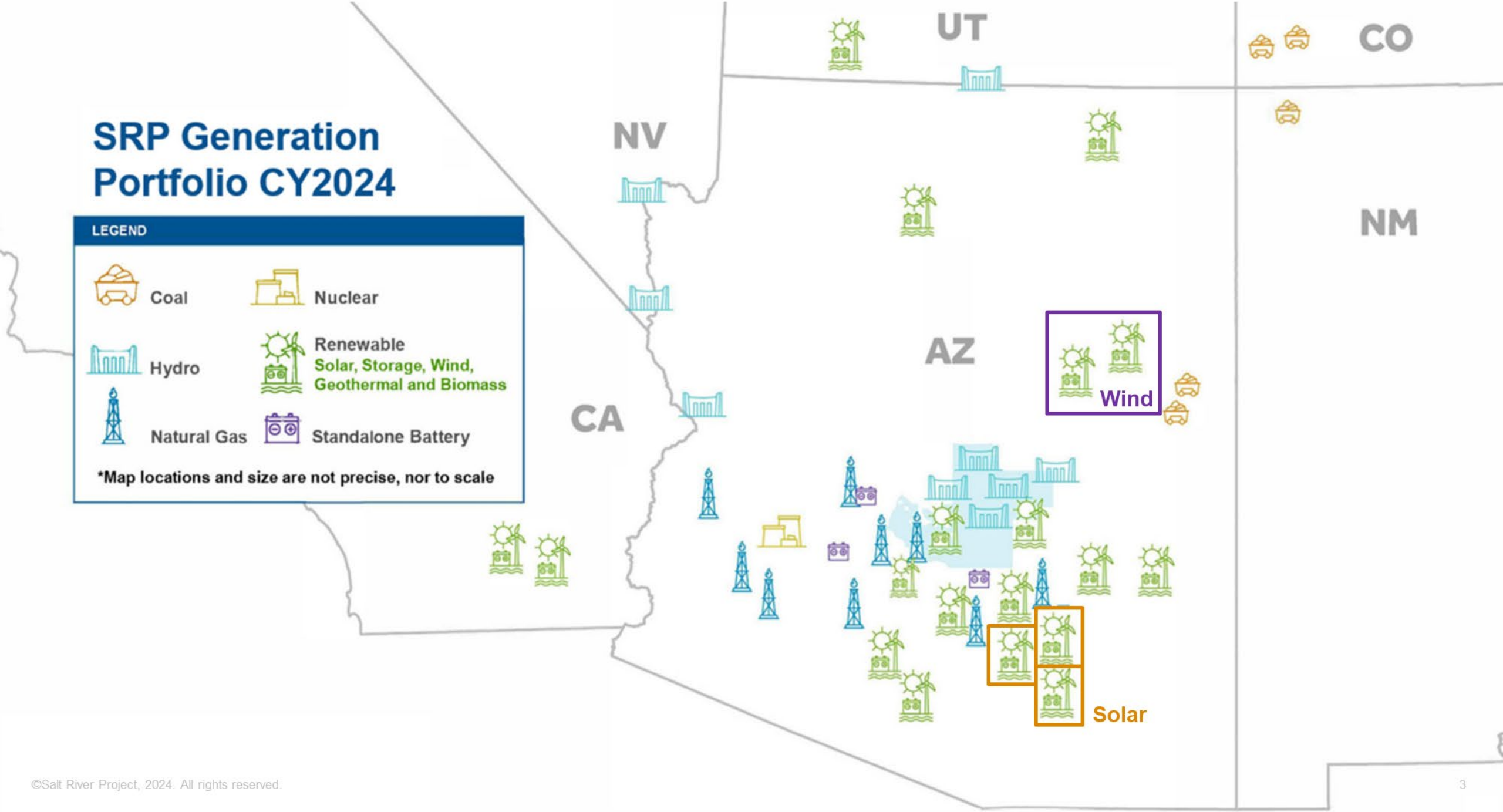
Hybrid Resource Forecasting

ESIG: Forecasting and Markets Workshop

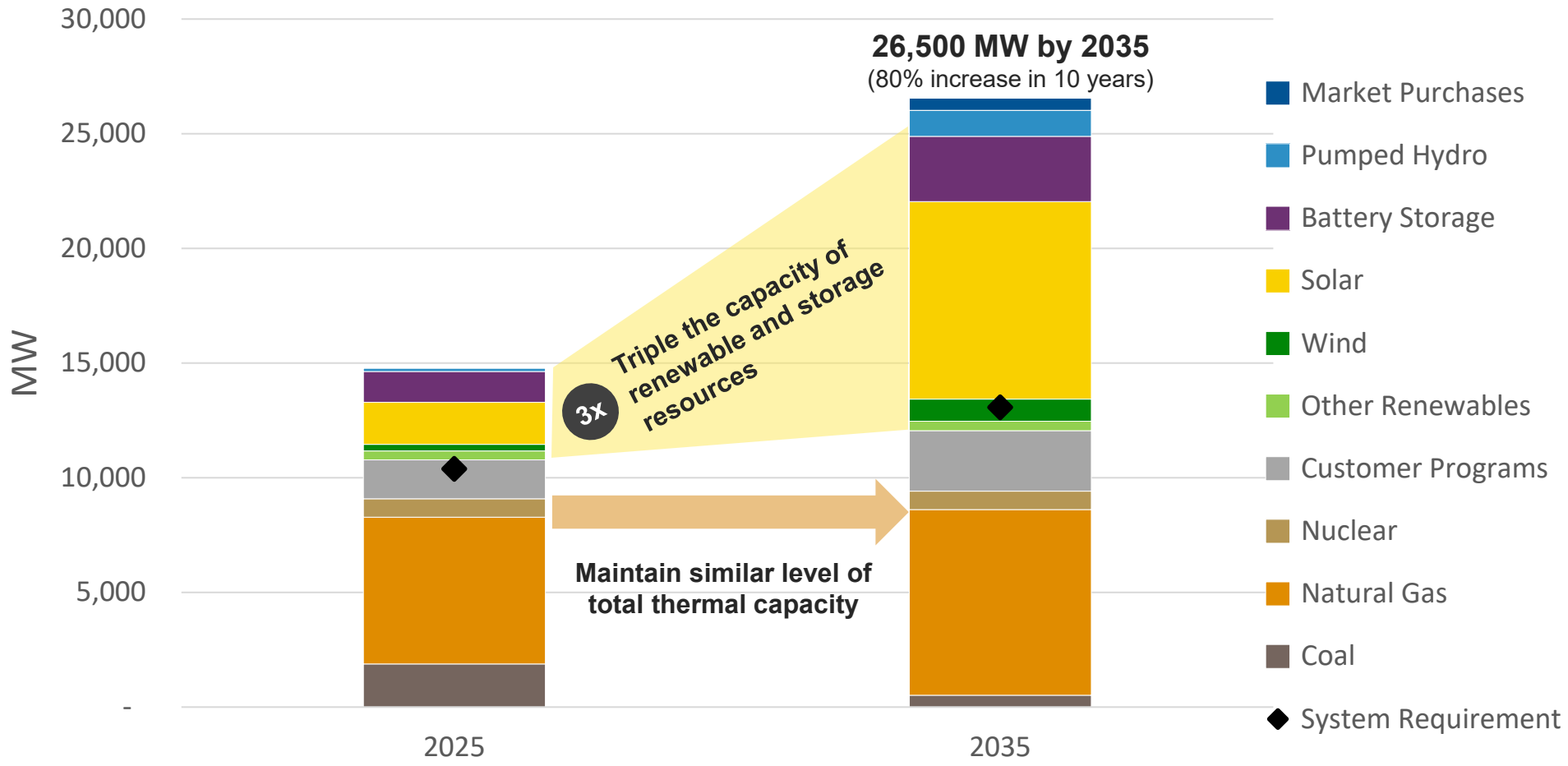
June 13, 2024

SRP Introduction

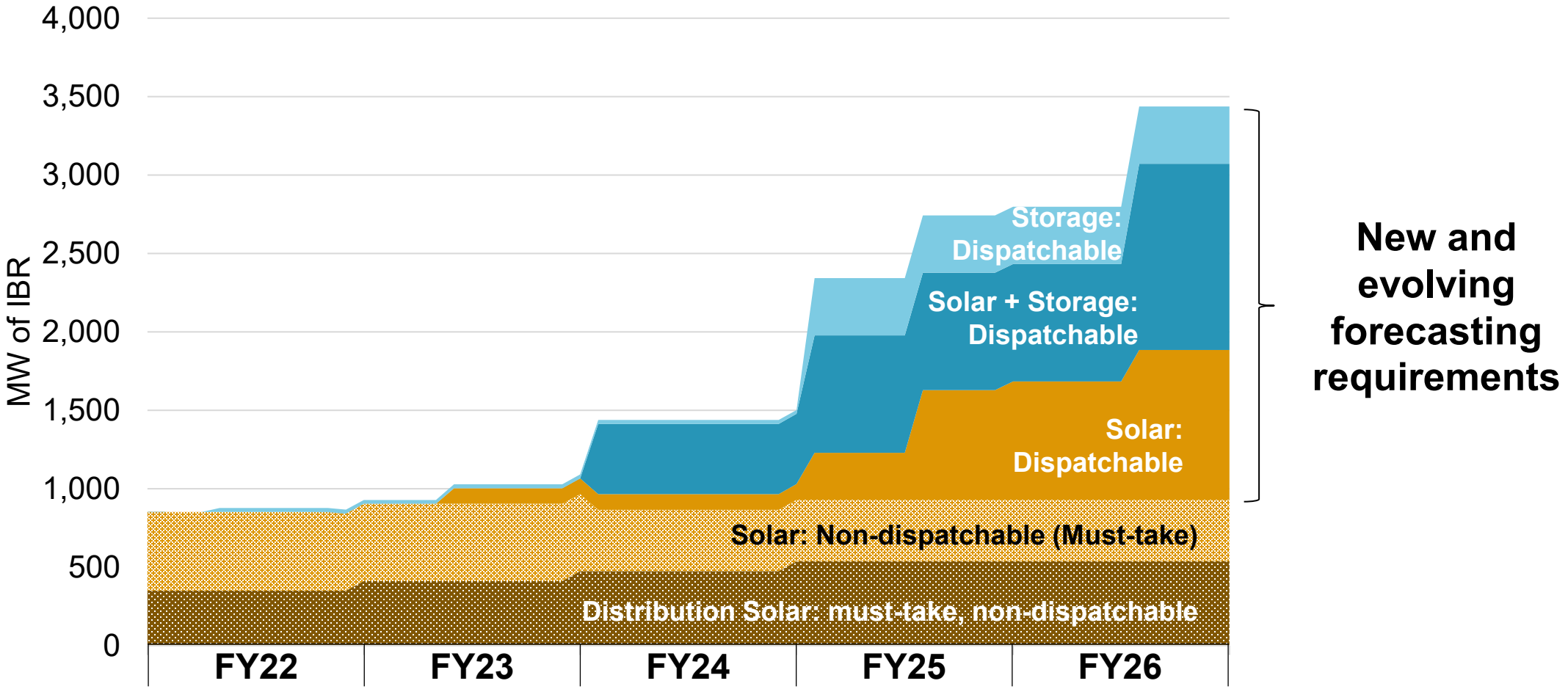
SRP Generation Portfolio CY2024



SRP's Generation Transition

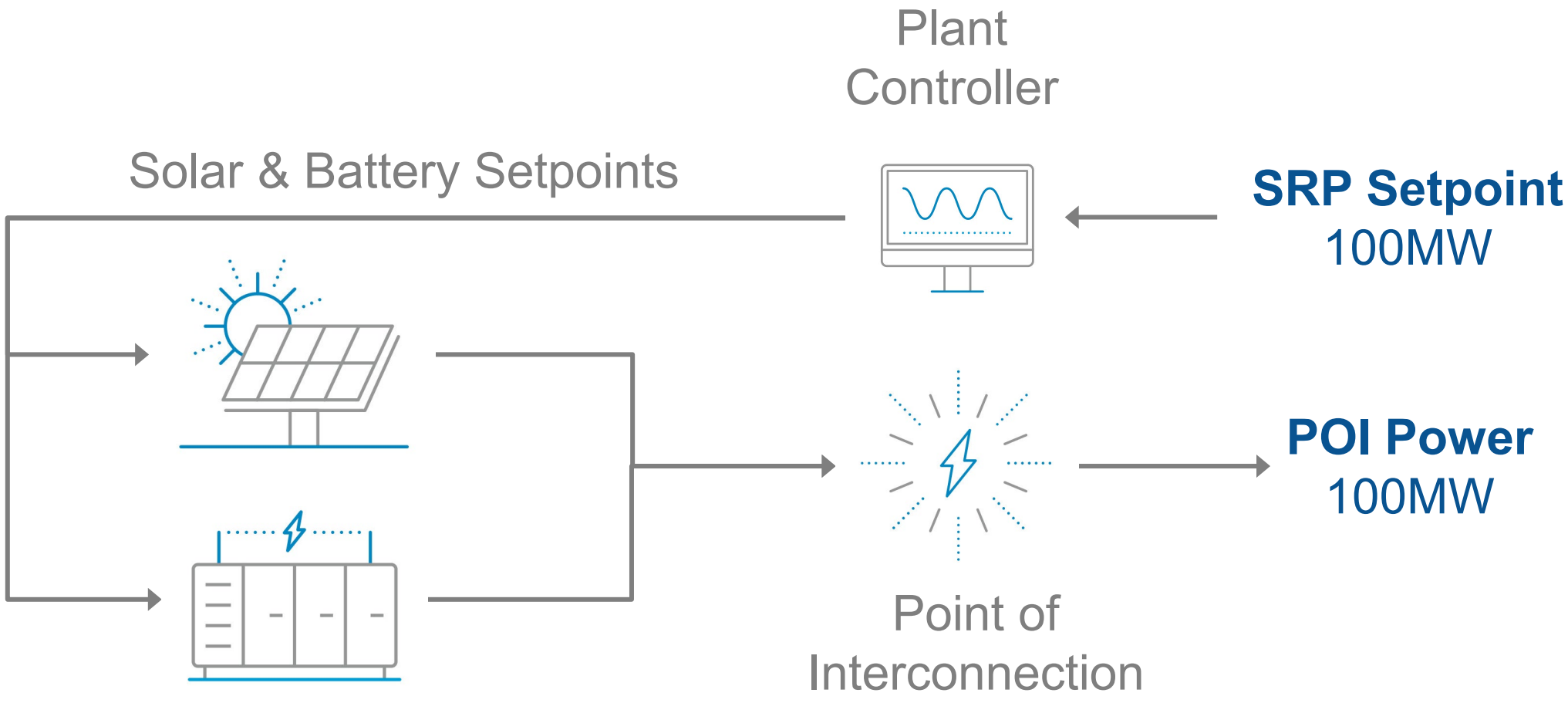


Growth of Dispatchable Renewables



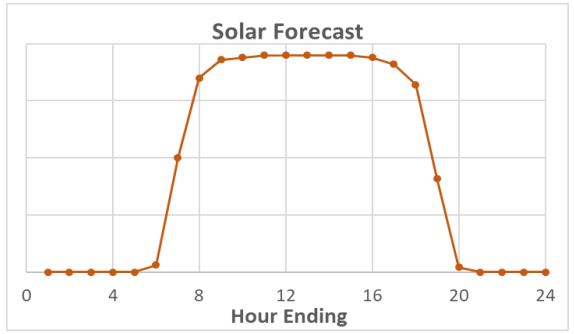
Hybrid Resources

Hybrid Site Overview



Hybrid Scheduling

Solar Forecasts → Battery Schedule → Net POI Schedule → Plant Controller



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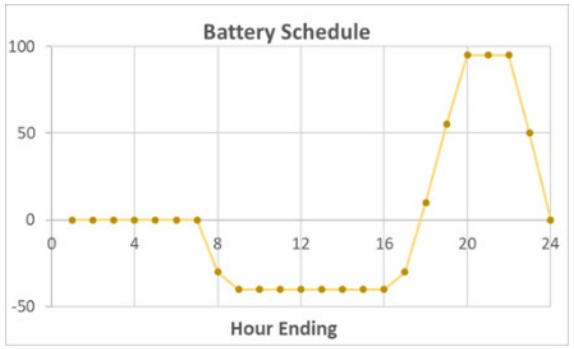
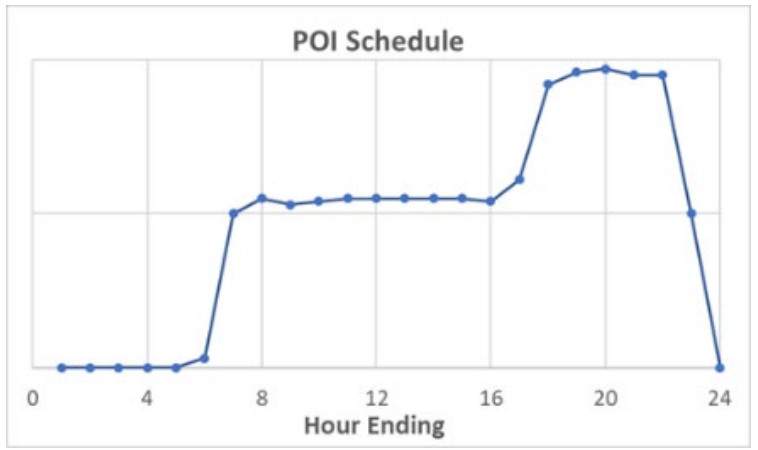
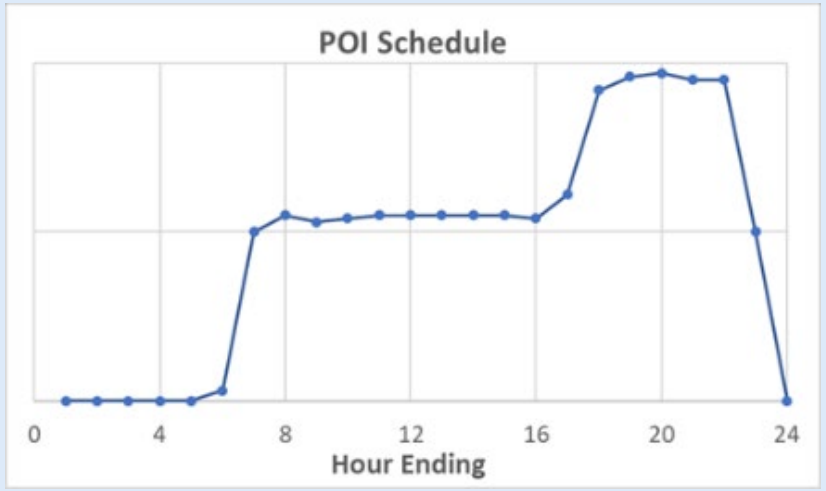


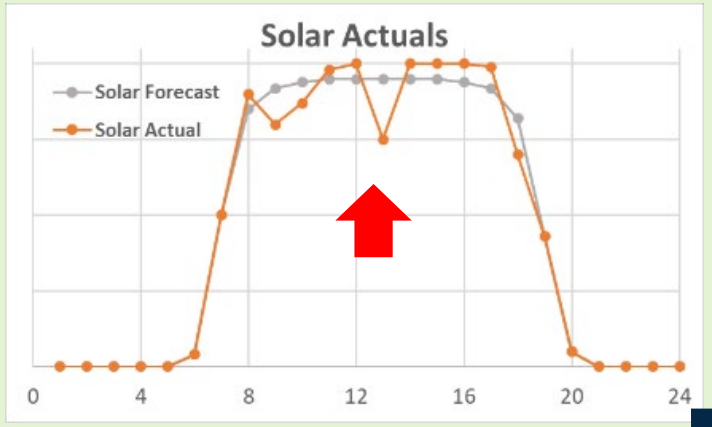


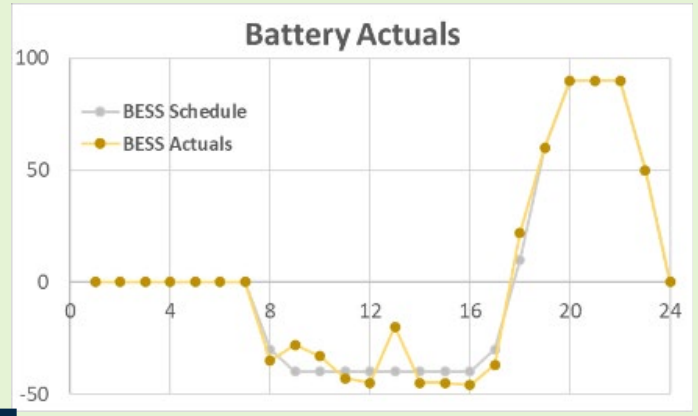
Actual Dispatch and Solar Forecast Error

Power Schedules

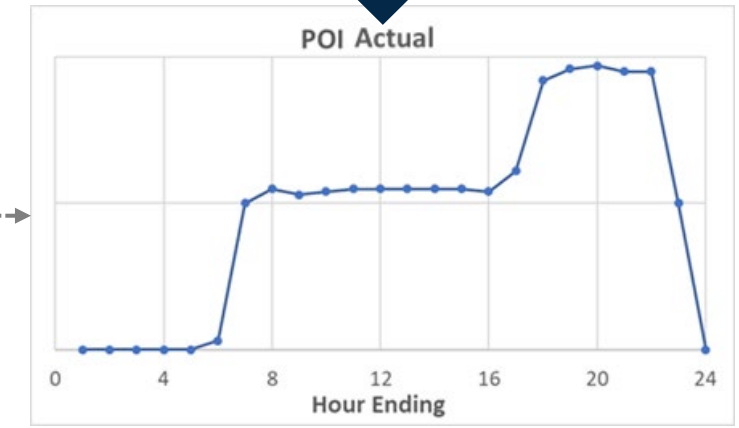


Solar & Battery Power Actuals



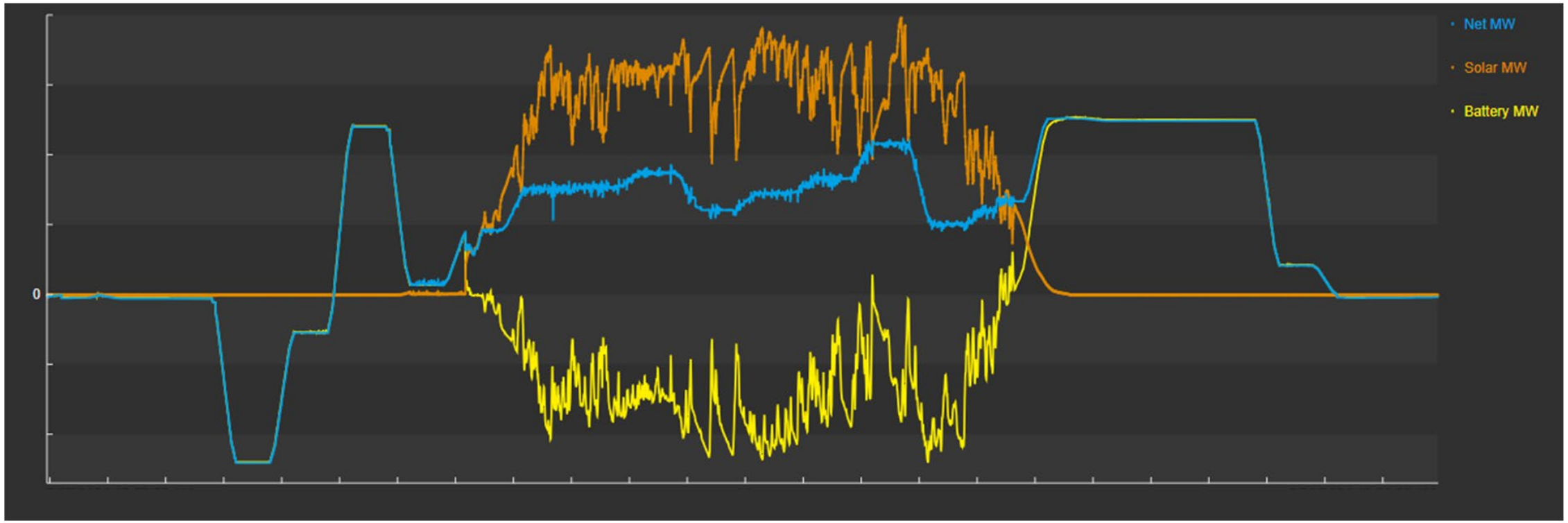


POI Schedule Met!



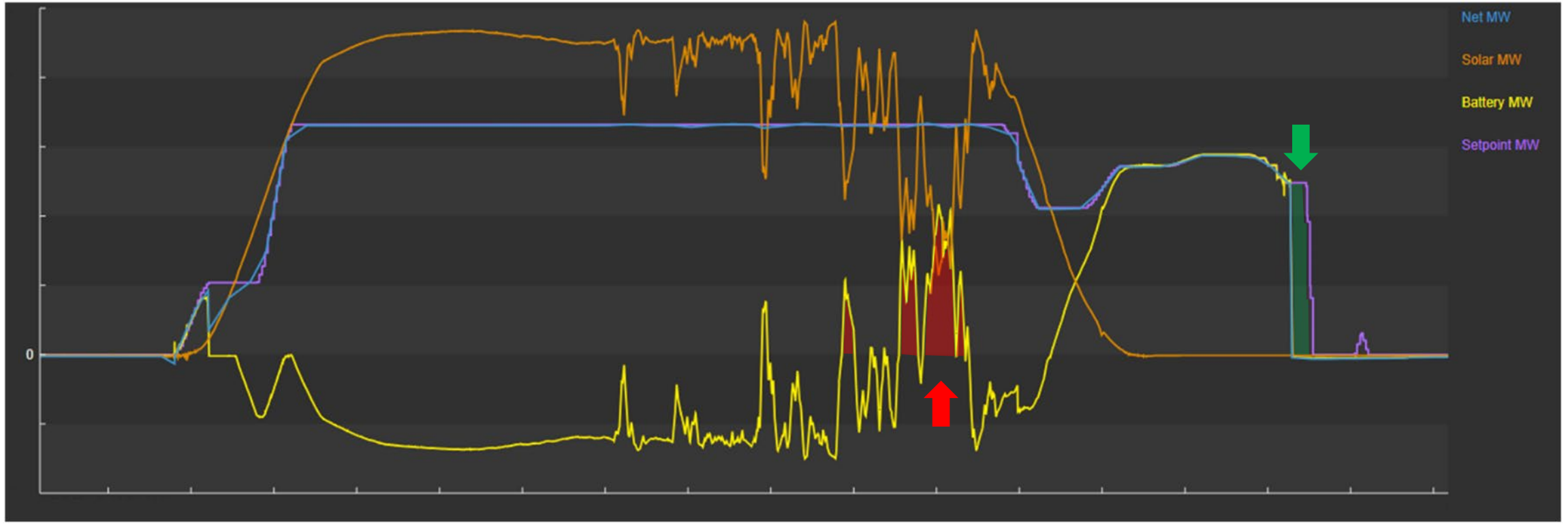
Unbiased Forecasts

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



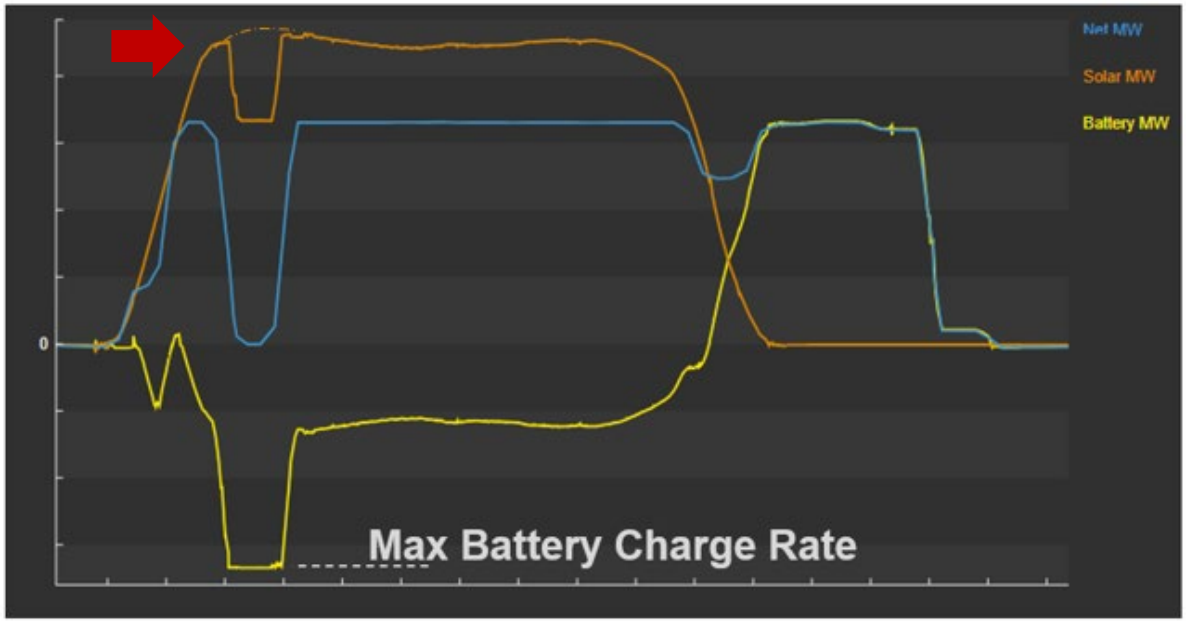
Biased-High Forecasts

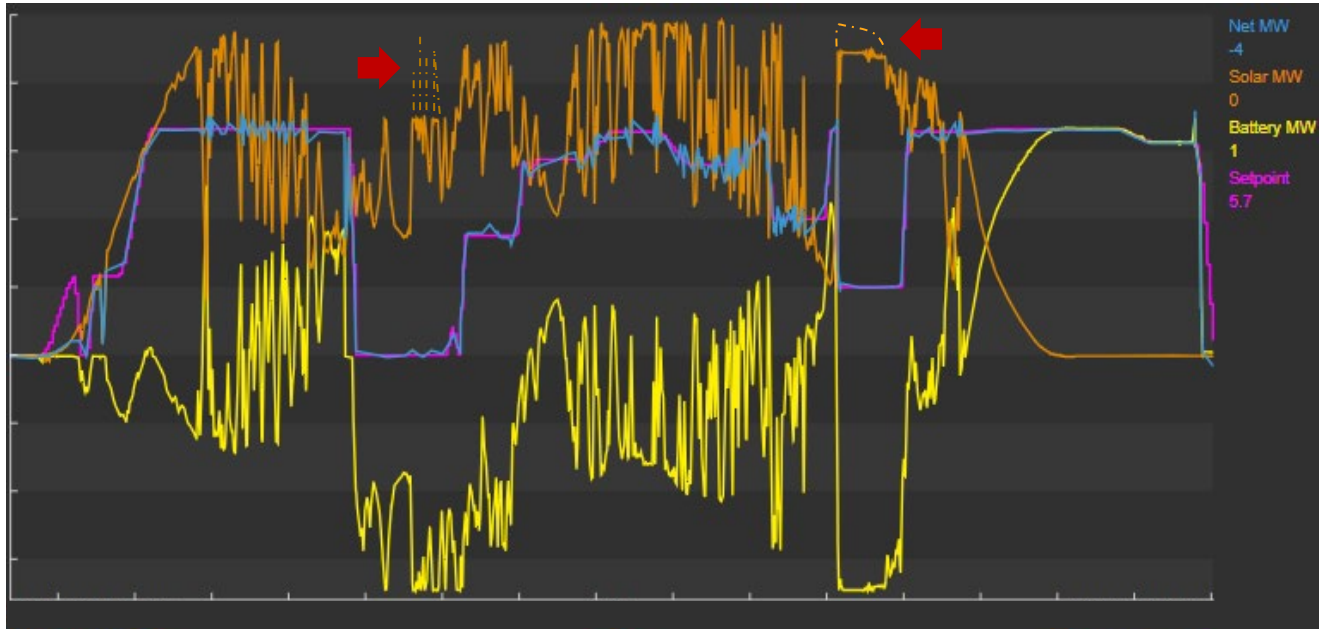
- Mid-afternoon clouds cause the battery to discharge *(red)*
- Shortfall occurred at the end of discharge *(green)*



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:

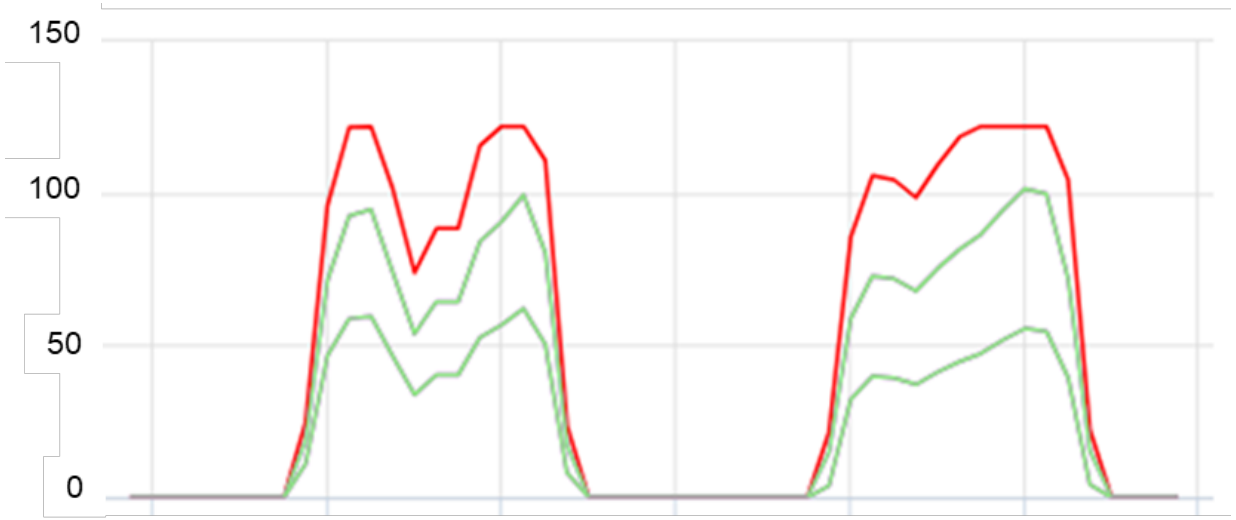
- Unbiased intraday solar forecast errors (<15% of the *battery* capacity) are tolerable
- Biased-high solar forecasts can create an energy shortfall that impacts after-sundown
- Biased-low solar forecasts can cause an immediate economic penalty due to solar curtailment
- Even if forecasts are perfect,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

Forecast Implications

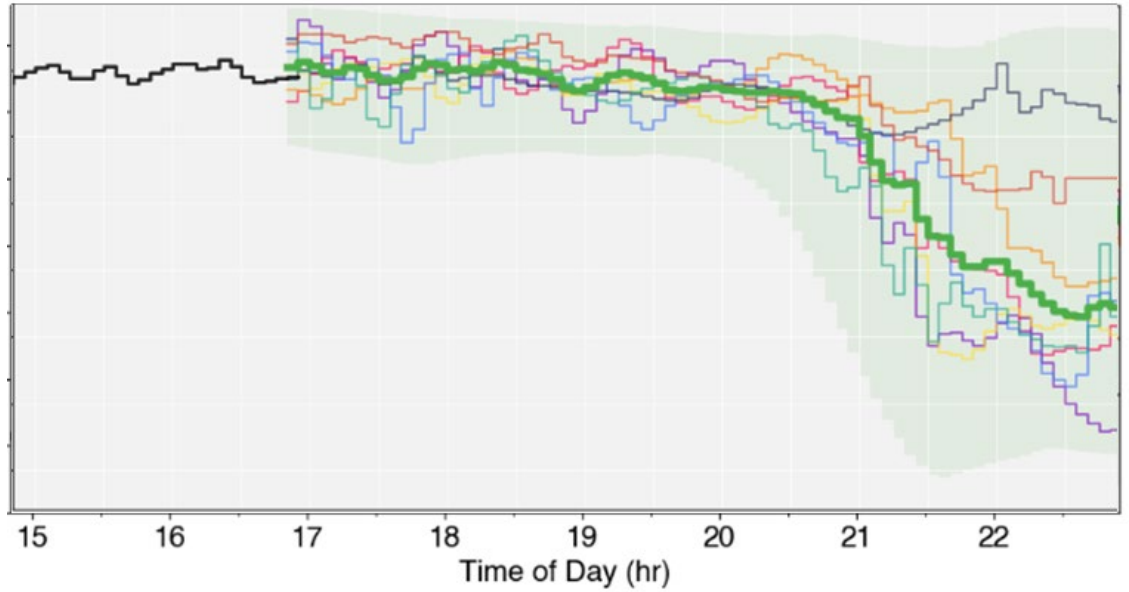
Current Hybrid Forecast Strategy

- 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

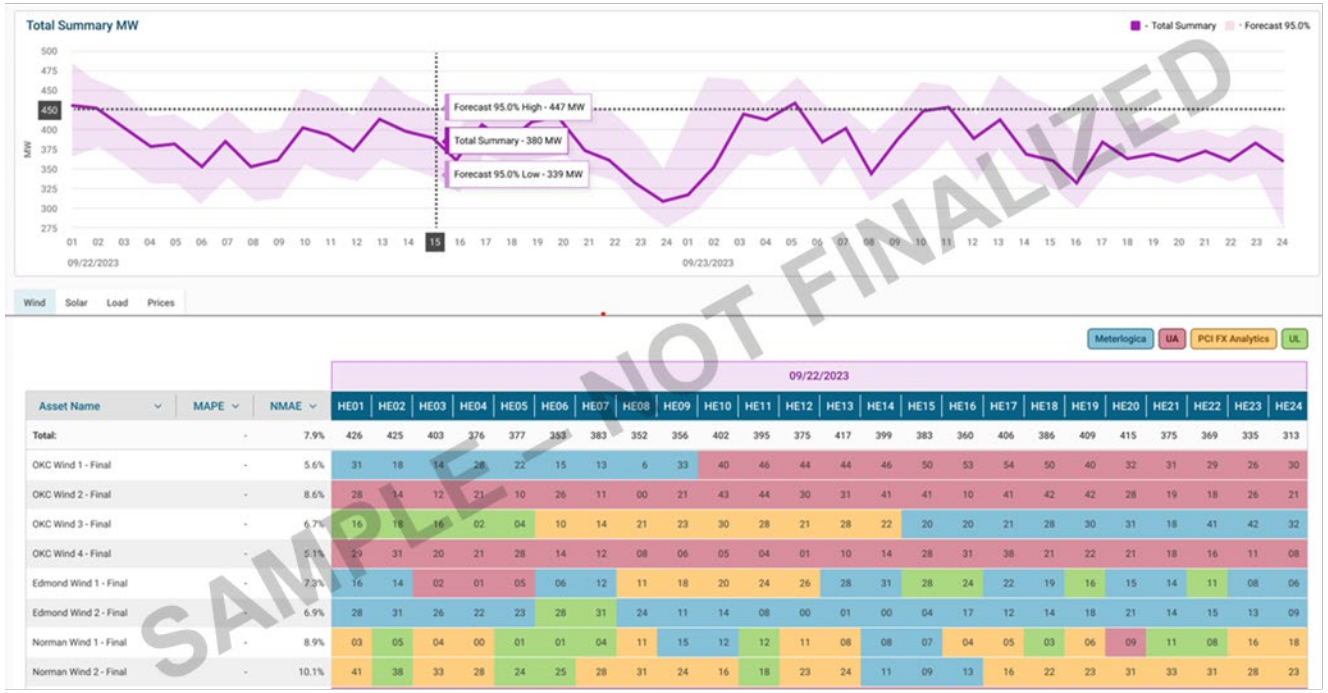
Current: Single Forecast Vendor for All Sites

RT Overview

StartDate: 05/09/2024 04:00 EndDate: 05/10/2024 03:00 Save Hide Zero Rows Show Grid

Name	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18
- Renewable	99	146	518	726	765	770	776	783	788	794	794	786	773	651
[redacted]	0	0	8	29	48	49	50	50	49	49	48	48	44	30
	0	0	5	15	19	19	19	19	19	19	18	18	17	14
	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	8	8	7	4	0	1	2	5	8	11	12	12	11	10
	8	7	6	2	0	1	2	5	8	12	13	11	10	10
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	0	0	2	8	10	10	10	10	9	9	9	9	9	6
	0	0	13	37	44	45	45	45	45	45	44	44	42	32
	0	7	122	282	300	300	300	300	300	300	300	300	300	224
	0	1	28	72	88	90	92	93	94	94	93	92	87	69
	0	1	35	81	98	98	97	97	97	96	95	94	90	73
	0	1	35	84	98	99	100	100	100	100	100	98	94	76
	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	0	0	7	12	15	15	15	15	15	15	15	15	25	25

Upcoming: Per-Site & Multi-Forecast Integration

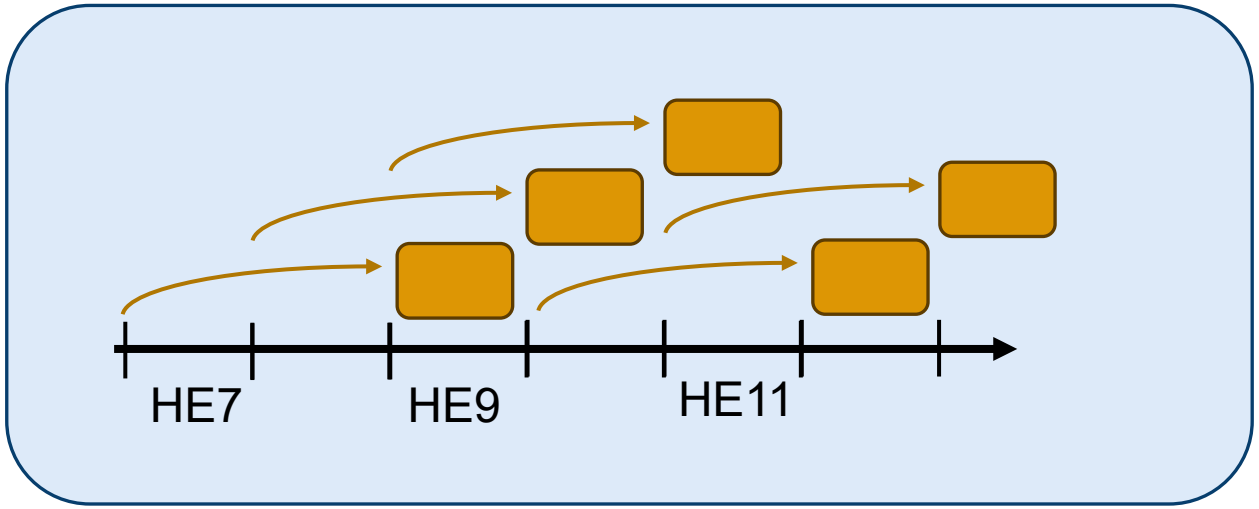


Subhourly Dispatch

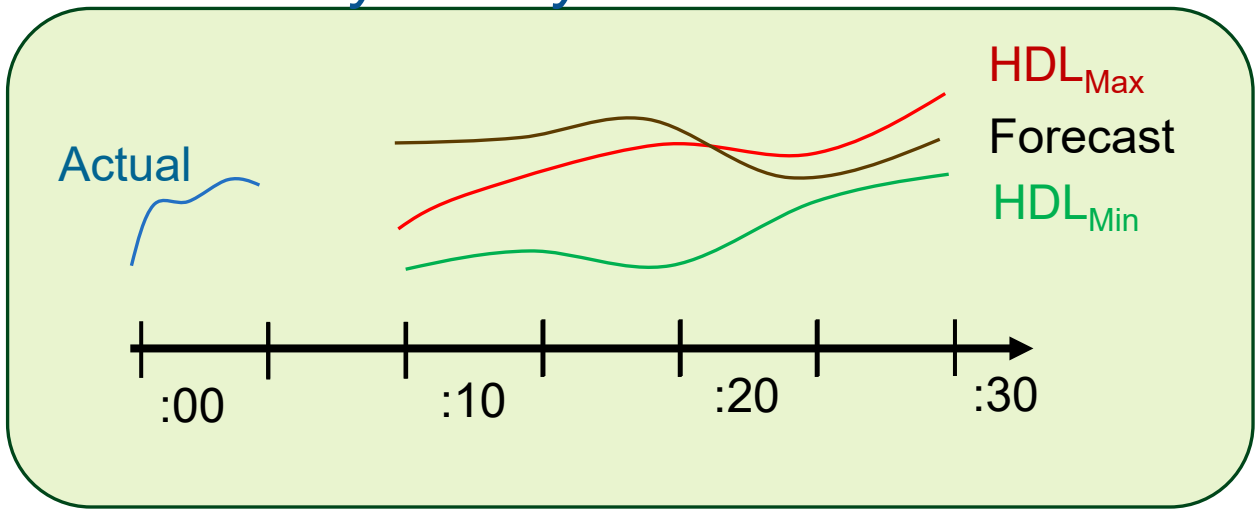
Hybrid dynamic limits will enable subhourly schedule adjustment and enable bidding

- 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

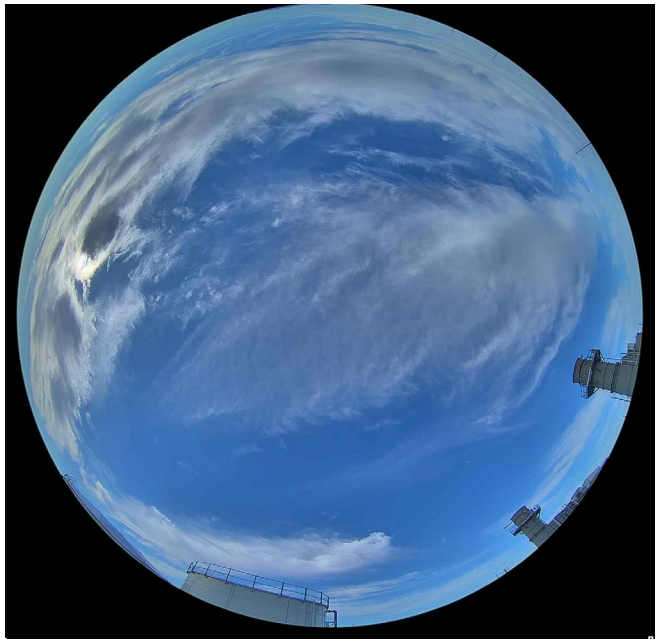
Base Schedules

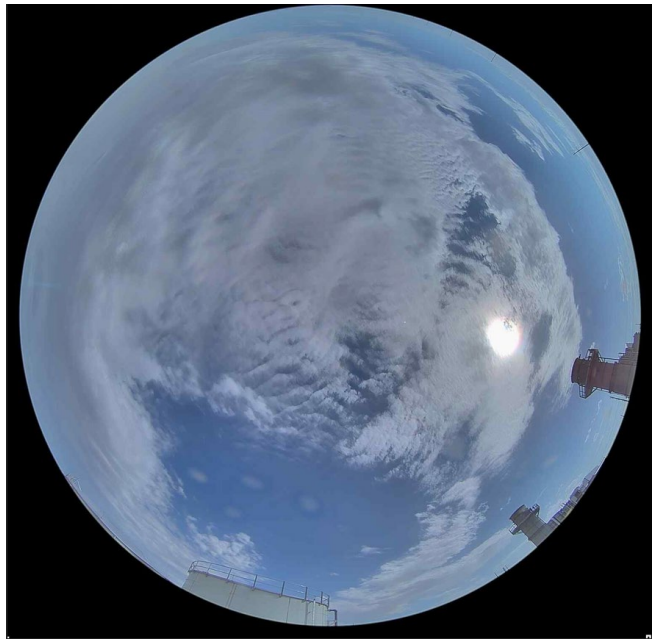


Hybrid Dynamic Limits



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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