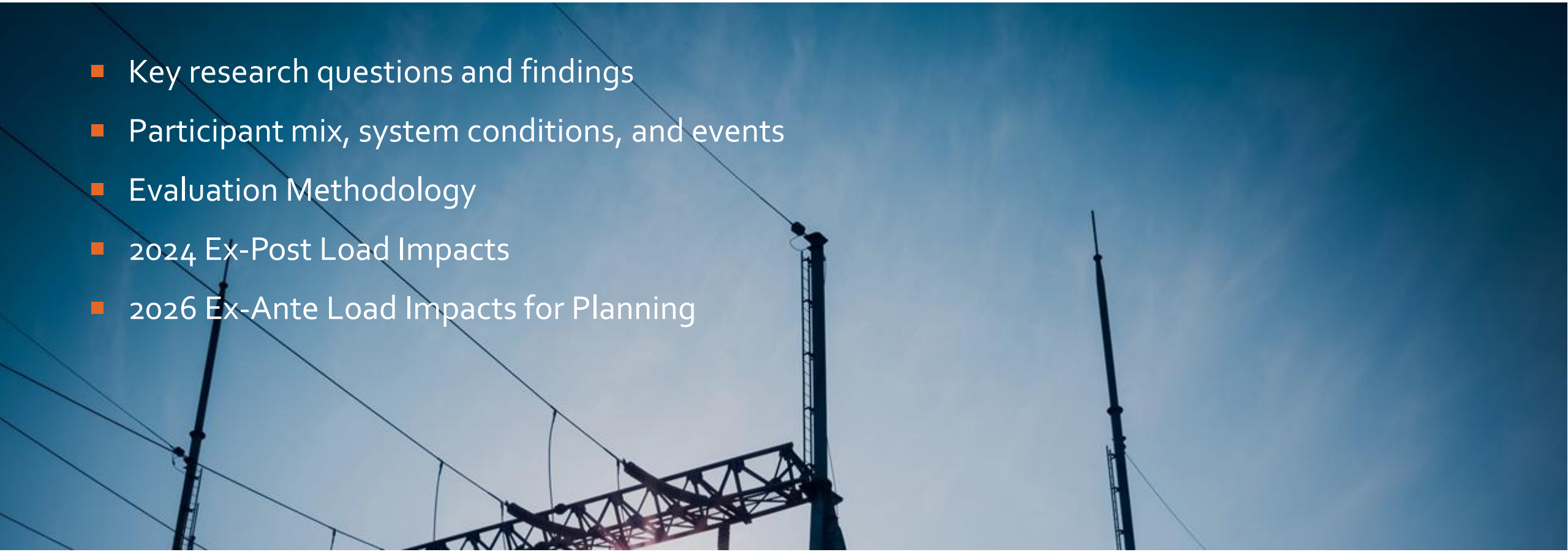
LOAD IMPACT EVALUATION OF ENERSPONSE CALIFORNIA DR RESOURCES

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

2025 DRMEC LIP WORKSHOP

MAY 14, 2025

PRESENTATION OVERVIEW



- Key research questions and findings
- Participant mix, system conditions, and events
- Evaluation Methodology
- 2024 Ex-Post Load Impacts
- 2026 Ex-Ante Load Impacts for Planning

Enersponse 2024 Key Facts

Demand Response Performance Metrics

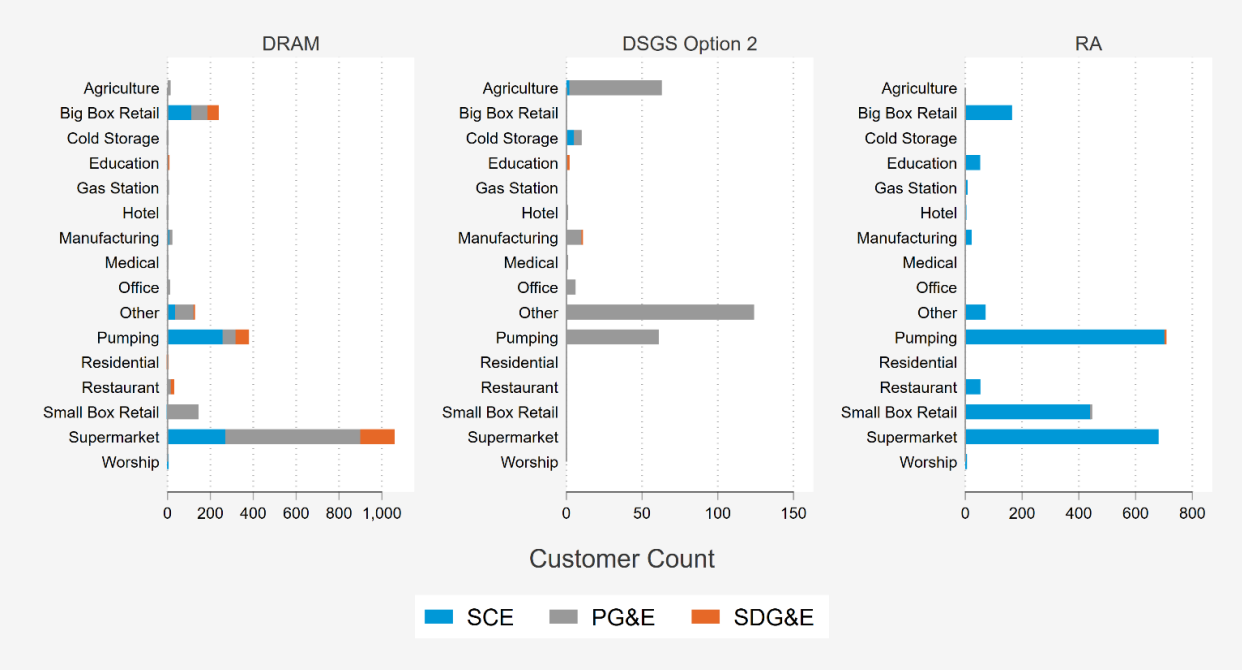
Customers **3,811**	Reference Load **308 MW**	Average Load Reduction (Ex-post) **34.3 MW**
2024 Full Resource Dispatch Days **None**	2024 Load Impacts for Planning Conditions (Ex-ante) **32.8 MW**	Awarded NQC Oct 2023-Jun 2024 **30 MW**
Awarded NQC Jul 2024-Sep 2024 **40 MW**	NQC Awarded for 2025 **10 MW**	NQC Requested for PY 2026 **39.8 MW**

Note: NQC = Net Qualifying Capacity, PY = Program Year, Ex-post = Historical Analysis, Ex-ante = Forecast Analysis

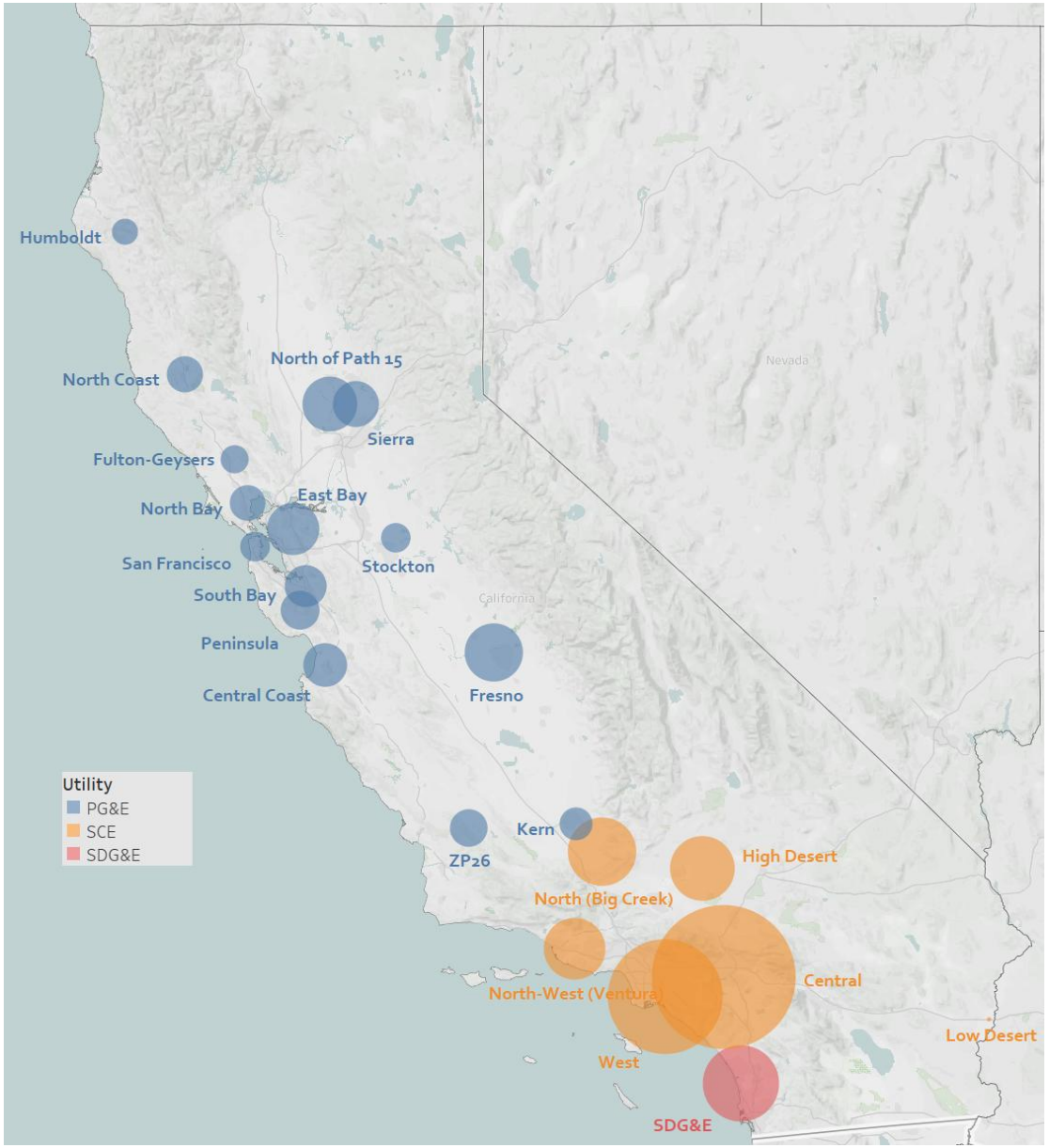
- Resources participated via either:
  - ✓ DRAM
  - ✓ Resource Adequacy contracts
  - ✓ DSGS
- Resources were dispatched locally by CAISO:
  - ✓ 43 unique event windows
  - ✓ At no point did CAISO dispatch the full Enersponse resources
  - ✓ CAISO dispatched the largest share of August 27, 2024, which was a top 10 load day for CAISO or any of the California utilities.

PARTICIPANT MIX, EVENTS, AND SYSTEM CONDITIONS

MIX OF PARTICIPANTS



- Over 50% of the demand response capability is concentrated among Ag & Pumping customers
- While supermarkets account for over 50% of sites, they deliver only 10% of the demand reduction capability
- The largest concentration of customers were in SCE's service territory, followed by PG&E



**Bubble size reflects the number of sites located in the highlighted area*

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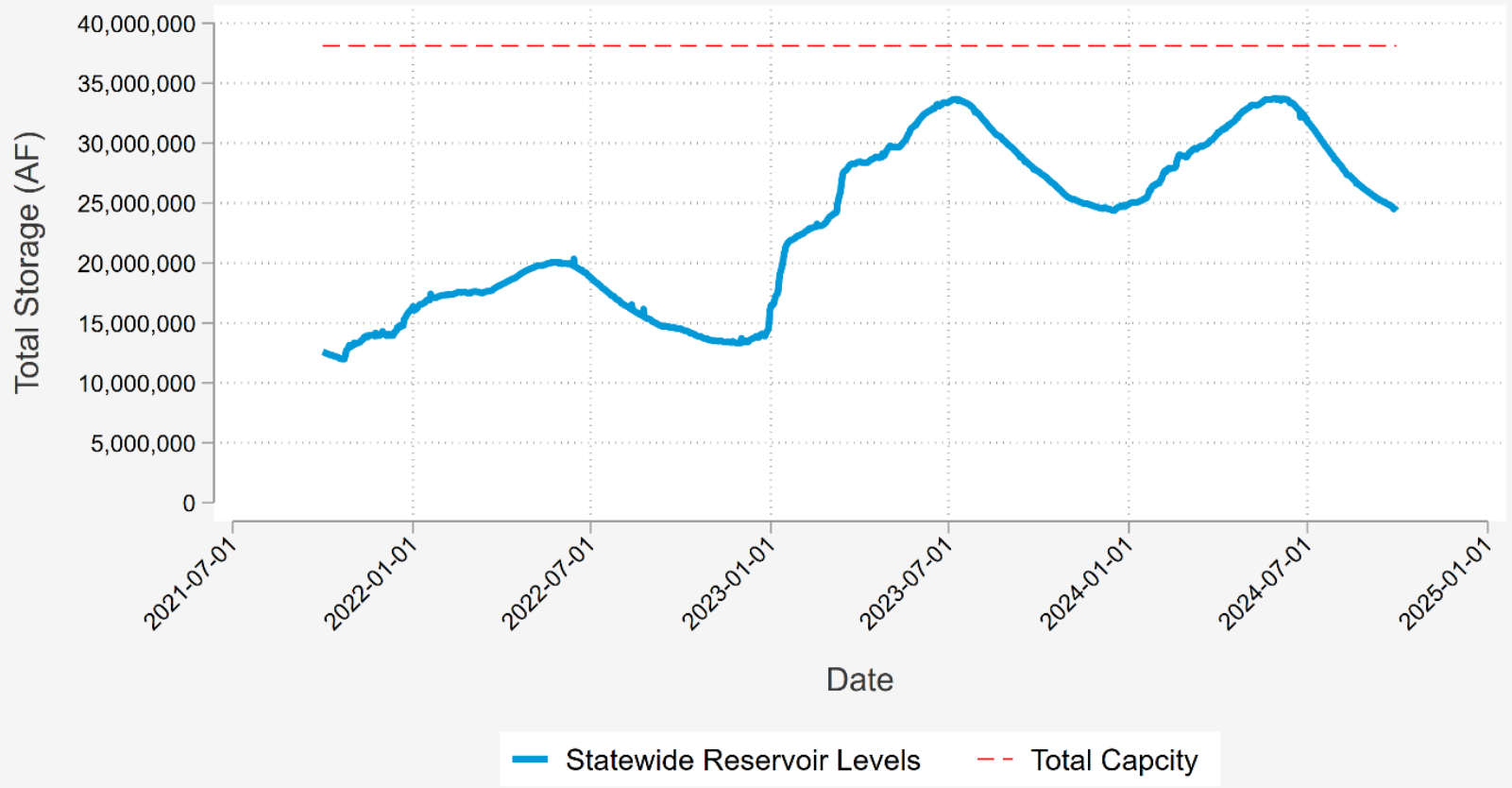
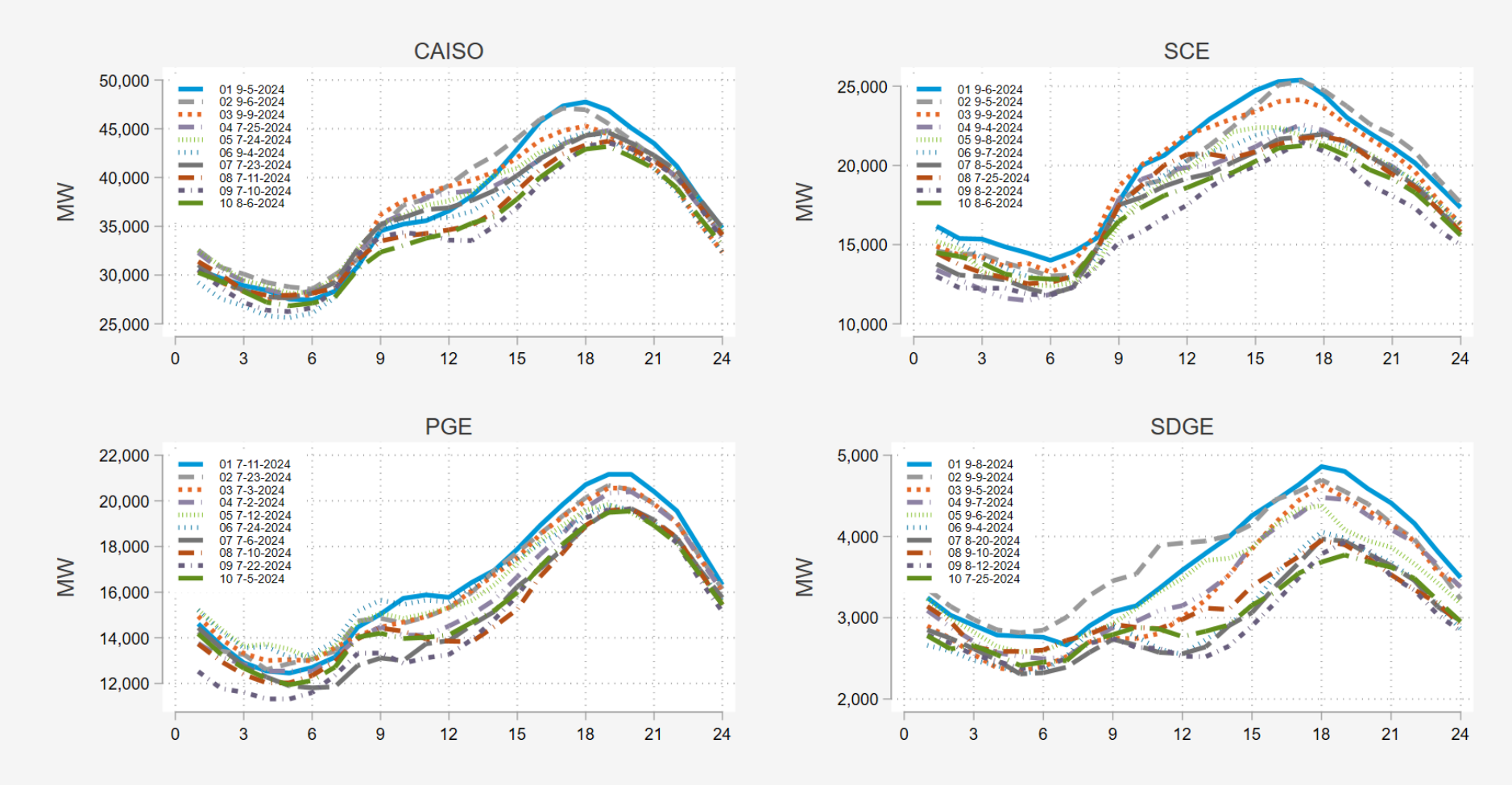
WATER RESERVOIR REMAINED RELATIVELY HIGH IN 2024



WHY THIS MATTERS

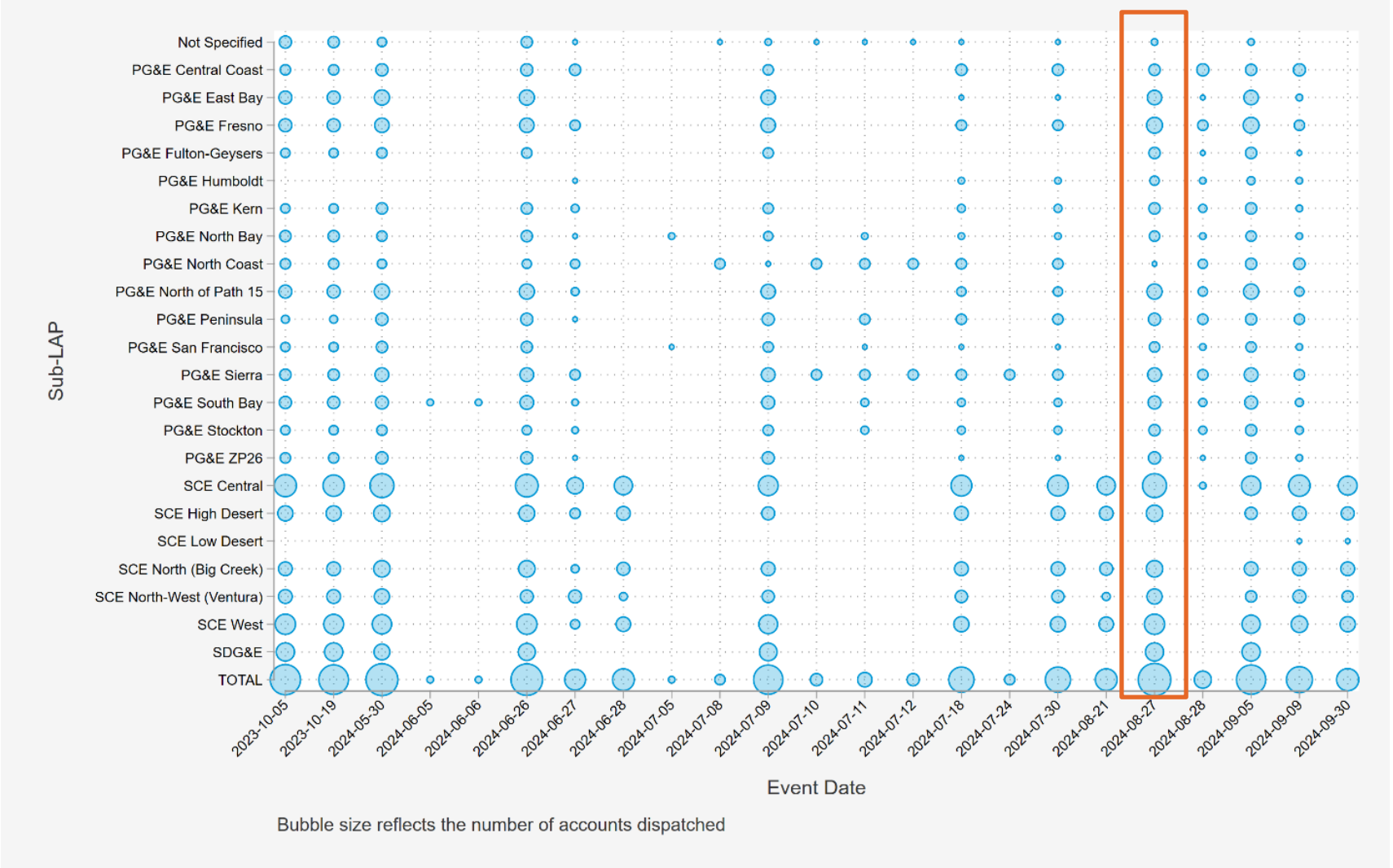
- Pump loads are correlated to water reservoir levels.
- Lower water reservoir levels lead to higher pump loads.
- Lower water reservoir levels increase the risk of resource shortages.
- Higher pump loads result in greater demand reductions.

SYSTEM CONDITIONS IN 2024



- Northern and Southern California experienced heat waves at different times
  - Northern California – 3 heat waves, mainly in June and July
  - Southern California – One long heat wave in early September
- No CAISO emergency or system-wide events
- Overall, CAISO loads were moderate
- SDG&E experienced an all-time peak on a Sunday (Sep 8th)

IN THE PY2024 SEASON, THERE WAS SIGNIFICANT VARIATION IN EVENT DISPATCH IN TERMS OF BOTH EVENT HOURS AND GEOGRAPHIC LOCATION

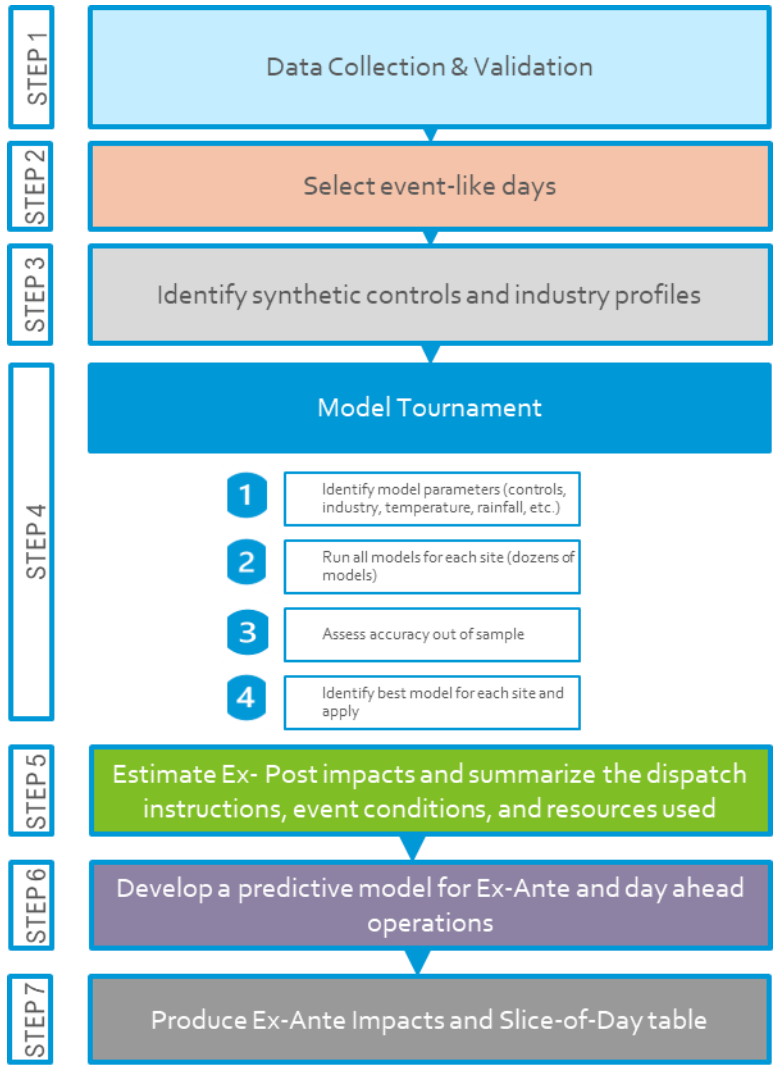


- Each individual site was dispatched by CAISO between 2 and 14 times.
- Many events called on the same day had different start and start times depending on the location and program.
- 43 unique event windows.
- At no point did CAISO dispatch the full Enersponse resources.
- CAISO dispatched the largest share of August 27, 2024:
  - ✓ DSGS resources were not dispatched at all
  - ✓ 2,639 sites dispatched (out of 3,800)
  - ✓ Not a top 10 load day for CAISO or any of the California utilities.

METHODOLOGY

METHODOLOGY OVERVIEW

Methodology Component	Description
Population or sample analyzed	The analysis considers the full population of participants active on the event days. 3,919 of 4,131 total participants had complete interval data. The population analyzed only includes these customers.
Data included in the analysis	The analysis utilized utility AMI data, CalMAC temperature data, California Data Exchange Center (CDEC) water data, and Enersponse provided customer characteristics and event information
Evaluation technique	Individual customer regressions
Model selection	Each individual participant was assigned a model identified based on out-of-sample metrics for bias and fit. The process relies on identifying proxy days to be used for out-of-sample testing. The models were developed using the training data and applied, out-of-sample, to the testing data using a cross-validation approach. For each model specified, we produce standard metrics for bias and goodness of fit. The best model is identified by narrowing the candidate models to the three with the least bias (% Bias) and then selecting the model with the highest precision (Relative RMSE).
Segmentation of impact results	The results were segmented by: ▪ Program ▪ Local Capacity Area ▪ Sub-LAP ▪ Sector ▪ Utility



KEY EXTERNAL DATA SOURCES

CALMAC

Weather data from 127 stations across California

Temperature data used in predictive modeling

Each site was matched to weather stations based on climate zone and distance

CDEC

Water supply, precipitation, and solar radiation data

Key variables: reservoir levels and solar irradiance

DYNAMIC LOAD PROFILES

Electricity use patterns by time, weather, and customer type

Each service account matched to appropriate load profile

PG&E SDGE SCE

A KEY GOAL WAS TO IDENTIFY WHAT VARIABLES ARE THE MOST PREDICTIVE FOR EACH SECTOR

Pumping: Demand decreases as rainfall and water levels rise.

Supermarkets & Retail: Strong correlations with temperature and DLPs

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TRAINING AND TESTING THE MODELS

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%.

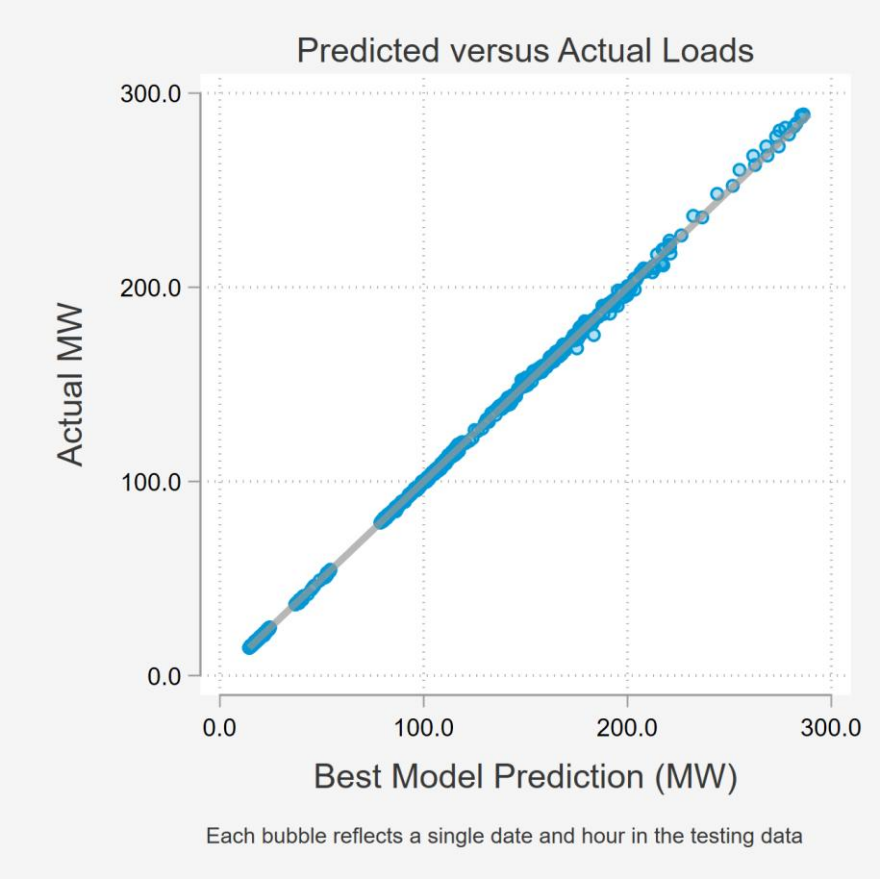
The final model was selected based on the lowest RRMSE.

THE BEST MODEL FOR EACH SITE PRODUCED THE BEST RESULTS

Portfolio (Aggregate) Performance for Each Model:

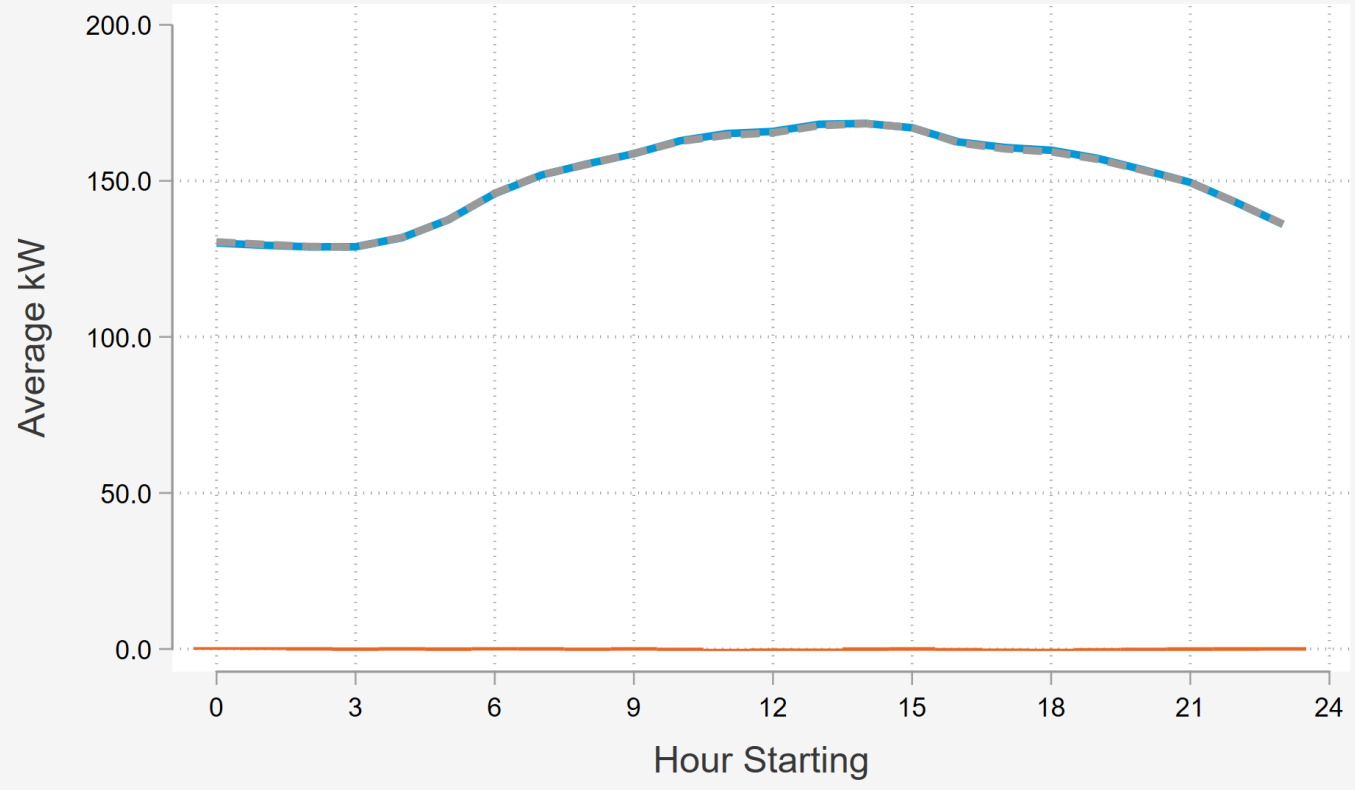
Model Number	Average Observed (kWh)	Average Predcited (kWh)	Average Error	RMSE	RRMSE	Absolute % Bias	R Squared
Best Model	106,659	106,629	-29.28	1,311.23	1.23%	0.03%	99.961%
1	106,659	106,963	304.81	4,245.60	3.98%	0.29%	99.594%
2	106,659	106,666	7.34	1,437.60	1.35%	0.01%	99.953%
3	106,659	106,666	7.74	1,446.05	1.36%	0.01%	99.953%
4	106,659	106,654	-4.44	1,407.14	1.32%	0.00%	99.955%
5	106,659	106,640	-18.60	1,403.98	1.32%	0.02%	99.956%
6	106,659	107,136	477.71	4,491.89	4.21%	0.45%	99.545%
7	106,659	106,640	-18.98	1,560.98	1.46%	0.02%	99.945%
8	106,659	106,640	-18.70	1,569.30	1.47%	0.02%	99.944%
9	106,659	106,621	-37.65	1,539.12	1.44%	0.04%	99.947%
10	106,659	106,605	-53.40	1,524.81	1.43%	0.05%	99.948%
11	106,659	106,994	335.62	4,003.05	3.75%	0.31%	99.639%
12	106,659	106,611	-47.96	1,329.35	1.25%	0.04%	99.960%
13	106,659	106,611	-47.36	1,311.73	1.23%	0.04%	99.961%
14	106,659	106,590	-69.13	1,335.24	1.25%	0.06%	99.960%
15	106,659	106,582	-76.61	1,319.50	1.24%	0.07%	99.961%
16	106,659	99,970	-6,688.21	10,550.75	9.89%	6.27%	97.491%

*Excludes models that failed to run for most customer

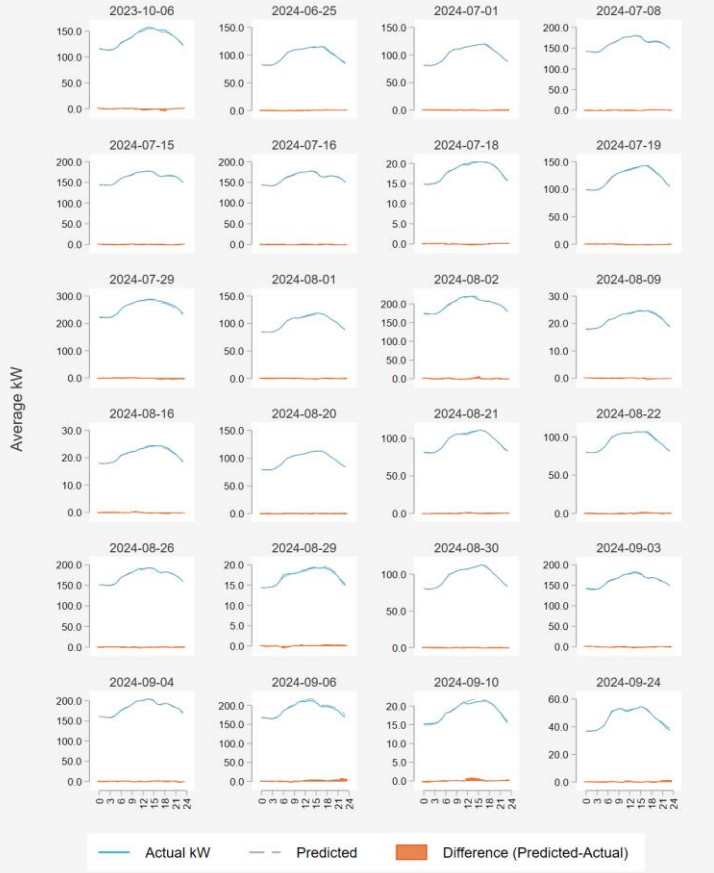


THE OUT OUT-SAMPLE-HOURLY PREDICTIONS WERE ACCURATE

Average Proxy Event Day



Individual Proxy Event Days



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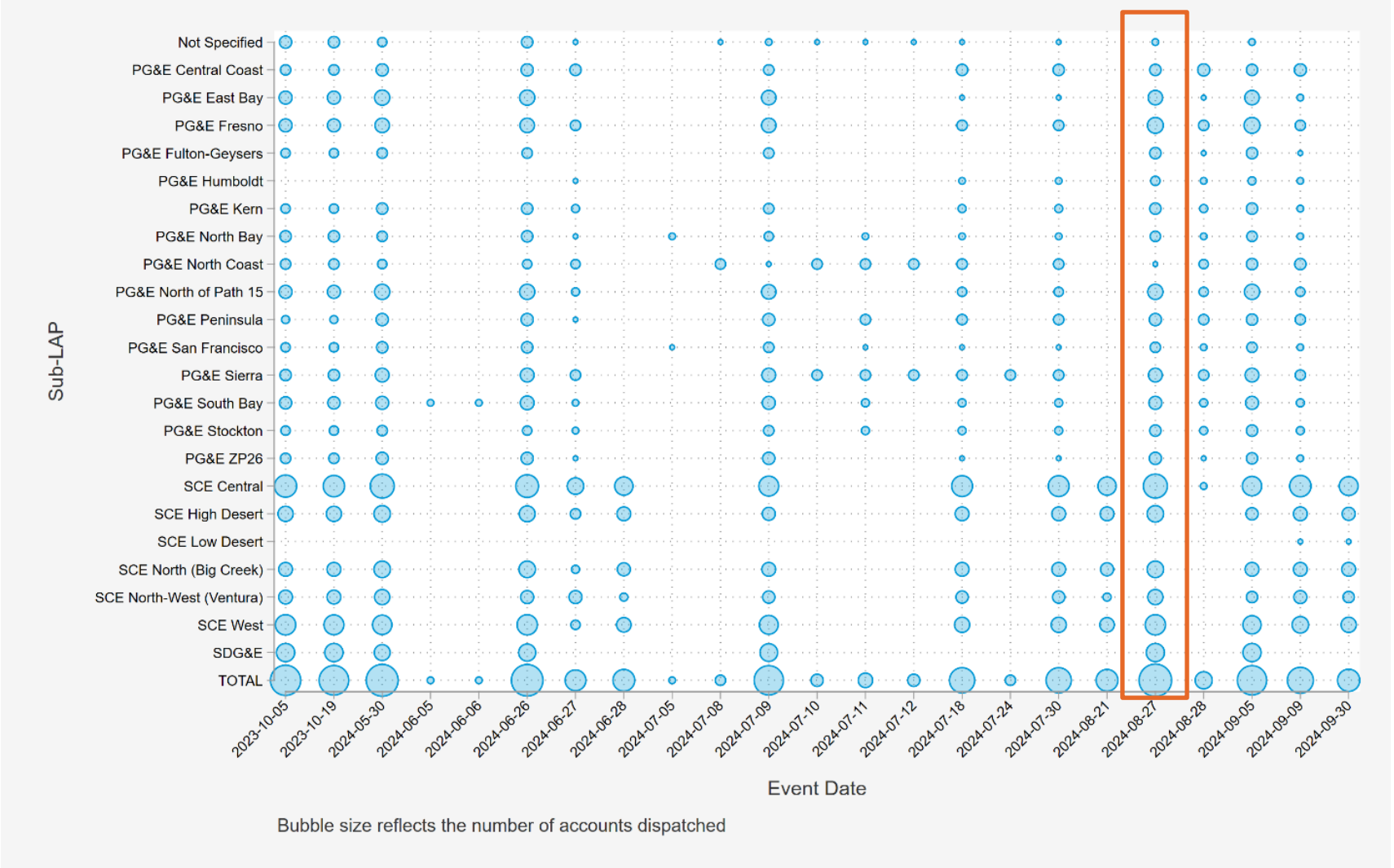
EVENT DAY LOAD IMPACTS

REMINDER: CAISO DID NOT DISPATCH THE FULL ENERSPONSE RESOURCES AT ANY POINT IN PY 2024



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- CAISO dispatched the largest share of August 27, 2024:
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AVERAGE EVENT HOUR IMPACTS

Key issue:

Not all resources were dispatched all at once

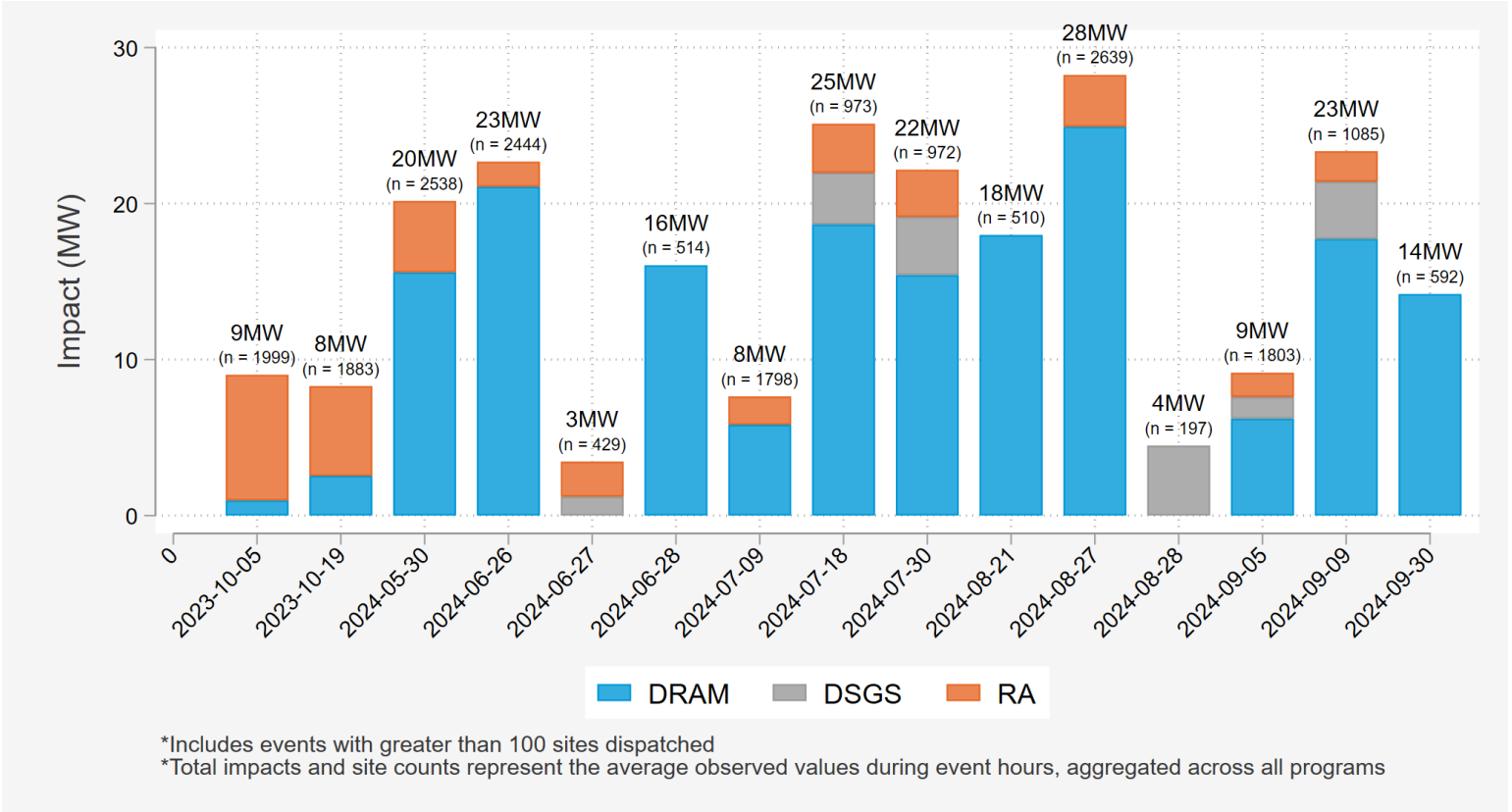
What was done:

- 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

Utility	Sub-LAP	Site Counts	Average Event Temperature (°F)	Per-Site Reference Load (kW)	% Impact	Per-Site Impact (kW)	Aggregate Impact (MW)
PG&E	PG&E Central Coast	95	69.3	85.1	36.5%	31.10	2.95
	PG&E East Bay	139	84.4	94.7	6.3%	5.94	0.83
	PG&E Fresno	173	98.6	67.8	2.8%	1.90	0.33
	PG&E Kern	55	97.5	60.5	6.0%	3.65	0.20
	PG&E North Bay	65	83.9	78.5	7.5%	5.89	0.38
	PG&E North Coast	66	72.7	18.3	-2.5%	-0.46	-0.03
	PG&E North of Path 15	151	94.1	98.3	5.4%	5.31	0.80
	PG&E Peninsula	77	76.6	84.9	5.9%	4.98	0.38
	PG&E San Francisco	46	70.6	176.4	3.4%	6.02	0.28
	PG&E Sierra	109	94.4	80.6	7.0%	5.62	0.61
	PG&E South Bay	88	83.0	99.2	4.6%	4.61	0.41
	PG&E ZP26	55	84.5	85.2	1.6%	1.40	0.08
SCE	SCE Central	988	92.5	91.1	22.0%	20.04	19.80
	SCE High Desert	199	93.8	44.4	10.0%	4.46	0.89
	SCE Low Desert	1	107.2	0.0	0.0%	0.00	0.00
	SCE North (Big Creek)	218	93.2	86.0	13.1%	11.23	2.45
	SCE North-West (Ventura)	184	77.5	63.7	4.1%	2.60	0.48
	SCE West	620	77.0	74.3	3.3%	2.44	1.52
SDG&E	SDG&E	298	78.4	56.2	6.2%	3.48	1.04
Other (Combined for confidentiality)		184	48.6	114.6	4.5%	5.1	0.94
TOTAL		**3,811**	**84.3**	**80.7**	**11.2%**	**9.01**	**34.33**

RESULTS BY EVENT

- The figure to the right shows the average hourly impacts for each event, aggregated by program
- Each program and event day includes a diverse mix of sectors and geographic locations (sub-LAPs)
- The report and tables provide a more detailed breakdown of these results



*Includes events with greater than 100 sites dispatched
*Total impacts and site counts represent the average observed values during event hours, aggregated across all programs

LOAD IMPACTS ON DAY WHEN MOST, BUT NOT ALL, RESOURCES WERE DISPATCHED (AUG 27)

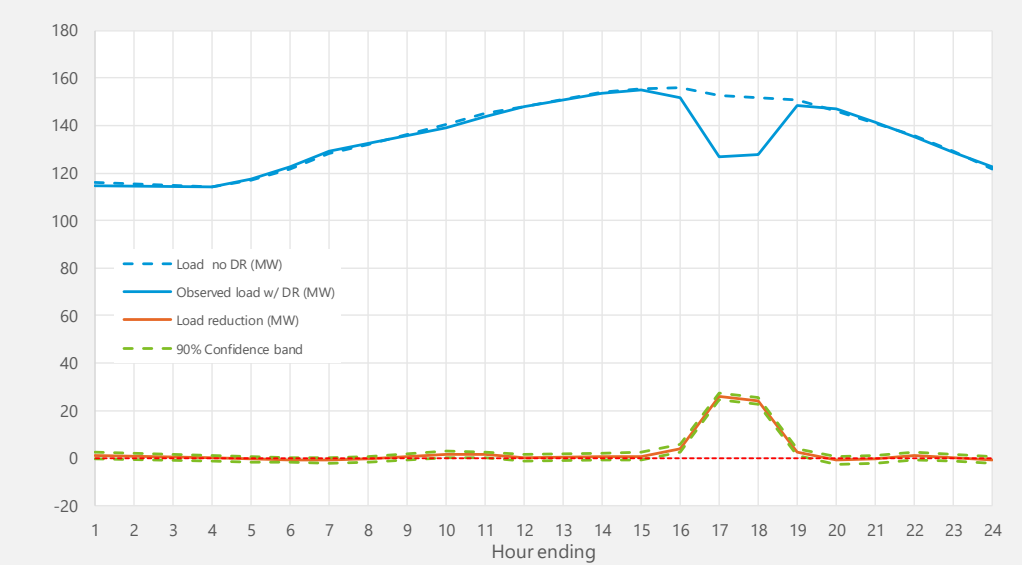
DRAM

Table 1: Menu options

Type of results	Aggregate
Program	DRAM
Event date and Time	08/27/2024 16:00 to 18:00
Hour Ending View	Prevailing Time

Table 2: Event Day Summary

Accounts Included in Estimation	1,576
Accounts Dispatched	1,577
% of Resources Dispatched	98%
Avg MW load reduction (Event Window)	24.94
% Load reduction (Event Window)	16.4%



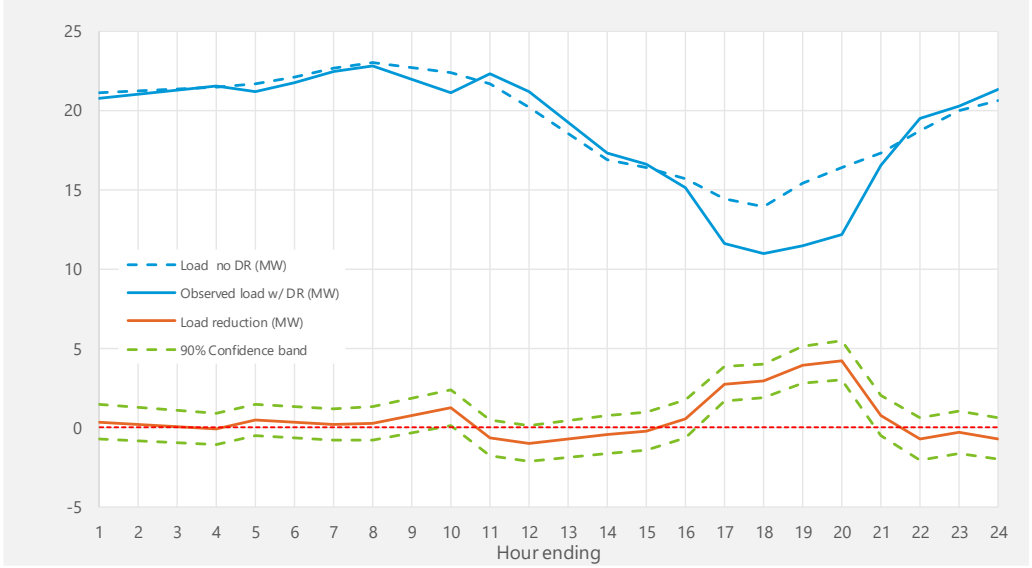
Resource Adequacy

Table 1: Menu options

Type of results	Aggregate
Program	RA
Event date and Time	08/27/2024 16:00 to 19:00
Hour Ending View	Prevailing Time

Table 2: Event Day Summary

Accounts Included in Estimation	847
Accounts Dispatched	849
% of Resources Dispatched	70%
Avg MW load reduction (Event Window)	3.23
% Load reduction (Event Window)	22.1%



DSGS resources were not dispatched

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AUGUST 27TH LOAD IMPACTS BY SECTOR

Program	Event Window	Sector	Sites Dispatched	Reference load (MW)	Load reduction (MW)	% Load reduction	Avg temp (F, site weighted)
DRAM	16:00 - 18:00	Other	152	15.88	0.88	5.5%	88.0
		Pumping & Agg.	309	18.32	13.61	74.3%	88.1
		Retail	351	27.43	2.26	8.2%	88.9
		Supermarkets	765	90.62	8.19	9.0%	87.2
RA	16:00 to 19:00	Pumping & Agg.	268	13.42	3.19	23.7%	85.7
	16:00 to 20:00	Pumping & Agg.	208	8.17	0.74	9.0%	83.1
		Retail	242	12.10	0.04	0.4%	83.2
		Supermarkets	303	8.88	0.07	0.8%	81.6
TOTAL			**2,598**	**194.81**	**28.97**	**14.9%**	**86.1**

- Three distinct event windows
- The distribution of load reductions is different than the distribution of sites

EX ANTE RESULTS FOR PLANNING AND OPERATIONS

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 projected enrollment changes

Ex ante Impacts

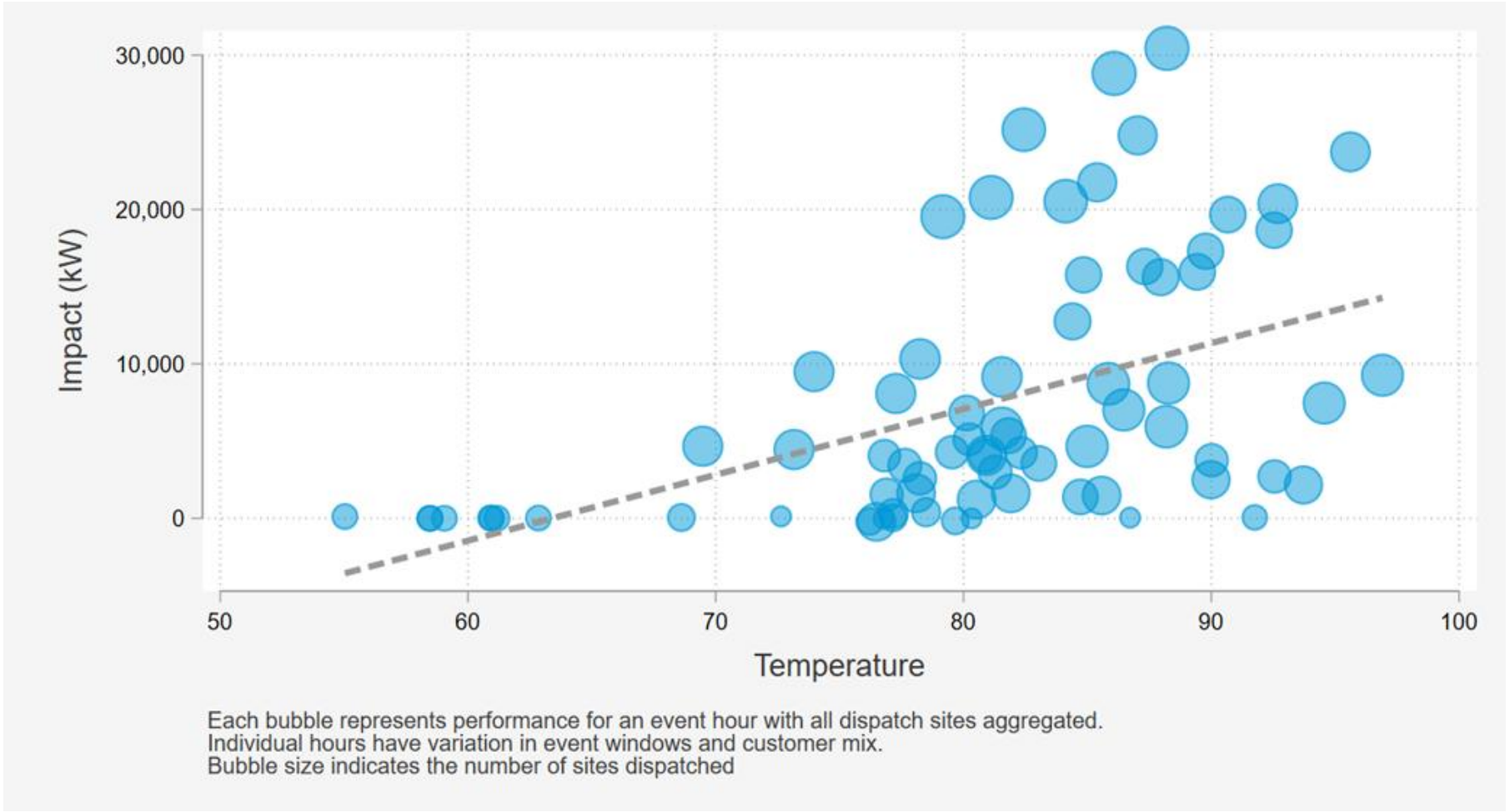
- What is the magnitude of program resources available under planning conditions defined by weather?
- Utility and CAISO weather conditions
- Produced for the system load worst day for each month
- Slice-of-Day table for resource adequacy

EX-ANTE ANALYSIS OVERVIEW

Methodology Component	Description
Historical Performance Used	PY2024 Ex-Post impacts and consumption data
Process for producing reference loads	Key steps included: ▪ Aggregate data to combinations of sub-LAP and sector groupings ▪ Estimate the relationship between non-event day consumption and temperature using a temperature spline model, absorbing individual customer fixed-effects ▪ Predict reference loads for ex-ante conditions
Process for producing ex-ante impacts	Key steps included: ▪ Identify candidate models to be used for making ex-ante predictions ▪ Run panel regression with fixed effects. Separate models by subLAP and industry sector ▪ Use cross-validation training and testing methodologies to estimate the out-of-sample performance of each model ▪ Predict impacts for ex-ante conditions
Accounting for enrollment growth	The estimates for future years assume 10% annual growth in resources until 2031, with a 3% growth rate thereafter. Rather than project large amount of growth, Enersponse has recently adopted a practice of grounding ex-ante impacts on resources it currently controls and forecasting very modest year-on-year growth. As result, the projections are lower than in prior evaluation reports.

IDENTIFYING THE RELATIONSHIP BETWEEN EX-POST IMPACTS AND TEMPERATURE

- Impacts were generally correlated with higher temperatures
- The exact pattern is difficult to see in raw data due to differences in the number and mix of resources dispatched on each event



EX-ANTE IMPACT MODEL PERFORMANCE

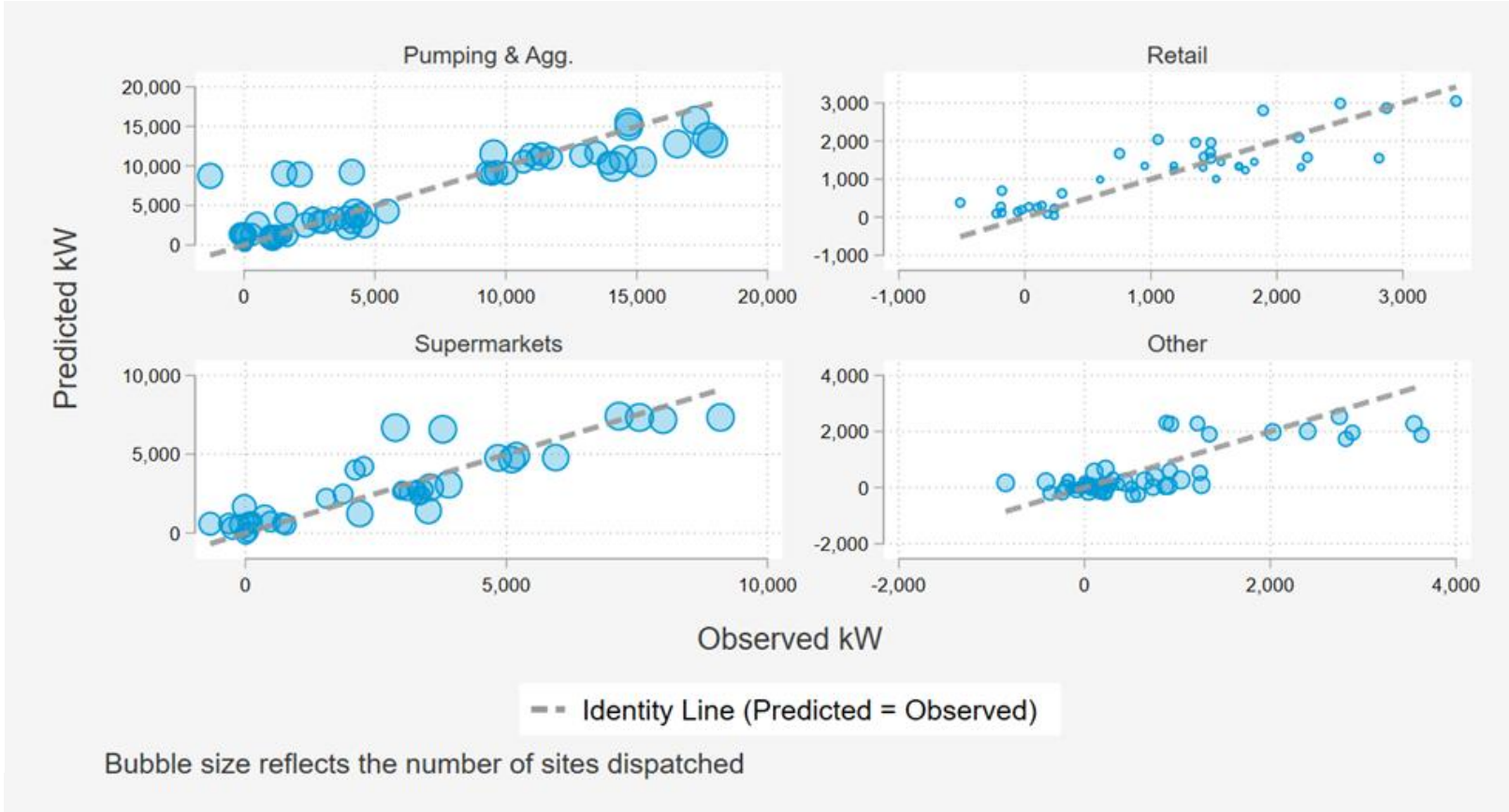
- The model performs well in aggregate (for the portfolio)

Ex-ante Model Performance Key Metrics

Proportion of variance explained by model
Higher is better (closer to 1.0)

Tendency to over or under predict
Closer to 0% is better

** All metrics were calculated out-of-sample*



FORECASTED LOAD REDUCTION CAPABILITY

(AUGUST WORST DAY / MONTHLY PEAK DAY)

Forecast Year	SCE 1-in-2	PG&E 1-in-2	SDG&E 1-in-2	Total
2024 (Base)	23.69	7.58	1.53	32.80
2025	26.06	8.34	1.69	36.09
2026 (NQC request)	28.66	9.17	1.86	39.70
2027	31.53	10.09	2.04	43.66
2028	34.68	11.10	2.24	48.03
2029	38.15	12.21	2.47	52.83
2030	41.97	13.43	2.72	58.12
2031	46.16	14.77	2.99	63.93
2032	47.55	15.22	3.08	65.85
2033	48.97	15.67	3.17	67.82
2034	50.44	16.14	3.27	69.86
2035	51.96	16.63	3.37	71.96

- 2026 NQC request is 39.70 MW
- 2025 NQC is 10 MW, substantially lower than the resources Enersponse currently controls
- The forecast assumes:
  - ✓ 10% year-on-year growth through 2031
  - ✓ 3% growth thereafter
- The projections are lower than in prior evaluation reports and grounded in resources Enersponse currently controls with modest year-on-year growth

PY 2026 SLICE-OF-DAY TABLE

Units: MW

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	-10.14	-10.47	0.00	0.00	0.00	-0.56	1.78	0.46	-0.98	-4.60	-6.28	-8.03
16	-1.64	-1.89	-9.69	-5.65	-2.39	7.67	10.39	8.18	7.60	4.12	2.40	0.57
17	21.61	21.08	-1.13	2.37	5.45	39.09	44.89	43.66	41.08	35.41	30.05	26.09
18	21.42	21.07	19.54	28.30	32.56	38.61	43.39	41.05	38.58	34.92	29.33	24.95
19	18.69	18.53	17.78	25.92	30.21	36.27	40.81	39.92	37.73	32.67	26.41	21.92
20	15.10	15.38	15.04	22.78	26.72	32.90	37.56	37.25	34.94	28.75	22.51	18.69
21	14.08	14.26	13.99	21.46	25.73	31.84	37.23	36.57	33.09	26.87	21.51	18.03
22	-2.32	-2.61	13.89	21.19	26.14	6.84	8.79	7.92	6.49	3.36	1.38	-0.39
23	-9.24	-9.82	-2.37	0.92	4.24	0.06	1.73	0.96	-0.36	-3.31	-5.50	-7.31
24	0.00	0.00	-9.98	-6.56	-3.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Demand reductions are positive (Blue)

Load increases are negative (Orange)

Summarizes the load reduction capability by month and hour for planning conditions

COMPARISONS

- The 2024 ex-ante impacts (32.8 MW)
  - ✓ Align with the ex-post impacts for the average event hour (34 MW)
  - ✓ Align with event day when most resources were dispatched (except DSGS) – 28 MW
- In aggregate the PY 2024 ex-ante impacts closely align between the 2023 and 2024 reports at a portfolio level
  - ✓ 33.5 MW (2023 report) versus 33.8 MW (2024 report)
  - ✓ Results were more variable by location than projected

Day Type	# Dispatched	Event Hour Avg Temp	Avg Cust Ref (kW)	% Impact	Avg Cust Impact (kW)	Agg Impact (MW)
Ex-Ante: 2024 August Worst Day 1-in-2 (4:00 - 9:00PM)	3,730	86.2	78.85	10.0%	8.79	32.80
Ex-Post: 8/27/2024	2,639	85.14	76.39	14.0%	10.7	28.26
Ex-Post Average Event Hour [1]	3,811	84.32	80.70	11.2%	9.01	34.33

[1] Due to variability in CAISO dispatch, the average reduction delivered over PY2024 event hours was calculated for each site, including all hours the sites was dispatched. Next, the site level impacts were aggregated to produce the load reduction for the average event hour.

Utility	Metric	2023 Report	2024 Report
PG&E	Impact (MW)	0.75	7.58
	Sites	656	1,224
	Reference Load (MW)	31.3	114.82
	% Reduction	2.40%	6.60%
SCE	Impact (MW)	32.38	23.69
	Sites	1,799	2,208
	Reference Load (MW)	255.0	189.12
	% Reduction	12.70%	12.52%
SDG&E	Impact (MW)	0.39	1.53
	Sites	166.0	298
	Reference Load (MW)	6	22.96
	% Reduction	6.30%	6.68%
Portfolio	**Impact (MW)**	**33.52**	**32.80**
	Sites	**2,621**	**3,730**
	Reference Load (MW)	**292.4**	**326.90**
	% Reduction	**11.5%**	**10.03%**

KEY FINDINGS AND TAKEAWAYS

Enersponse 2024 Key Facts

Demand Response Performance Metrics

Customers **3,811**	Reference Load **308 MW**	Average Load Reduction (Ex-post) **34.3 MW**
2024 Full Resource Dispatch Days **None**	2024 Load Impacts for Planning Conditions (Ex-ante) **32.8 MW**	Awarded NQC Oct 2023-Jun 2024 **30 MW**
Awarded NQC Jul 2024-Sep 2024 **40 MW**	NQC Awarded for 2025 **10 MW**	NQC Requested for PY 2026 **39.8 MW**

Note: NQC = Net Qualifying Capacity, PY = Program Year, Ex-post = Historical Analysis, Ex-ante = Forecast Analysis

- Resources participated via either:
  - ✓ DRAM
  - ✓ Resource Adequacy contracts
  - ✓ DSGS
- Resources were dispatched locally by CAISO:
  - ✓ 43 unique event windows
  - ✓ At no point did CAISO dispatch the full Enersponse resources
  - ✓ CAISO dispatched the largest share of August 27, 2024, which was a top 10 load day for CAISO or any of the California utilities.

QUESTIONS?

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