

LOAD IMPACT EVALUATION OF LEAP CALIFORNIA DR RESOURCES

2026 DRMEC LIP WORKSHOP
MAY 11, 2026




Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS





PRESENTATION OVERVIEW

- Key research questions and findings
 - Participant mix and events
 - Evaluation Methodology
 - 2025 Ex-Post Load Impacts
 - 2025 Ex-Ante Load Impacts for Planning
- 

KEY FACTS AND PERFORMANCE METRICS

Customer Counts

29,000 residential
3,700 non-residential
Over 45 technology partners

Events

Over 890 unique dispatch events.
Average site experienced 28 hours of dispatch

Growth

Rapid growth in residential storage
Steady growth in HVAC resources

2025 Observed Load Reductions (Ex-Post)

44.9 MW for average event hour

2025 Load Impacts for Planning Conditions (Ex-Ante)

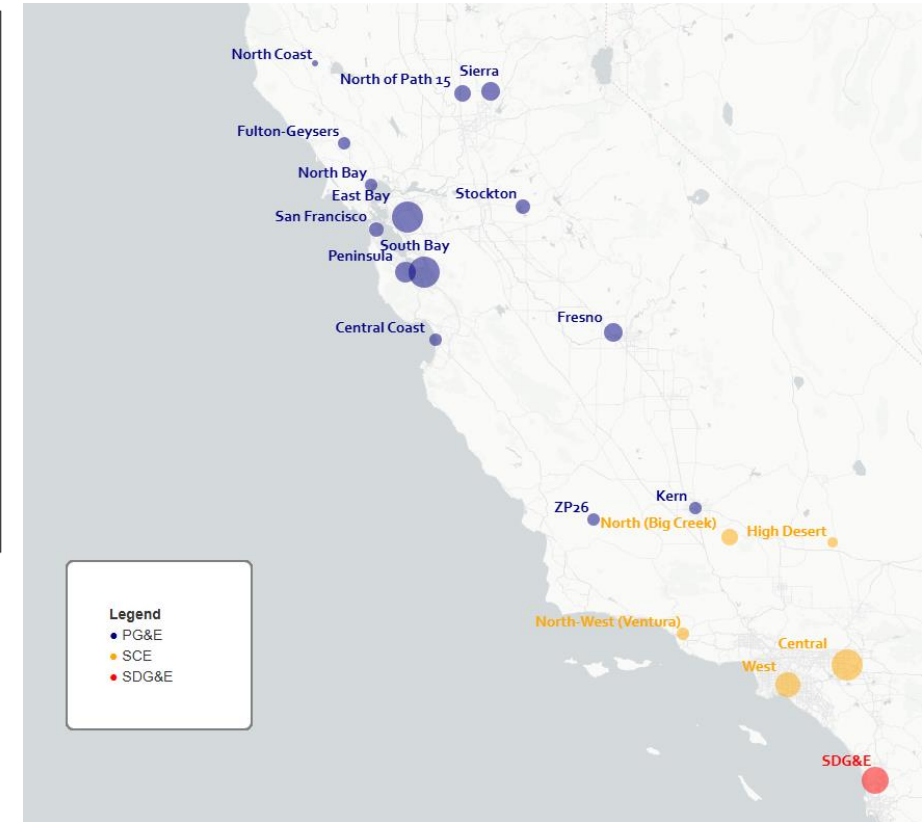
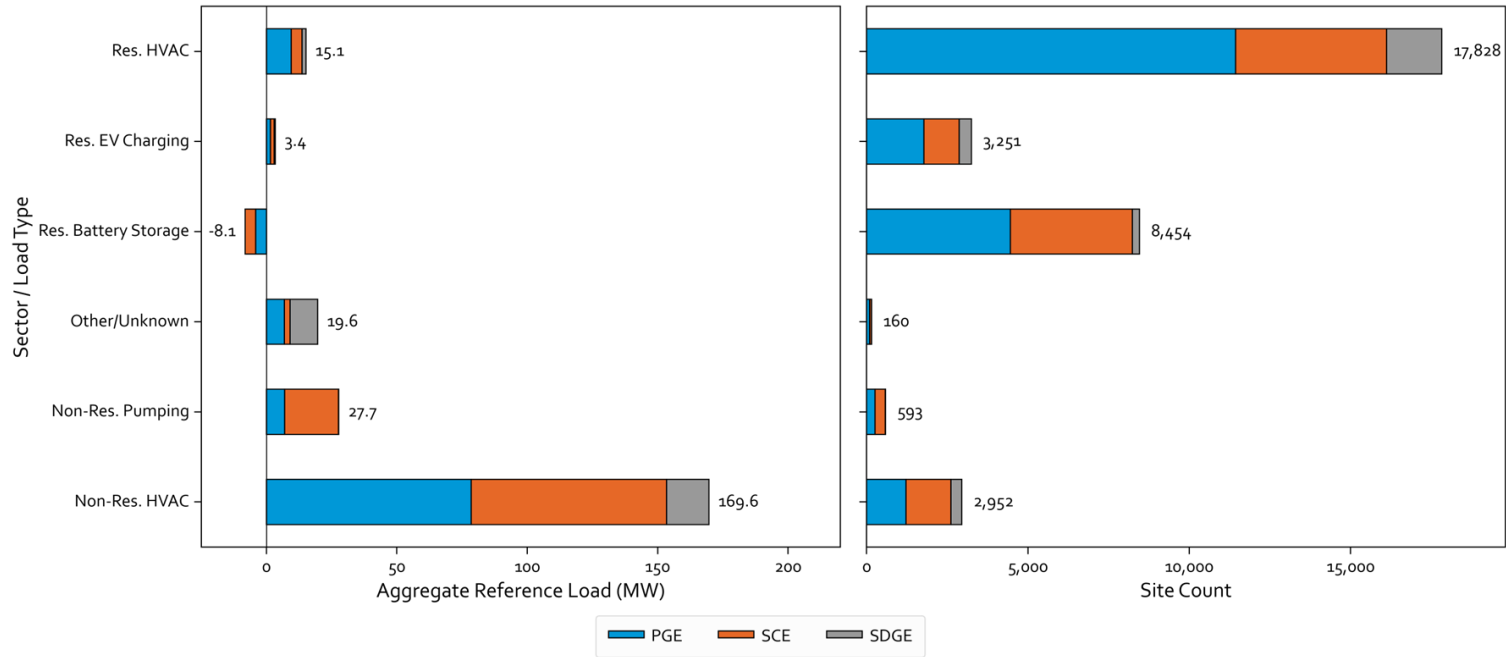
54.02 MW

NQC request for 2027

74.2 – 89.1 MW

PARTICIPANT MIX, EVENTS, AND SYSTEM CONDITIONS

THE PORTFOLIO HAS A DIVERSE MIX OF PARTICIPANTS

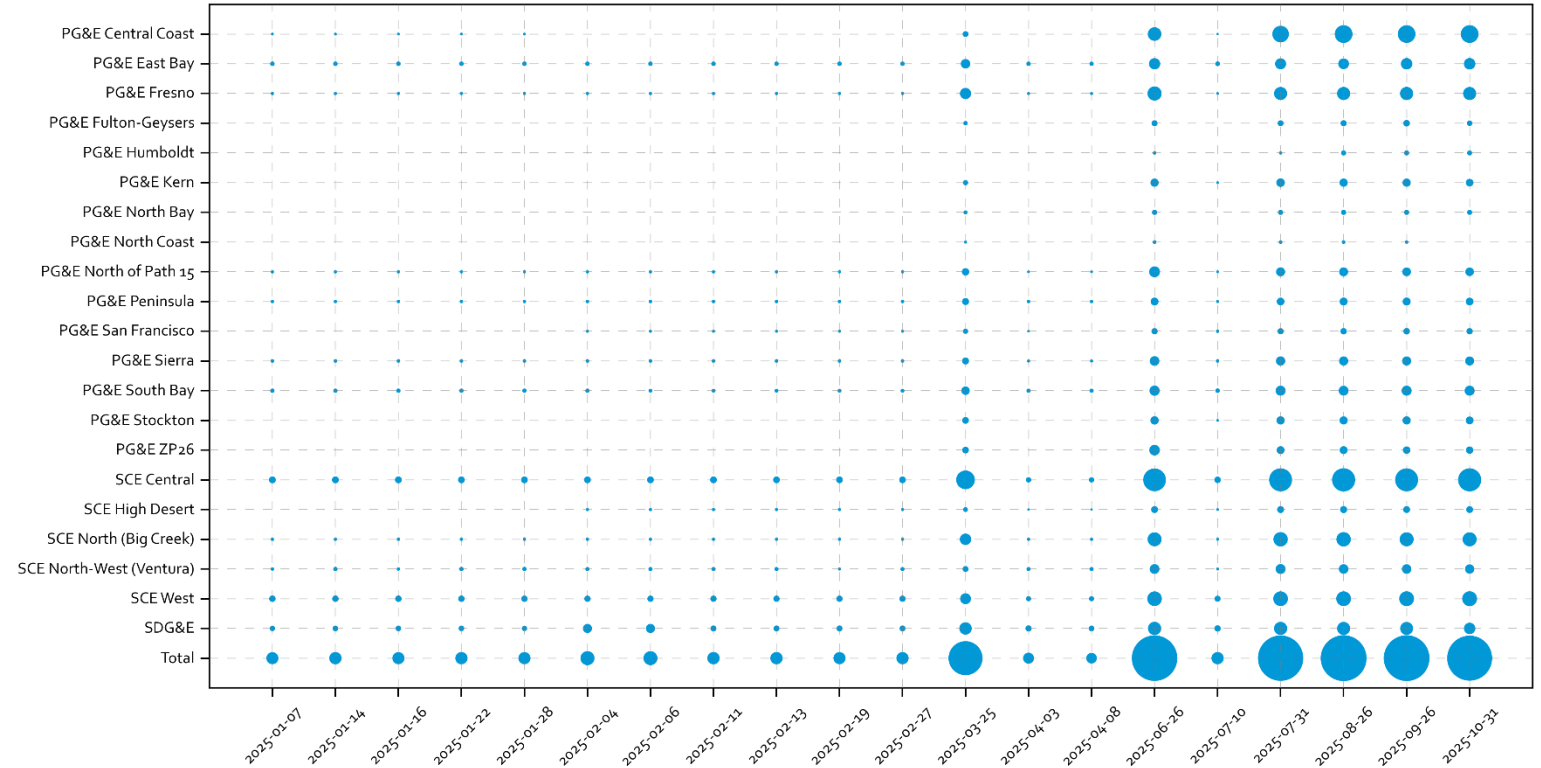


*Bubble size reflects the number of accounts in a given subLAP

- Program participation varied by customers in each jurisdiction
- The largest concentration of load was in PG&E's service territory, followed by SCE, then SDG&E
- The most prevalent load types were HVAC, with the next key load types being EV Charging and then Pumping

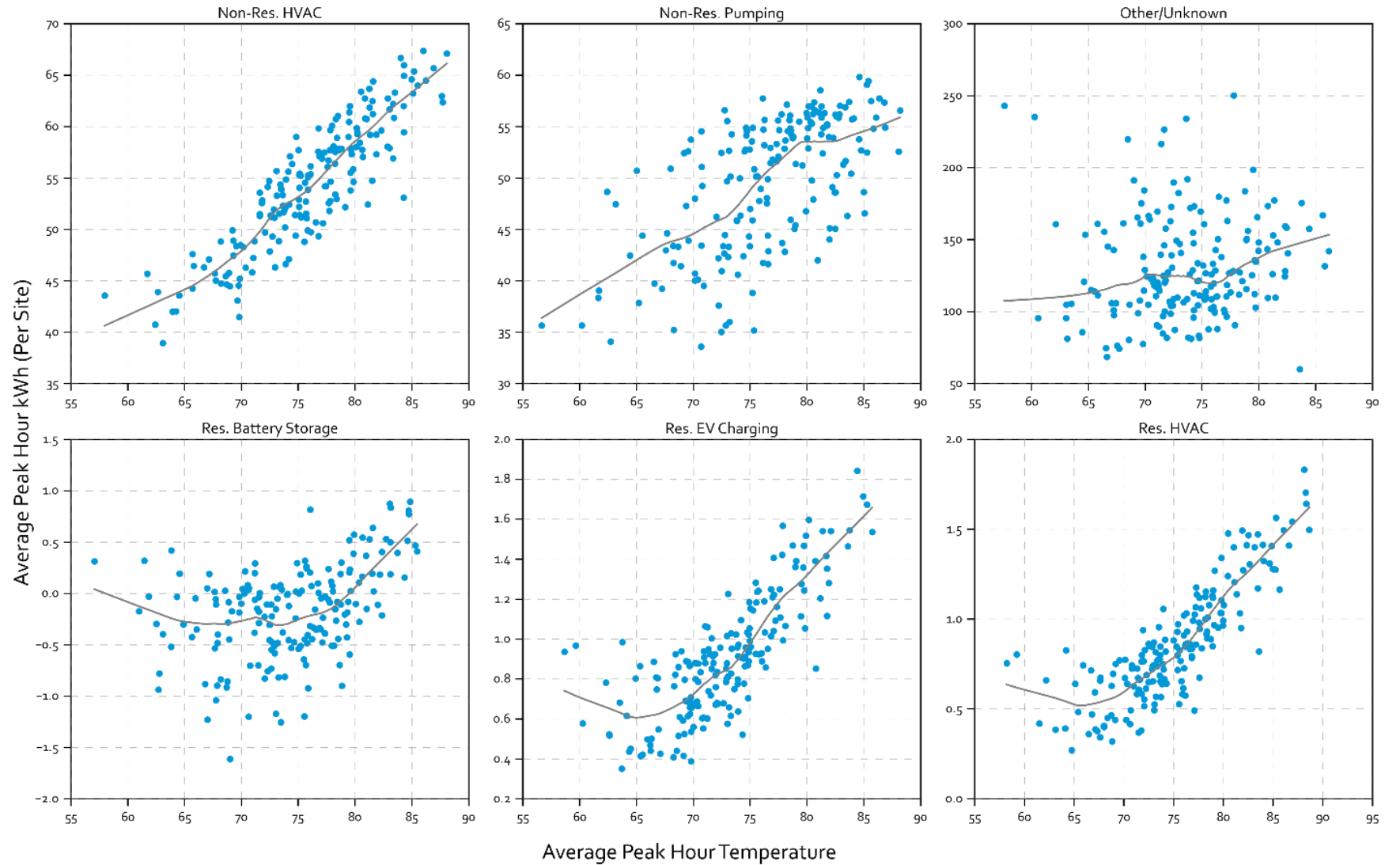
IN THE PY2025 SEASON, THERE WAS SIGNIFICANT VARIATION IN EVENT DISPATCH IN TERMS OF BOTH EVENT HOURS AND GEOGRAPHIC LOCATION

- At no point was the full LEAP portfolio dispatched
- DSGS resources (batteries) were dispatched all at once on different dates



Sector/Load Type	Sites	Mean Event		Percentiles				
		Hours	5%	25%	50%	75%	95%	
Res. HVAC	17,583	18	4	16	20	24	24	
Res. Battery Storage	8,454	11	3	4	5	10	11	
Res EV Charging	3,125	132	4	16	96	203	385	
Non-Res. HVAC	2,929	32	4	16	20	24	152	
Non-Res. Pumping	593	20	4	20	24	24	24	
Other/Unknown	160	55	2	8	20	48	259.7	
Total	32,844	29	4	8	20	24	141	

A SUBSTANTIAL SHARE OF THE RESOURCES ARE WEATHER SENSITIVE



EX ANTE IMPACTS REFLECT THE MAGNITUDE OF PROGRAM RESOURCES AVAILABLE UNDER PLANNING CONDITIONS DEFINED BY WEATHER

Ex post Impacts

- What were the reductions delivered?
- Varies based on:
 - ✓ Temperature
 - ✓ Magnitude of resources dispatched
 - ✓ Hours of dispatch
 - ✓ Length of dispatch
 - ✓ Program/rate changes
 - ✓ Participant mix

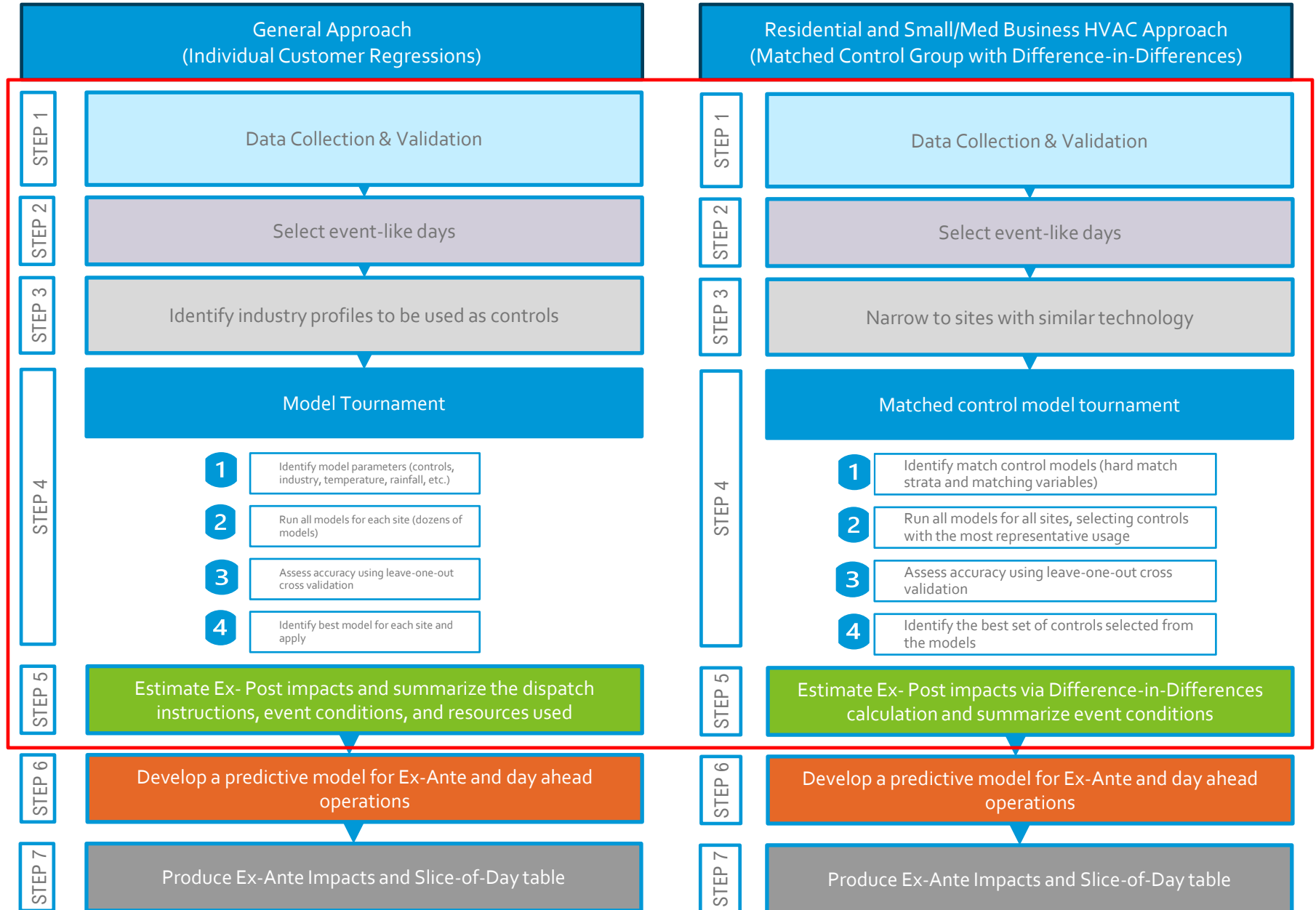
Adjustments

- Standardize weather
- Assume full dispatch of resources available
- Standardize hours and length of dispatch
- Incorporate program/rate changes
- Adjust for project enrollment changes

Ex ante Impacts

- What is the magnitude of program resources available under planning conditions defined by weather?
- Utility and CAISO weather conditions
- Produced for the system load worst day for each month
- Slice-of-Day table for resource adequacy

STUDY DESIGN



THE BEST MODEL FOR EACH SITE PRODUCED THE BEST RESULTS

Training Procedure

Models are run on all summer weekdays, except for a subset of proxy days (excluded for validation) and event days.

Validation Process

Predictions were made for the left-out proxy days.
Repeated the process three times, excluding three sets of proxy days.

Comparison

Compare the predicted and actual observed loads for each out-of-sample proxy day.

Scoring Metrics

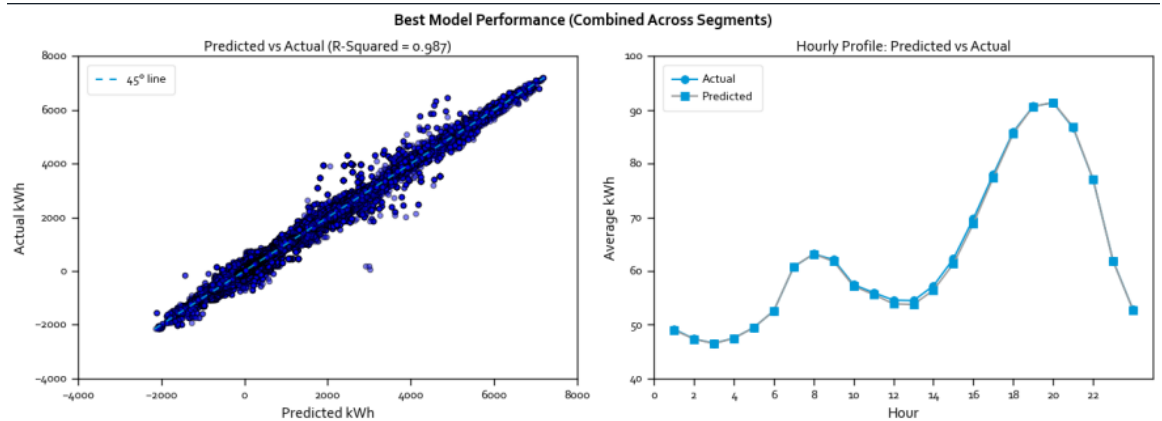
Absolute % Bias: Measures the tendency to over or under predict.

RRMSE: Evaluates how close predictions are to actual values (least noise).

Model Selection Criteria

Filtered to models with an absolute % bias < 1%.

The final model was selected based on the lowest RRMSE.



*Pictured Commercial HVAC

EX POST LOAD IMPACTS

AVERAGE EVENT HOUR IMPACTS – LOAD TYPE

Utility	Sector/Load Type	Avg Number of Event Hours	Avg. Event Hour Temp (F)	Aggregate Impact (MW)
PGE	Non-Res. HVAC	22	78.5	6.33
	Non-Res. Pumping	21	75.5	1.98
	Other/Unknown	43	72.4	4.73
	Res. Battery Storage	13	75.2	8.01
	Res. EV Charging	87	69.8	0.05
	Res. HVAC	18	78.0	1.59
SCE	Non-Res. HVAC	34	76.9	9.40
	Non-Res. Pumping	20	77.3	3.87
	Other/Unknown	61	75.1	0.06
	Res. Battery Storage	7	78.0	5.49
	Res. EV Charging	201	69.7	0.14
	Res. HVAC	19	78.7	0.72
SDGE	Non-Res. HVAC	61	64.5	1.67
	Other/Unknown	88	64.1	0.54
	Res. Battery Storage	58	56.0	0.01
	Res. EV Charging	99	64.1	0.03
	Res. HVAC	17	65.9	0.23
Total	Total	28	75.9	44.85

Key issue:

Not all resources were dispatched all at once

What was done:

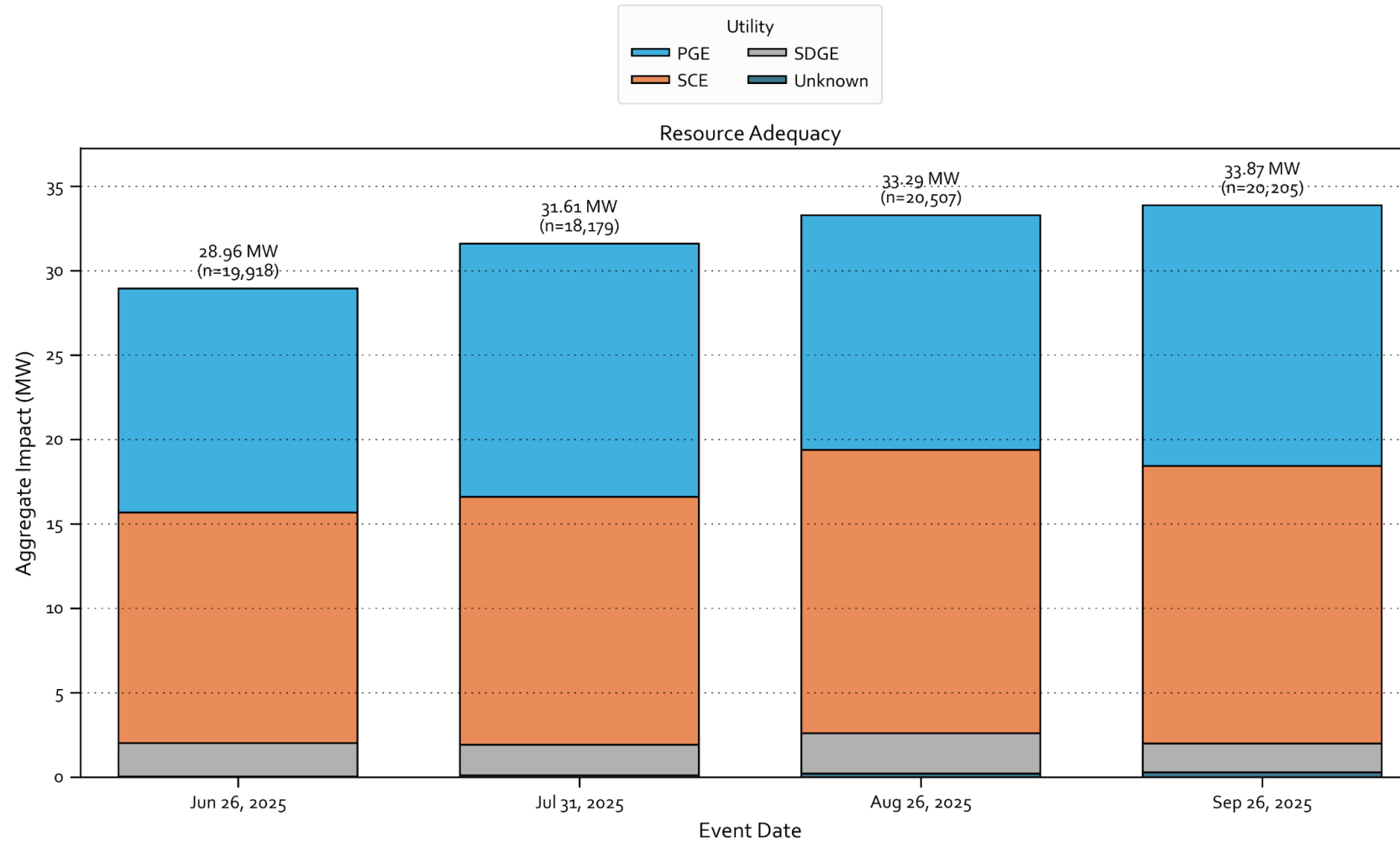
- Narrow to event hours for each site
- Calculate the average reduction per event hour for each site
- Aggregate the site level per-event hour impacts

Note:

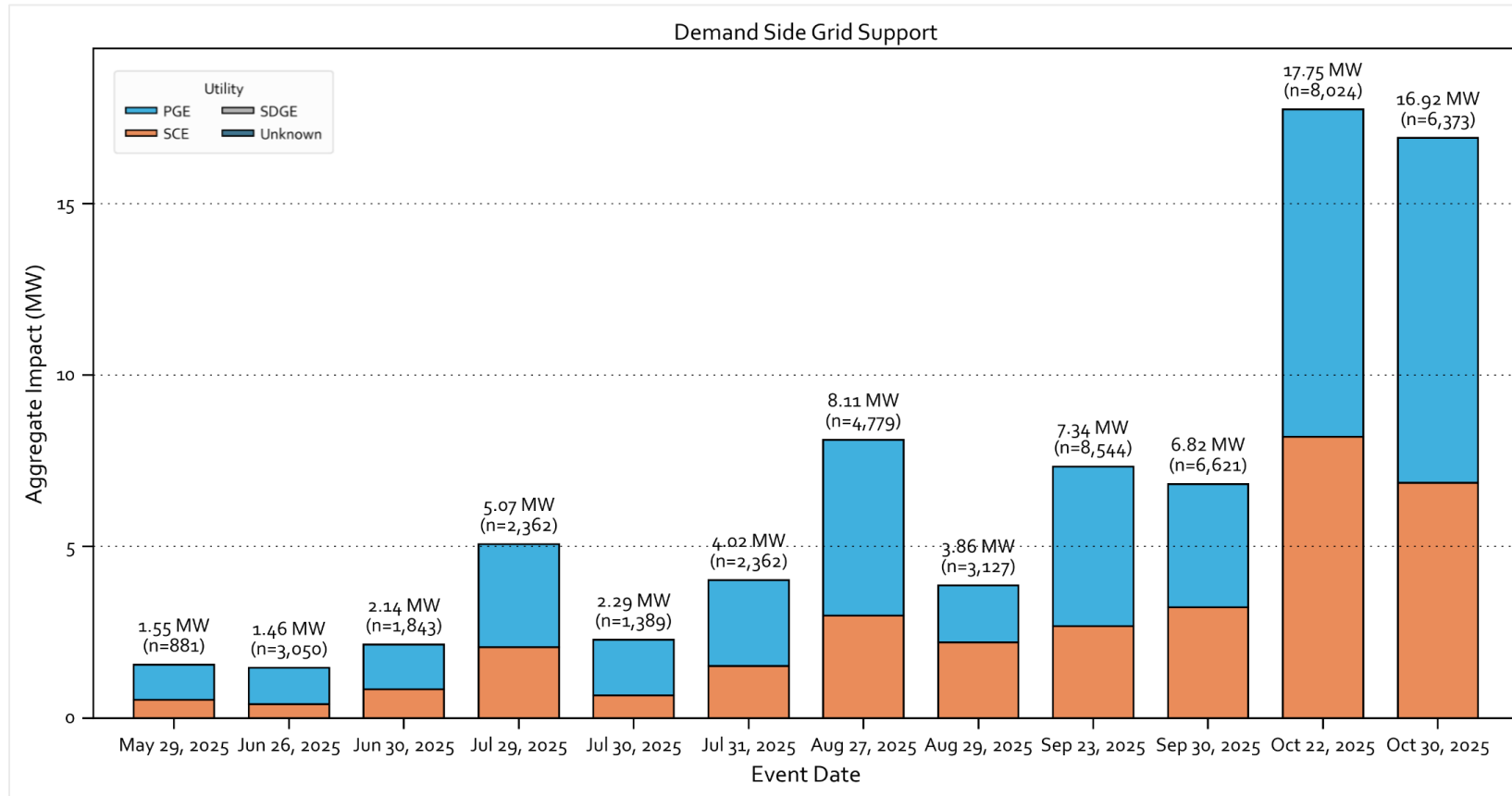
Only includes sites enrolled by Sep 2025 and actively enrolled as of Oct 2025.

Test event days provide insight into the overall portfolio capability, but differed for the main portfolio (4) and DSGS resources (12).

RESULTS FOR MAIN PORTFOLIO ON TEST EVENT DAYS



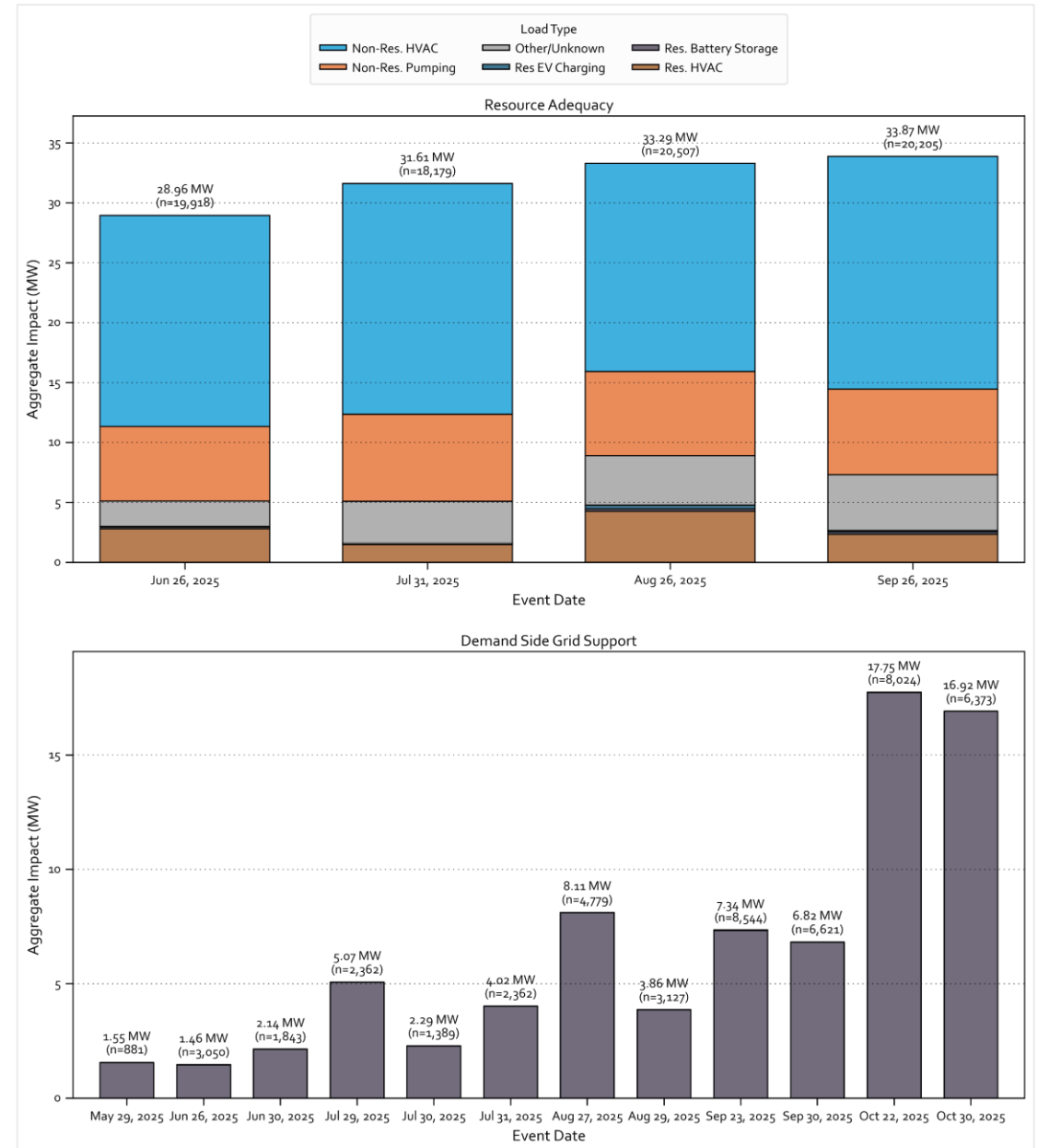
RESULTS FOR DSGS RESOURCES ON TEST EVENT DAYS



- Mostly residential batteries on Net Billing Tariffs
- Impacts are incremental to what batteries did on non-event days
- Rapid growth in resources
- Incremental per site impacts are lower in August and September due to existing NBT response
- Different set of customers dispatched on different test event days

LOAD REDUCTION BY LOAD TYPE

- Biggest contributors were:
 - Non-res HVAC (~39%)
 - Res battery storage (~30%)
 - Pumping load (13%)
- Substantial share of resources are weather sensitive and deliver larger impacts under hotter conditions
- Rapid growth in battery storage and continued growth in non-res HVAC



EX ANTE IMPACTS REFLECT THE MAGNITUDE OF PROGRAM RESOURCES AVAILABLE UNDER PLANNING CONDITIONS DEFINED BY WEATHER

Ex post Impacts

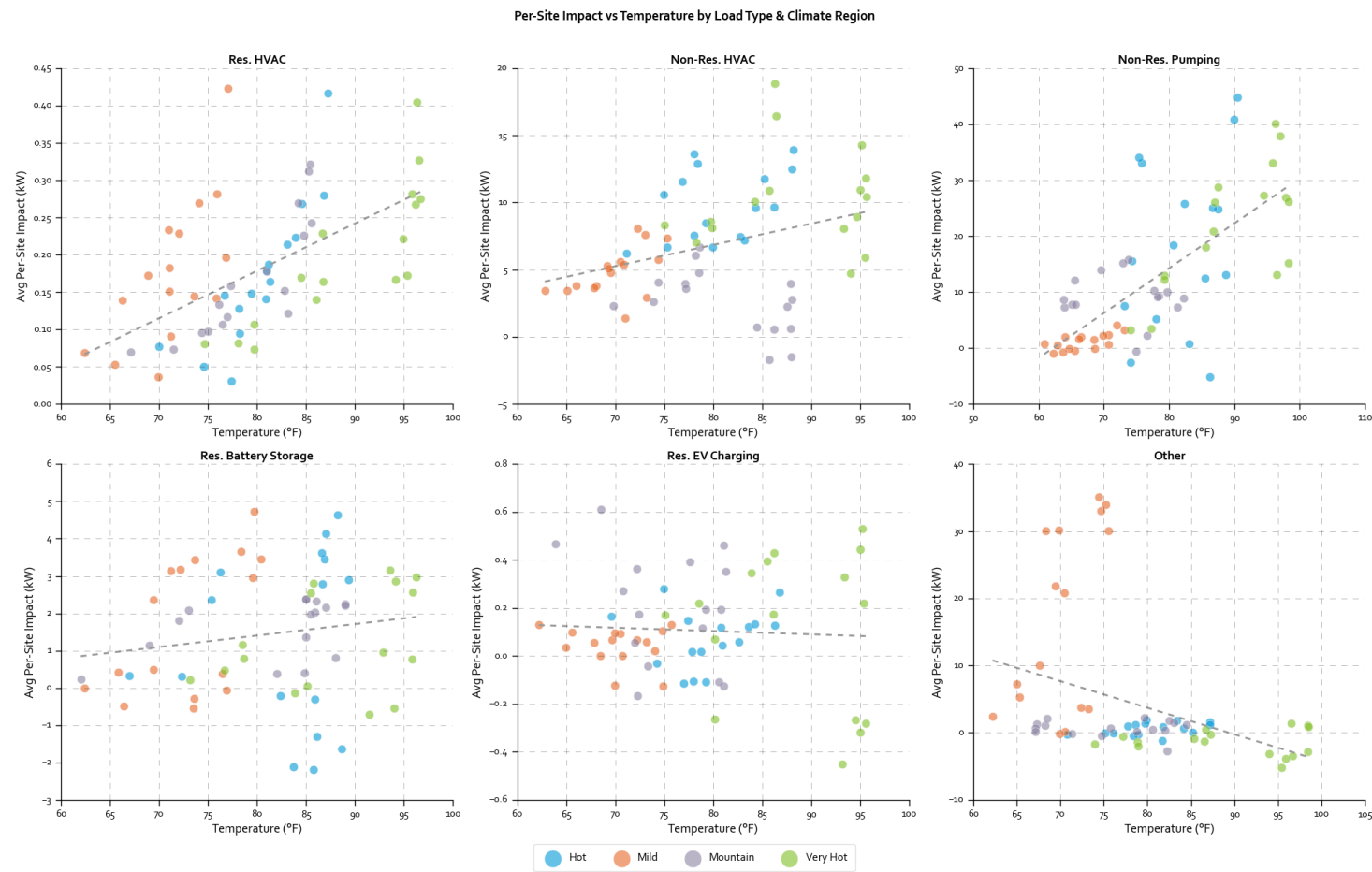
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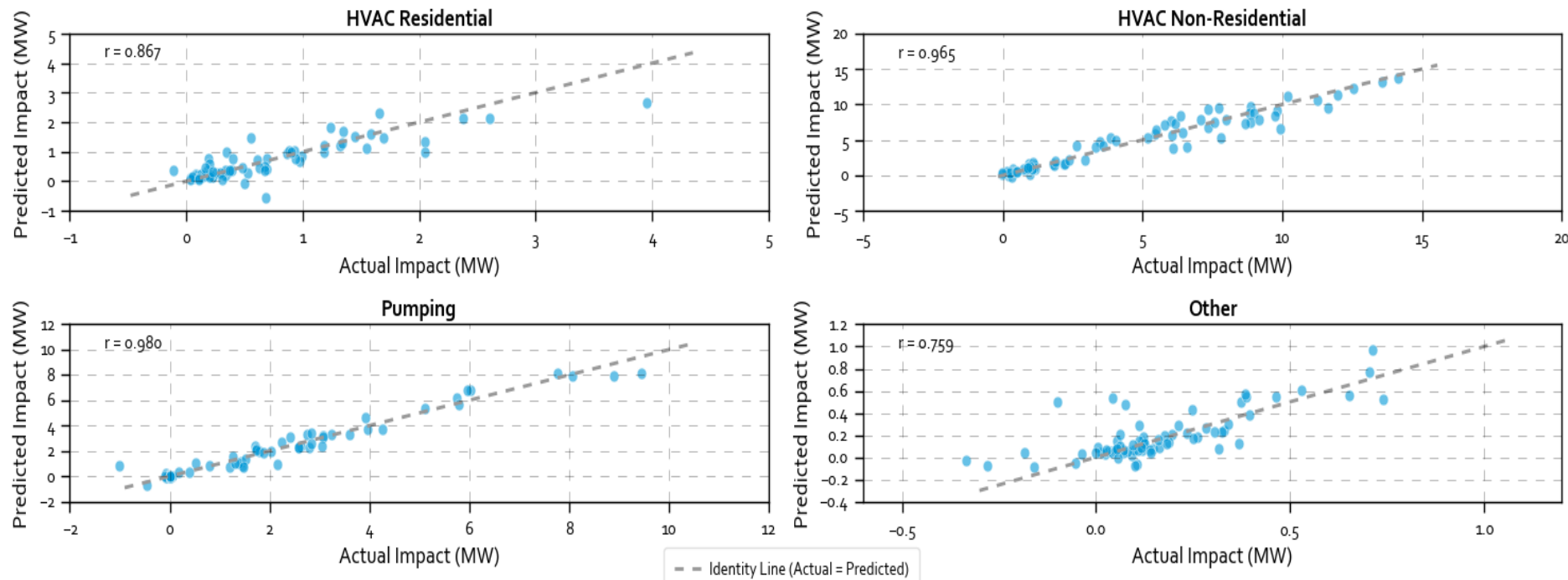


Each point represents a climate-region-level event-hour average.

PER CUSTOMER IMPACTS VERSUS WEATHER BY LOAD TYPE

THE PREDICTIVE MODEL WAS BASED ON EX POST IMPACTS AND WAS HIGHLY PREDICTIVE

Ex-Ante Model Fit: Actual vs Predicted Impact by End Use



Each point represents a utility-level event-hour

- Panel model models estimated impacts as a function of weather, hour of day, event duration
- Predictive models were produced by:
 - Load type
 - Customer size
 - Utility
 - Climate region

THE EX-ANTE MODELING FOR BATTERIES DIFFERED AND FOCUSED ON CHANGE IN BATTERY STATE OF CHARGE

Key issue:

The dispatch of the energy stored in batteries differs if it is spread over 2 or 4 hours

What was done:

- Estimate the battery state of charge on event and non-event days

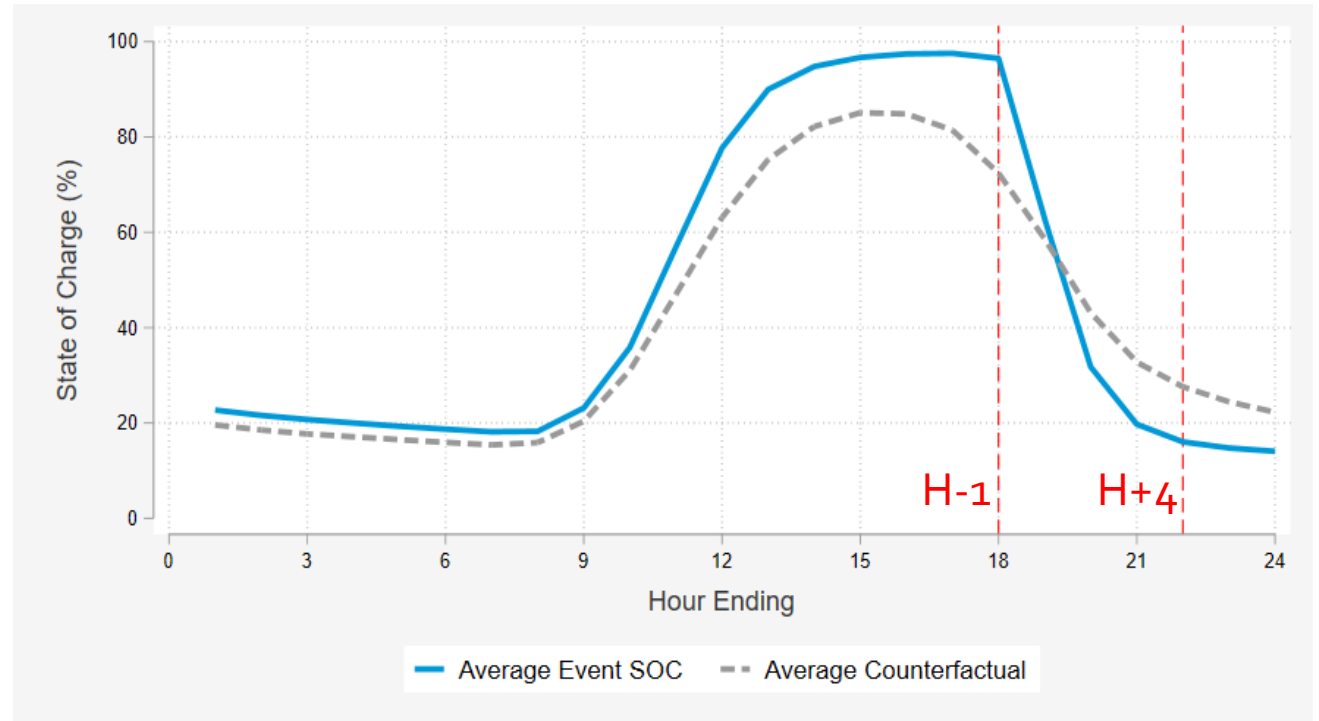
$$SOC\ Impact = (SOC_{h-1,event} - SOC_{h+4,event}) - (SOC_{h-1,nonevent} - SOC_{h+4,nonevent})$$

- Spread incremental battery resource over 4 hour period in RA window

How do batteries provide incremental resources?

- Ensure the battery is a near full state of charge at start of event
- Draw the battery down further. Typical batteries have 40% reserve for backup power. During event batteries are drawn down to 15%-20% state of charge.
- Export to the grid. Most batteries just offset whole home loads.
- Deliver the resource on hours most needed by the grid

Example average SOC versus Modeled SOC for Events starting at 6:00 PM



2027 LOAD REDUCTION CAPABILITY UNDER SLICE-OF-DAY FRAMEWORK

Units: MW

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-0.11	-0.09	-0.07	0.04	0.09	0.22	0.15	-0.15	0.07	0.22	-0.02	-0.12
2	-0.30	-0.27	-0.25	-0.13	-0.15	0.14	0.14	-0.16	0.02	0.13	-0.22	-0.34
3	0.02	0.02	0.02	-0.06	-0.15	0.10	0.16	-0.12	0.08	0.09	-0.05	0.03
4	0.02	0.02	0.02	-0.05	-0.16	0.02	-0.07	-0.07	-0.01	0.15	-0.02	0.02
5	0.01	0.01	0.01	-0.03	-0.14	0.01	-0.02	-0.09	0.03	0.16	-0.02	0.02
6	0.05	0.04	0.04	0.00	-0.06	0.03	-0.16	-0.12	0.01	0.16	0.03	0.05
7	-0.54	-0.47	-0.43	-0.07	0.03	0.03	-0.32	-0.08	0.04	0.09	-0.29	-0.60
8	0.20	0.18	0.16	0.06	0.05	0.17	-0.95	-0.85	-0.45	0.06	0.13	0.23
9	-0.57	-0.52	-0.46	-0.13	-0.08	-0.02	-1.76	-1.12	-1.29	0.78	-0.35	-0.65
10	-1.28	-1.13	-0.99	-0.28	-0.17	-0.69	-2.25	-1.87	-2.47	0.73	-0.75	-1.41
11	-0.45	-0.45	-0.44	-0.34	-0.42	-1.47	-1.00	-2.00	-3.18	-0.20	-0.52	-0.53
12	-0.36	-0.36	-0.36	-0.54	-1.20	-1.36	-0.56	-0.36	-1.33	0.49	-0.55	-0.42
13	-0.28	-0.28	-0.28	-0.38	-0.64	-1.38	0.99	1.23	0.12	0.40	-0.42	-0.32
14	-0.33	-0.33	-0.33	-0.41	-0.57	-1.10	0.77	1.15	0.81	-0.36	-0.46	-0.39
15	-0.14	-0.14	-0.14	-0.20	-0.26	-0.60	0.42	0.63	0.30	-1.46	-0.22	-0.16
16	0.01	0.02	0.06	-0.19	-0.25	-1.15	-1.62	-1.21	-0.95	-2.83	-0.11	-0.08
17	-2.33	-2.08	-1.50	-4.34	-6.30	-15.09	-15.33	-16.04	-14.49	-14.95	-3.74	-4.01
18	28.51	26.24	25.47	43.31	62.17	91.90	94.58	101.04	103.73	98.67	46.46	37.73
19	28.00	26.08	26.32	41.14	57.50	78.29	82.13	86.46	87.11	82.21	41.60	35.64
20	22.12	21.03	21.89	31.45	42.77	54.96	58.04	60.17	61.33	59.24	30.69	27.55
21	19.80	19.24	20.18	26.52	36.56	44.41	47.35	49.19	50.80	49.72	26.50	24.78
22	-0.98	-0.92	-0.85	-1.55	-2.35	-2.56	-2.25	-3.96	-3.27	-5.41	-1.49	-1.39
23	-0.88	-0.88	-0.87	-1.13	-1.73	-2.57	-2.42	-1.95	-1.52	-3.24	-1.20	-1.11
24	-0.72	-0.72	-0.70	-0.90	-1.37	-2.05	-1.93	-1.53	-1.36	-2.61	-0.96	-0.92

Demand reductions are positive (Blue)

Load increases are negative (Orange)

COMPARISON OF EX-POST AND EX-ANTE

Main Portfolio

Day Type	# Dispatched	Avg Daily Temp (°F)	Avg Cust Ref (kW)	% Impact	Avg Cust Impact (kW)	Agg Impact (MW)
Ex-Post: 8/26/2025 (4:00 PM-8:00 PM)	20,533	81.8	10.07	16.1	1.62	33.29
Ex-Ante: Adjusted for planning conditions	20,533	83.8	12.84	15.2	1.95	39.40

DSGS (battery storage)

Day Type	# Dispatched	Avg Daily Temp (°F)	Avg Cust Ref (kW)	% Impact	Avg Cust Impact (kW)	Agg Impact (MW)
Ex-Post: 8/29/2025 (DSGS)*	3,132	86.5	-1.37	90.1	1.24	3.87
Ex-Ante: Adjusted for planning conditions	3,132	88.6	-1.05	59.3	0.62	1.95

*DSGS Event was for a 1-hour event from 7:00 PM – 8:00 PM contrasting with the 4-hour impact over a 5:00 – 9:00 PM window for ex-ante estimates

- Comparison holds population constant, adjusts for weather differences and dispatch period differences
- Main portfolio impacts are larger under planning conditions. 2025 was substantially cooler.
- Battery per site impacts are lower because a 4-hour dispatch was modeled
- The 8/29 event shown for DSGS is mid-season
 - Impacts would be higher later in the season (i.e., Sep/Oct)

KEY FINDINGS AND TAKEAWAYS

KEY FINDINGS

1

Leap resources actively enrolled in October 2025, delivered 44.9 MW for the average event hour in 2025.

2

The average site was dispatched for 28 event hours (for sites enrolled by September 1, 2025), and most sites experienced four-hour events

3

Resources were actively bid in CAISO markets, with the exception of residential battery storage, which participated in the DSGS program.

4

Ex-ante per customer impacts were consistent with ex-post load impacts after adjusting for weather conditions.

5

2025 event conditions were cooler than planning condition

6

Residential batteries in the Leap portfolio grew from under 1,000 in May 2025 to over 8,000 by October 2025. The batteries delivered resources over and above typical behavior under NBT.

7

Segmented ex-post results show that impacts are generally consistent across the portfolio, with higher reductions from larger systems and hotter regions

8

Leap is requesting between 74.22 to 89.06 MW of Net Qualifying Capacity for 2027, due to growth in battery storage and HVAC sectors.

QUESTIONS?



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