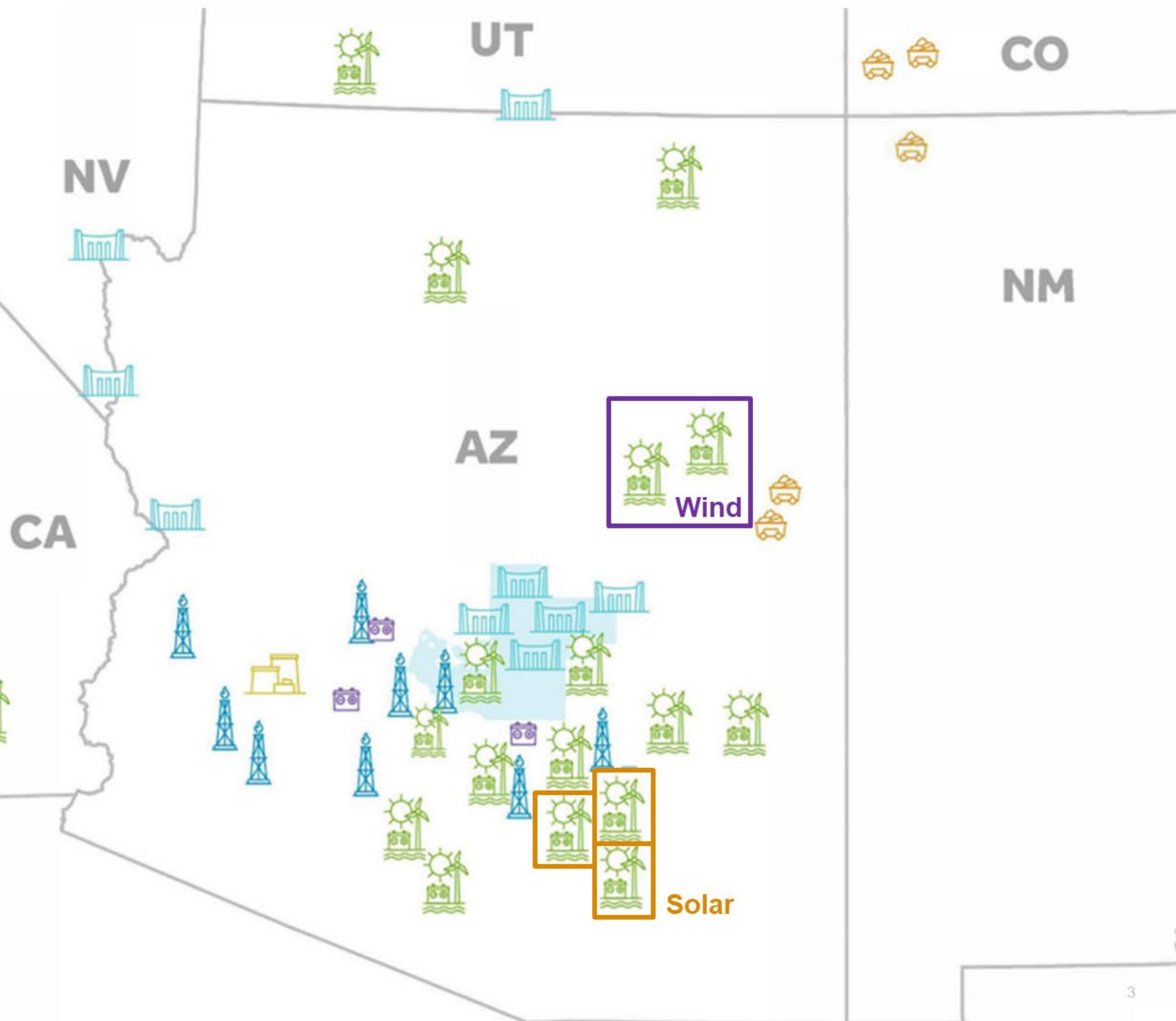
SRP Introduction

SRP Generation Portfolio CY2024

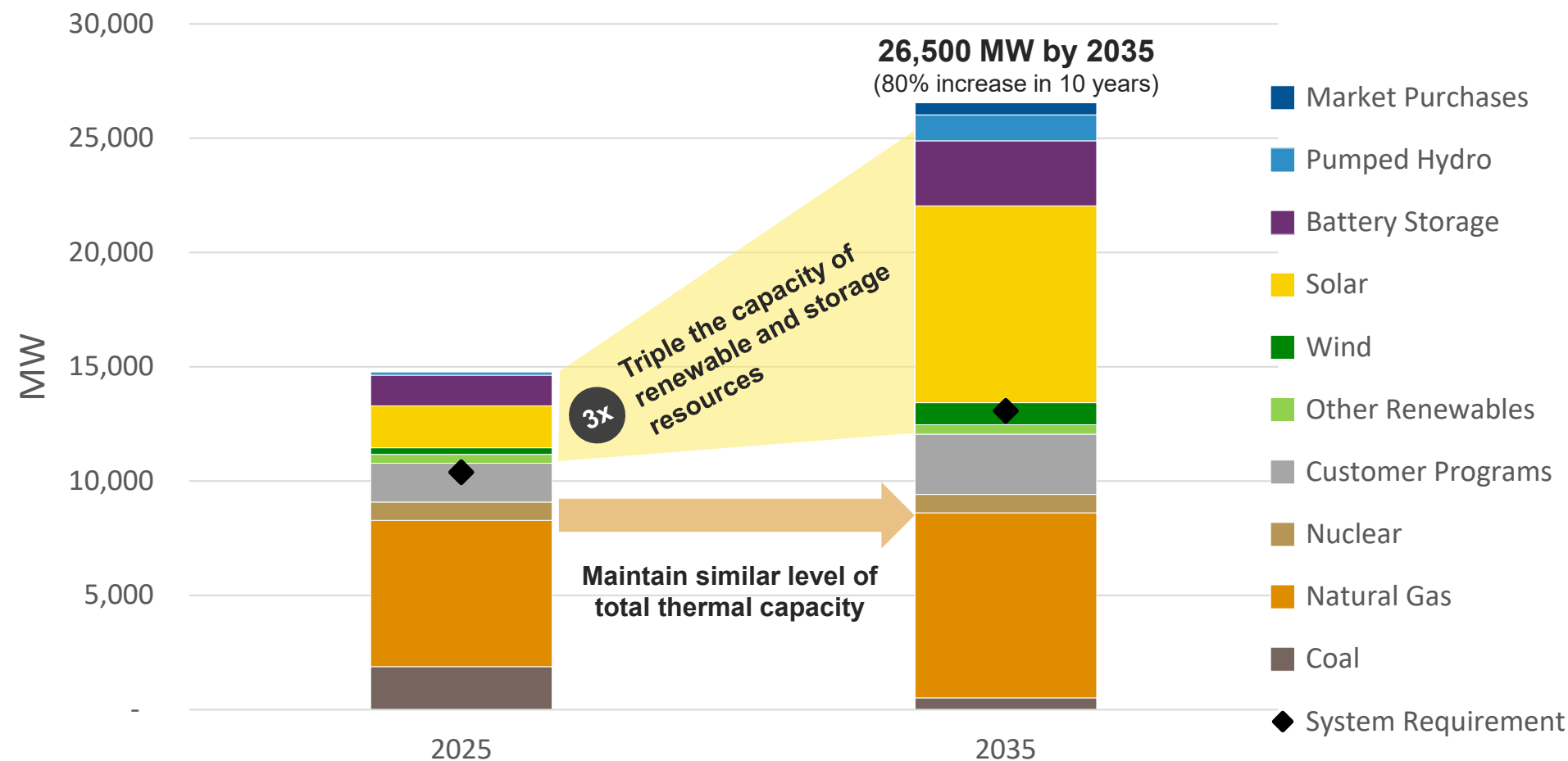
LEGEND



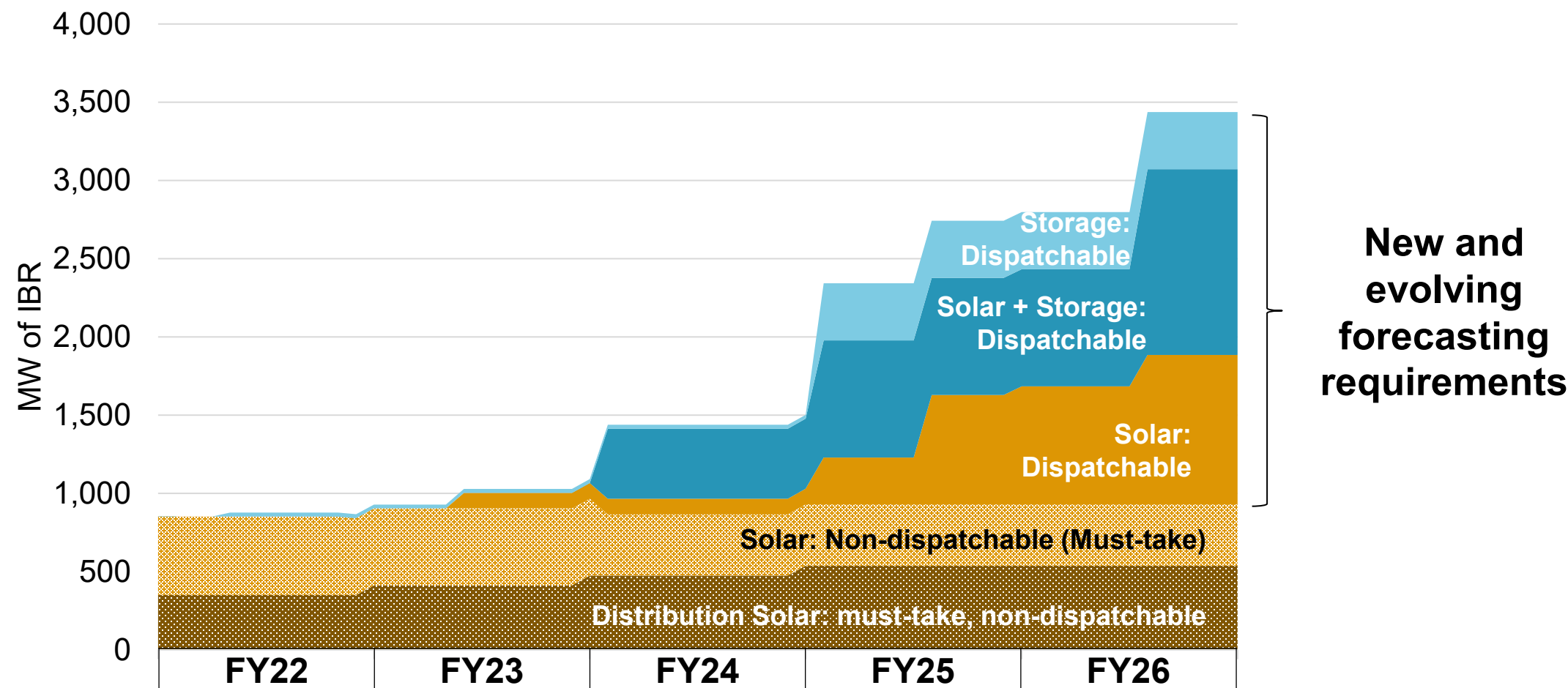
*Map locations and size are not precise, nor to scale



SRP's Generation Transition

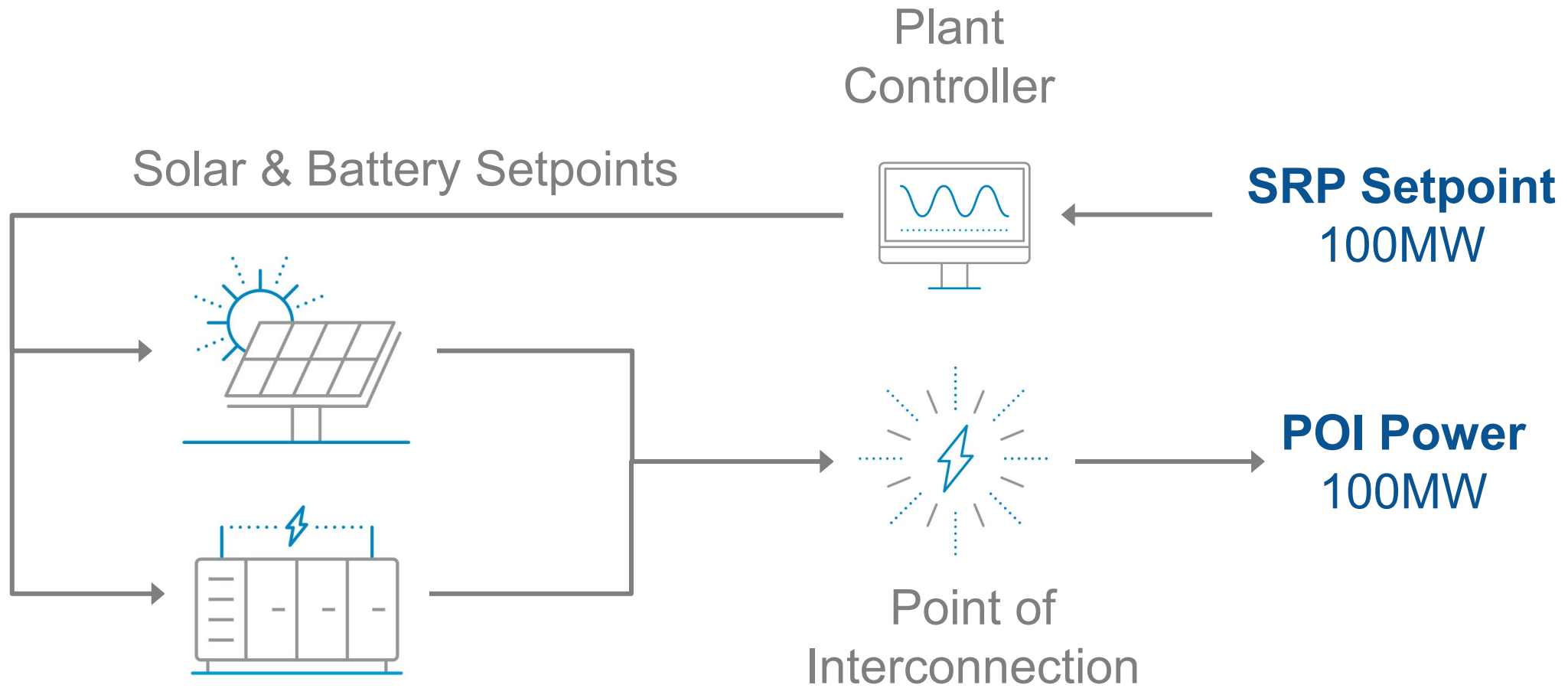


Growth of Dispatchable Renewables

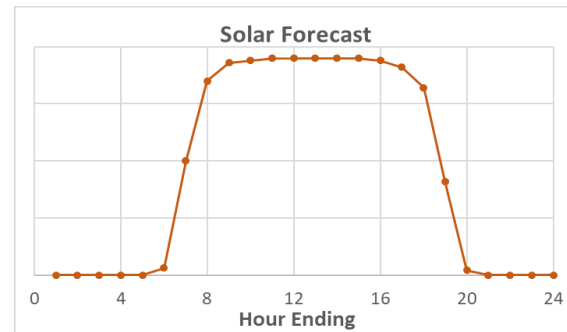


Hybrid Resources

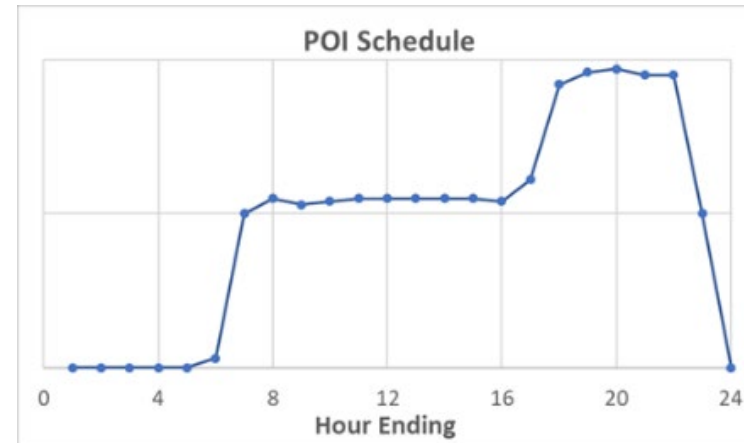
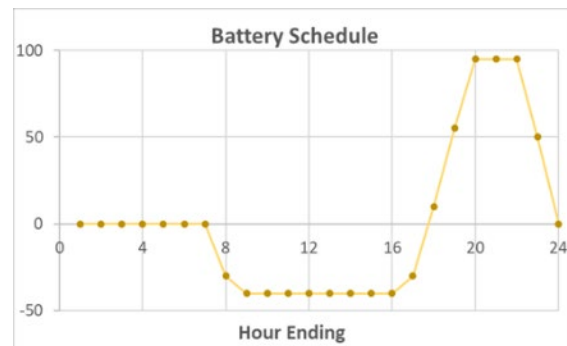
Hybrid Site Overview



Hybrid Scheduling

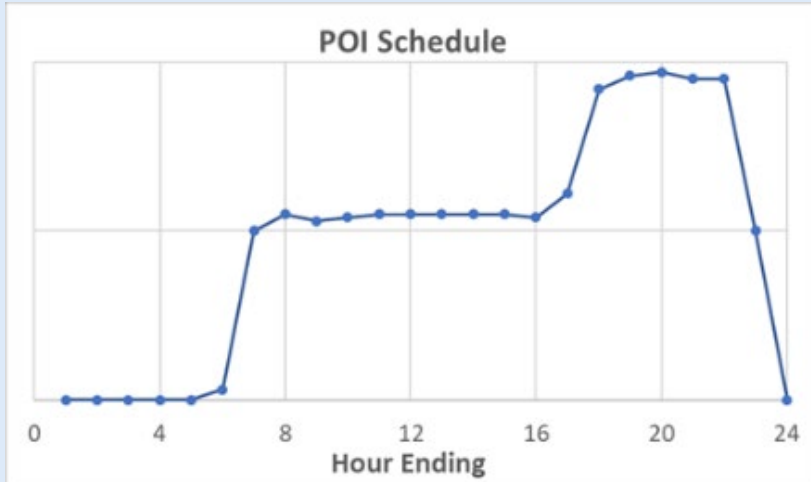


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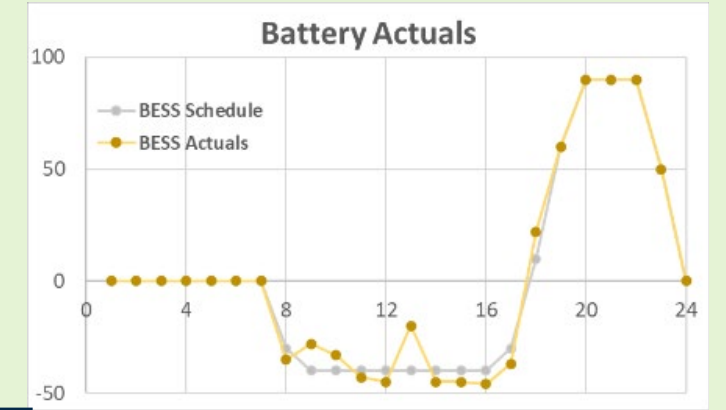
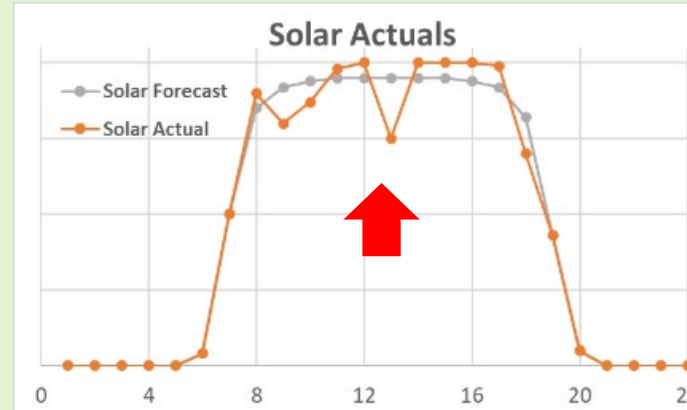


Actual Dispatch and Solar Forecast Error

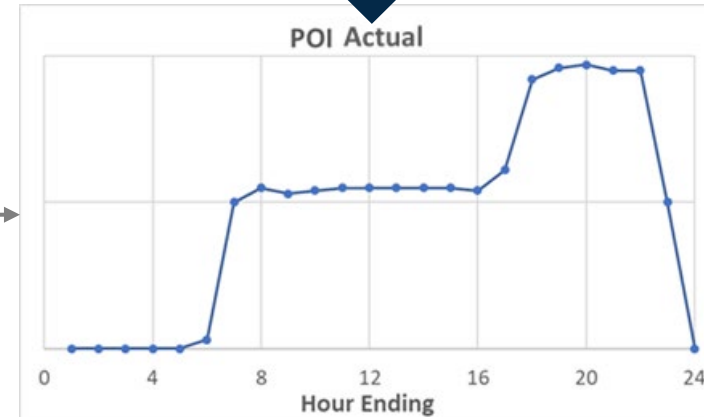
Power Schedules



Solar & Battery Power Actuals

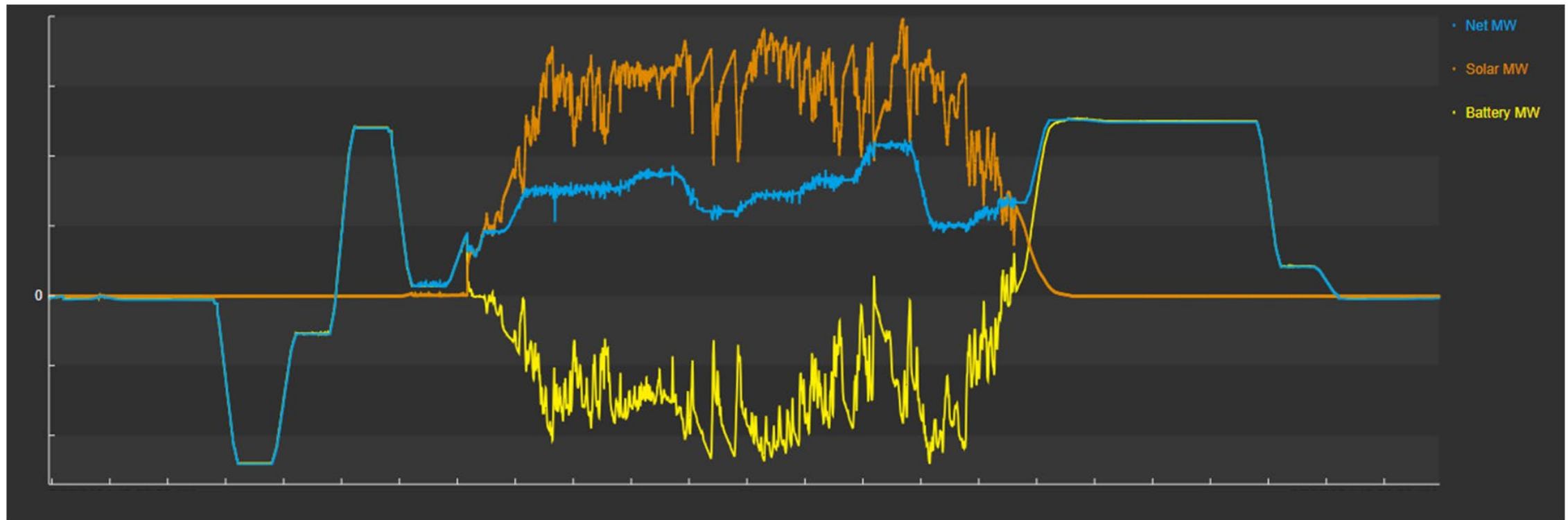


✓ POI Schedule Met!



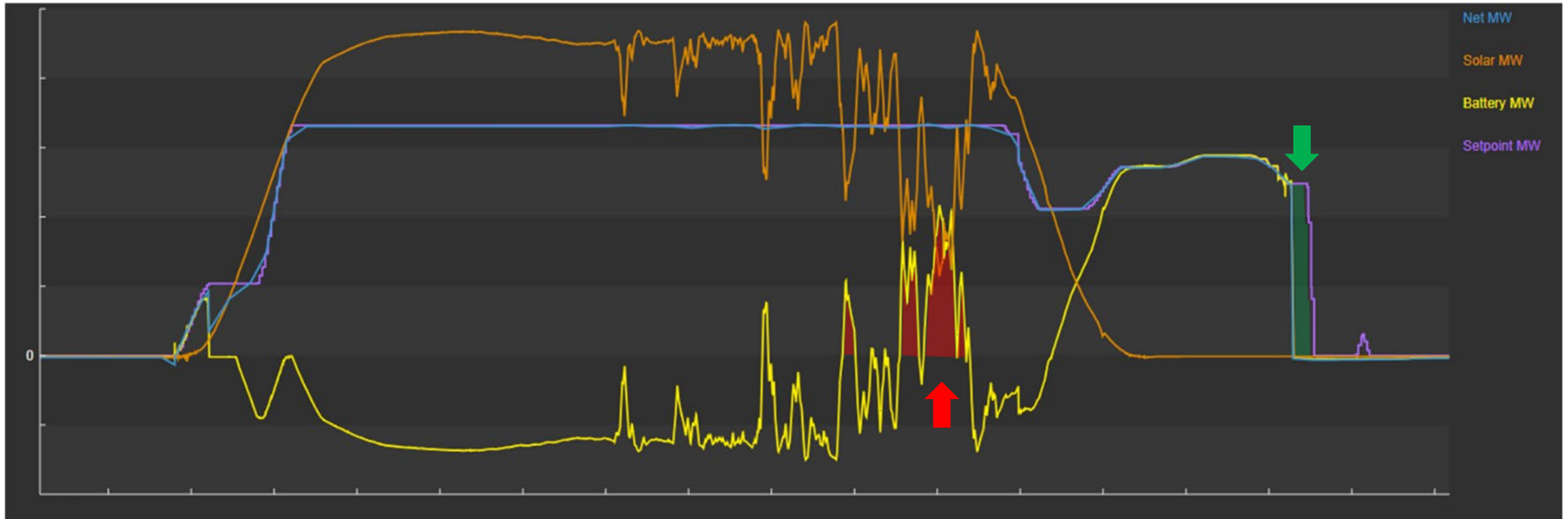
Unbiased Forecasts

- Solar ramps were reduced over 12x
- Charged over 95% and fully served evening peak



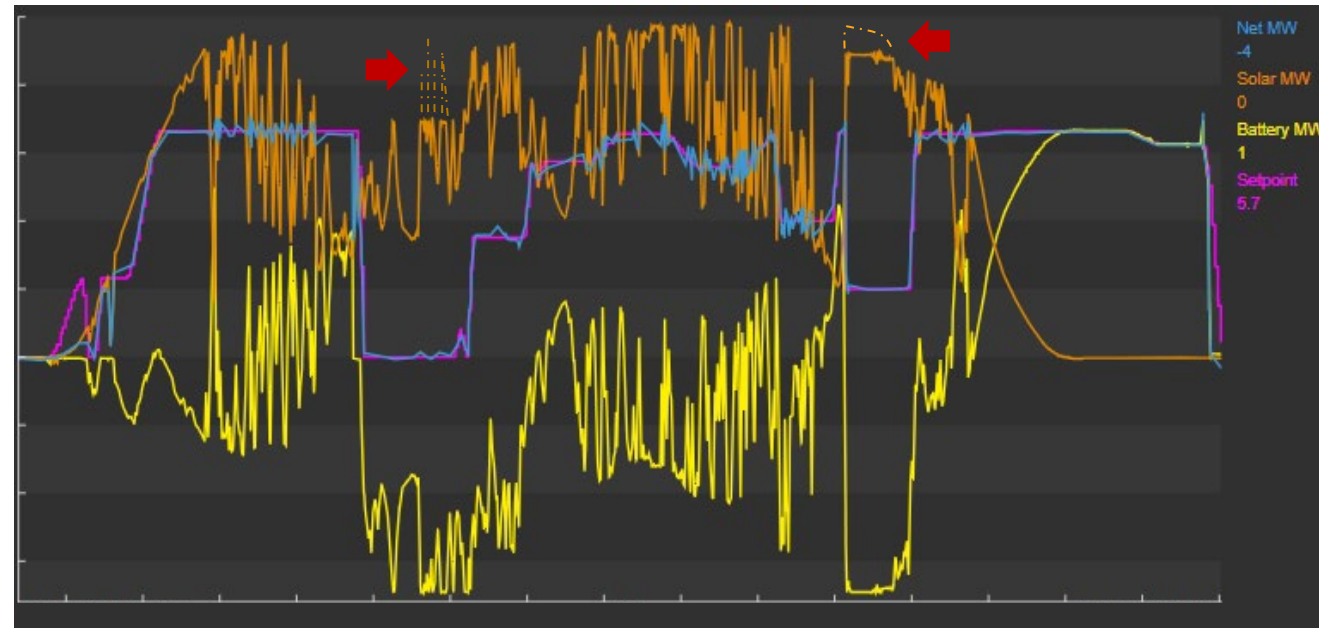
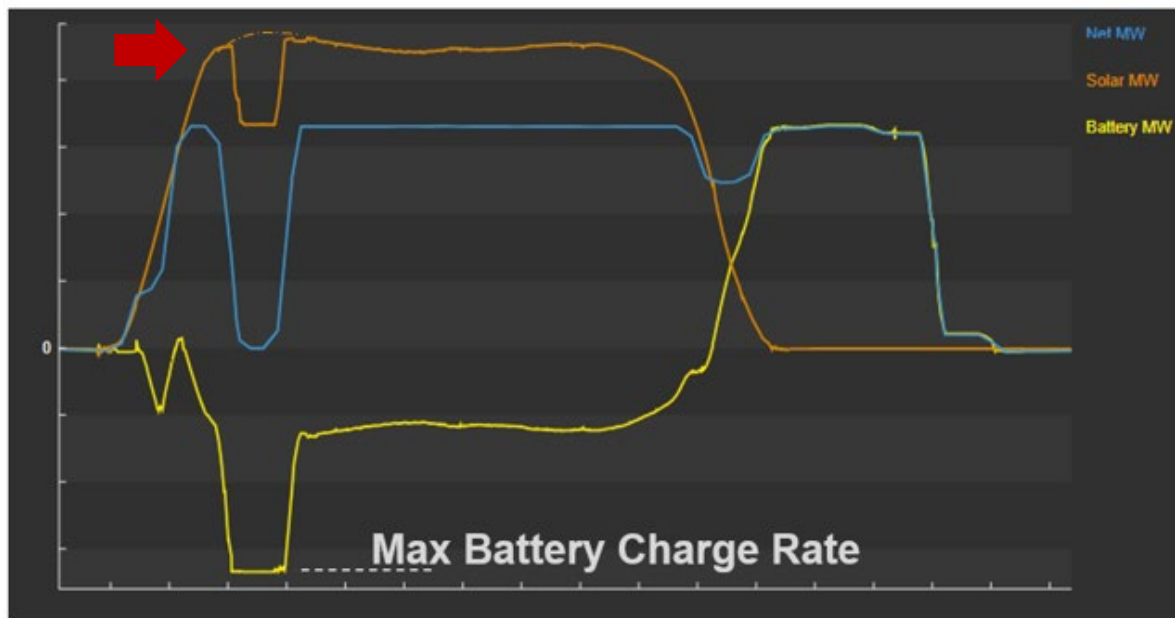
Biased-High Forecasts

- Mid-afternoon clouds cause the battery to discharge (*red*)
- Shortfall occurred at the end of discharge (*green*)



Biased-Low Forecasts

- Setting the POI too low for any interval can result in curtailment (*left*)
- Hybrid schedules need to comprehend intra-interval variability (*right*)



Mid-term Battery Constraints

Resource	Max Annual Cycles	Max Annual Avg. SOC%
Resource A	365	40%
Resource B	330	50%
Resource C	330	50%
Resource D	365	50%

Scheduling needs to comprehend annual resource-specific constraints

- Many of these are annual constraints for cycling and state of charge (SOC)
- SRP runs a months-ahead midterm model with projected weather and system conditions to estimate dispatch guidance for the daily engine (TMY/historic/climate-adjusted)

Summary

Hybrids integrate forecast error and impose new objectives outside of error reduction:

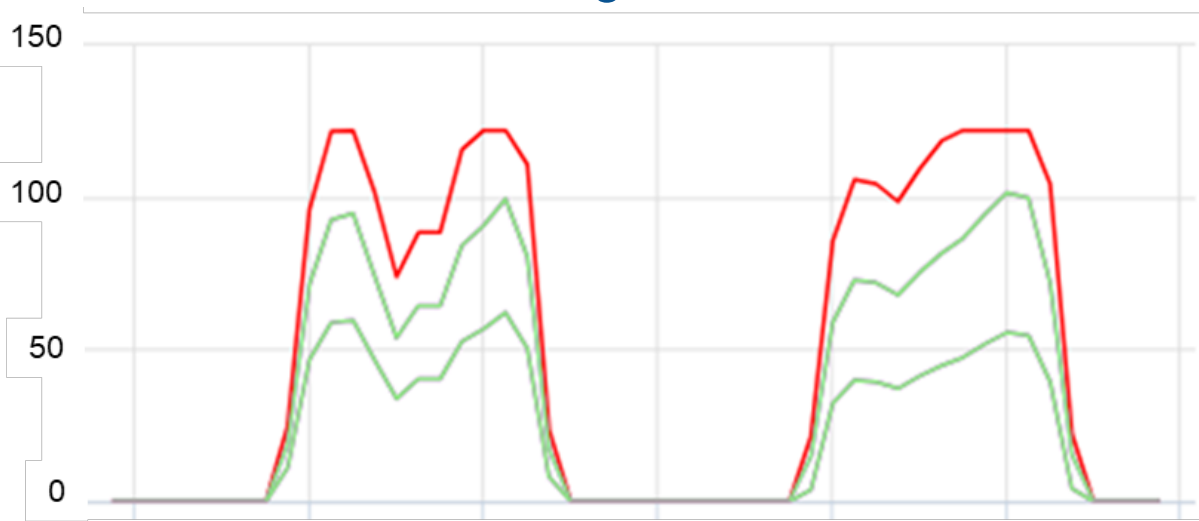
- Unbiased intraday solar forecast errors (<15% of the *battery* capacity) are tolerable
- Biased-high solar forecasts can create an energy shortfall that impacts after-sundown
- Biased-low solar forecasts can cause an immediate economic penalty due to solar curtailment
- Even if forecasts are perfect, intra-interval variability can induce solar curtailment

Forecast Implications

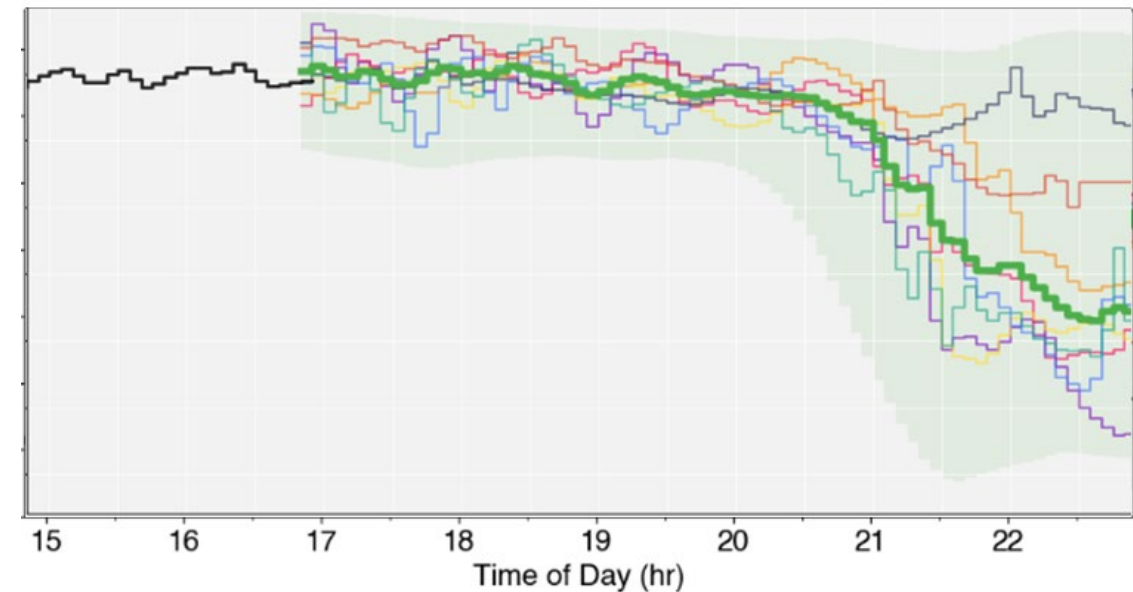
Current Hybrid Forecast Strategy

- Use biased-high forecasts to avoid solar curtailment
- Comprehend intra-interval variability (5 minute) in scheduling
- Partner with forecast vendor to ensure these new forecast products are accurate

Biased-High Forecasts



Intra-interval (5min) Variability



Scheduling Engine Forecasting Upgrades

Need to be able to pivot between biased & unbiased forecasts, make more informed decisions

- Direct integration with our current scheduling engine facilitates integration
- Multi-forecast integration increases resiliency and forecast accuracy

Current: Single Forecast Vendor for All Sites

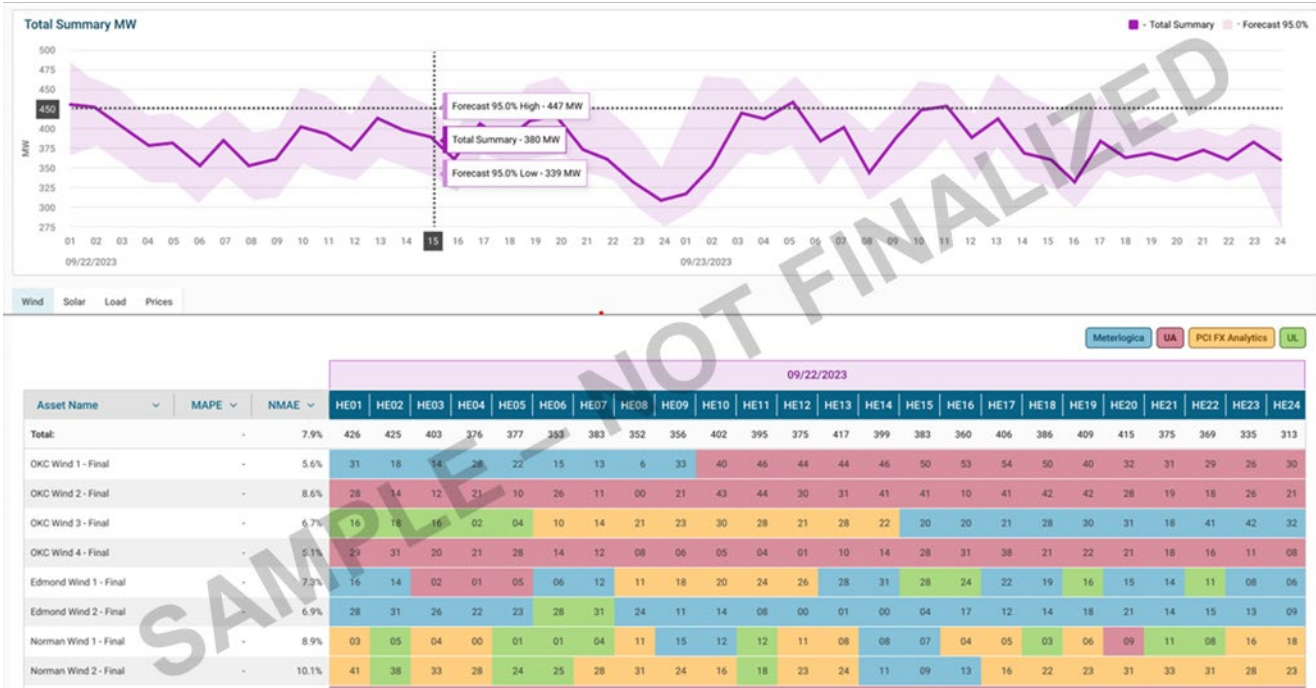
RT Overview

Start Date:05/09/2024 04:00

End Date:05/10/2024 03:00

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Upcoming: Per-Site & Multi-Forecast Integration

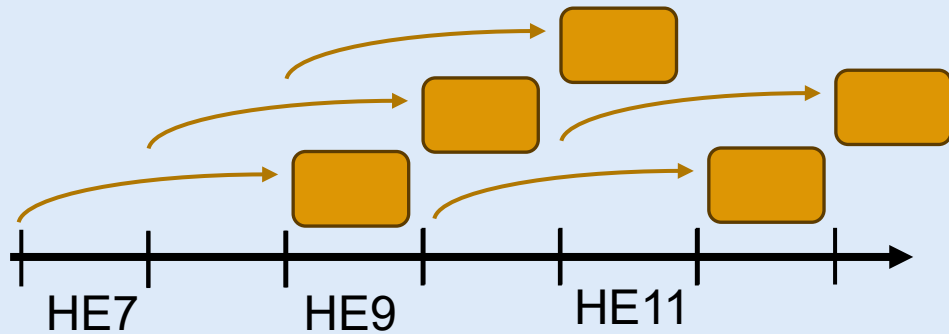


Subhourly Dispatch

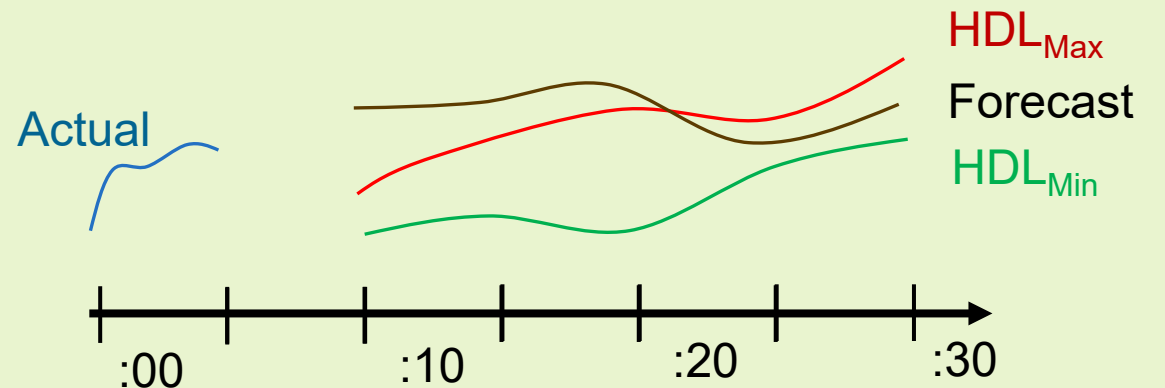
Hybrid dynamic limits will enable subhourly schedule adjustment and enable bidding

- Need to strategize each layer of scheduling
- Sub-hourly dispatch may further change forecast strategy
- Ongoing work with CAISO to understand when/how HDLs can be used

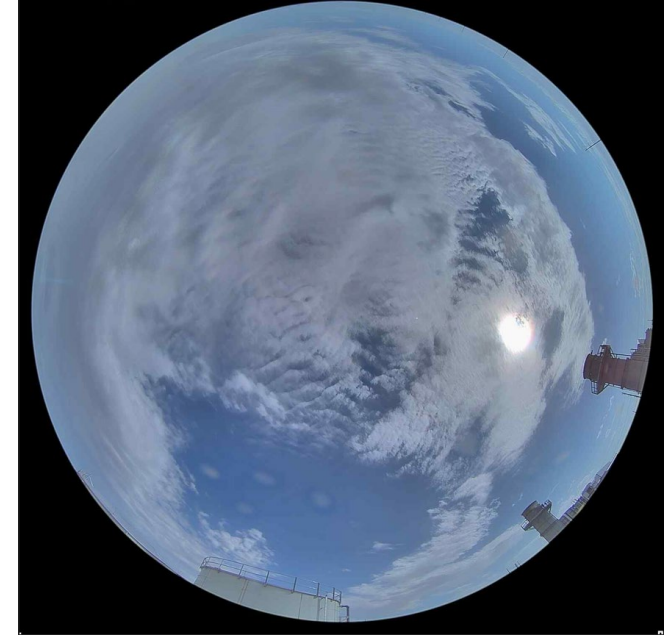
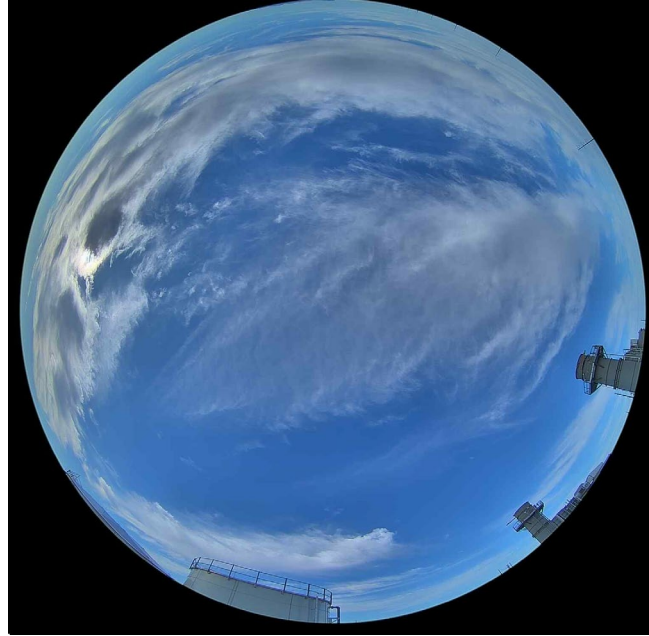
Base Schedules



Hybrid Dynamic Limits



Forecasting Research Collaboration



SRP is open to any collaboration on several research initiatives:

- Sky Camera Based Nowcasting (ConvLSTM): Improvements and Integration (horizons <60min)
- Forecasting and Impact of Aerosols and Dust on Solar Output
- Mitigation of Forecast Risk: Dynamic Reserves and DynADOR Integration

thank you!

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