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DR QUALIFYING CAPACITY WORKING GROUP FINAL DRAFT PROPOSAL

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

SEPTEMBER 8, 2022

AGENDA

1 Context and background

2 Proposal

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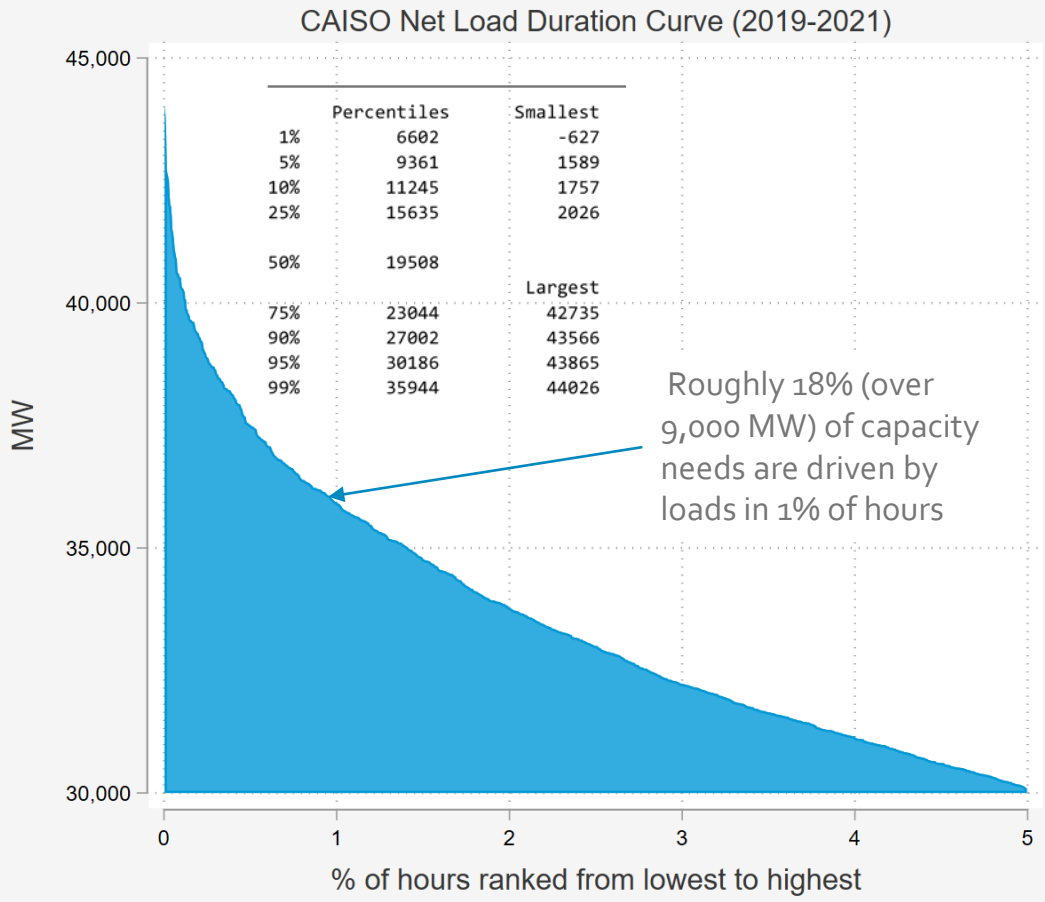
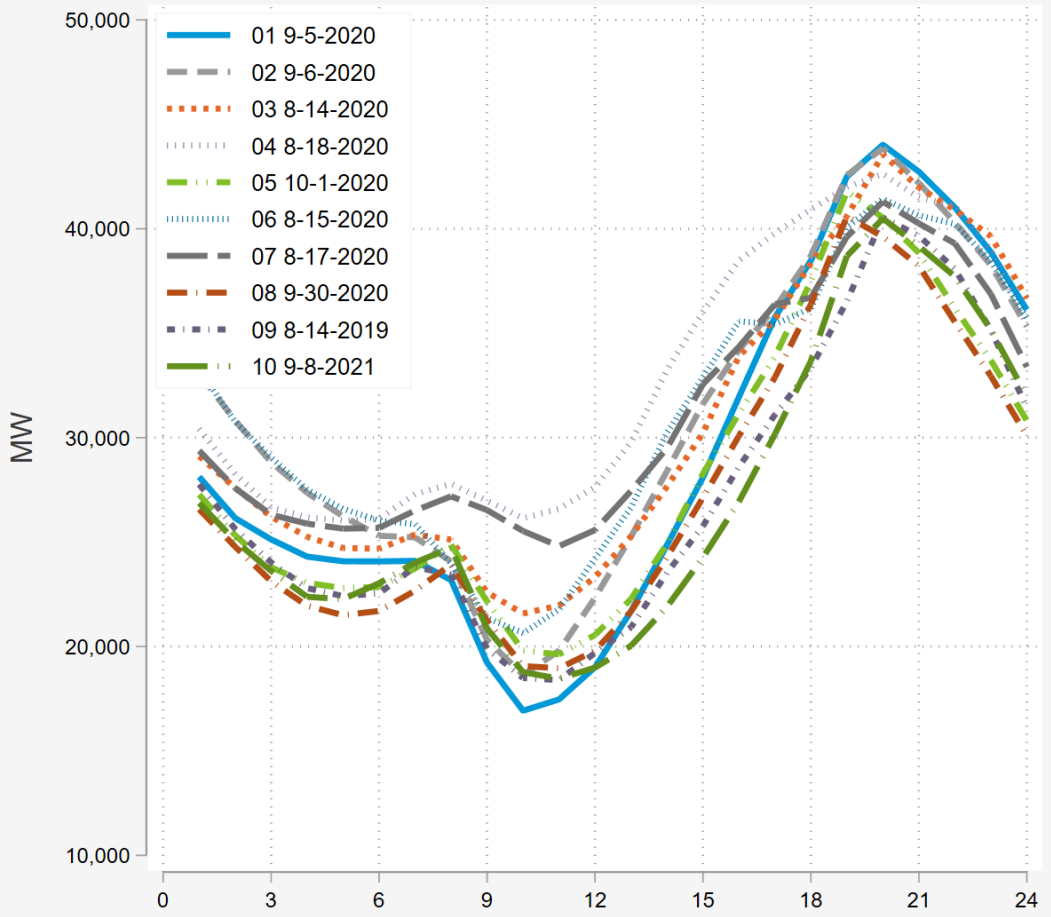
BACKGROUND AND CONTEXT

PEAK LOADS ARE HIGHLY CONCENTRATED AND RISK OF CAPACITY SHORTAGES IS CONCENTRATED IN HIGH NET LOAD HOURS





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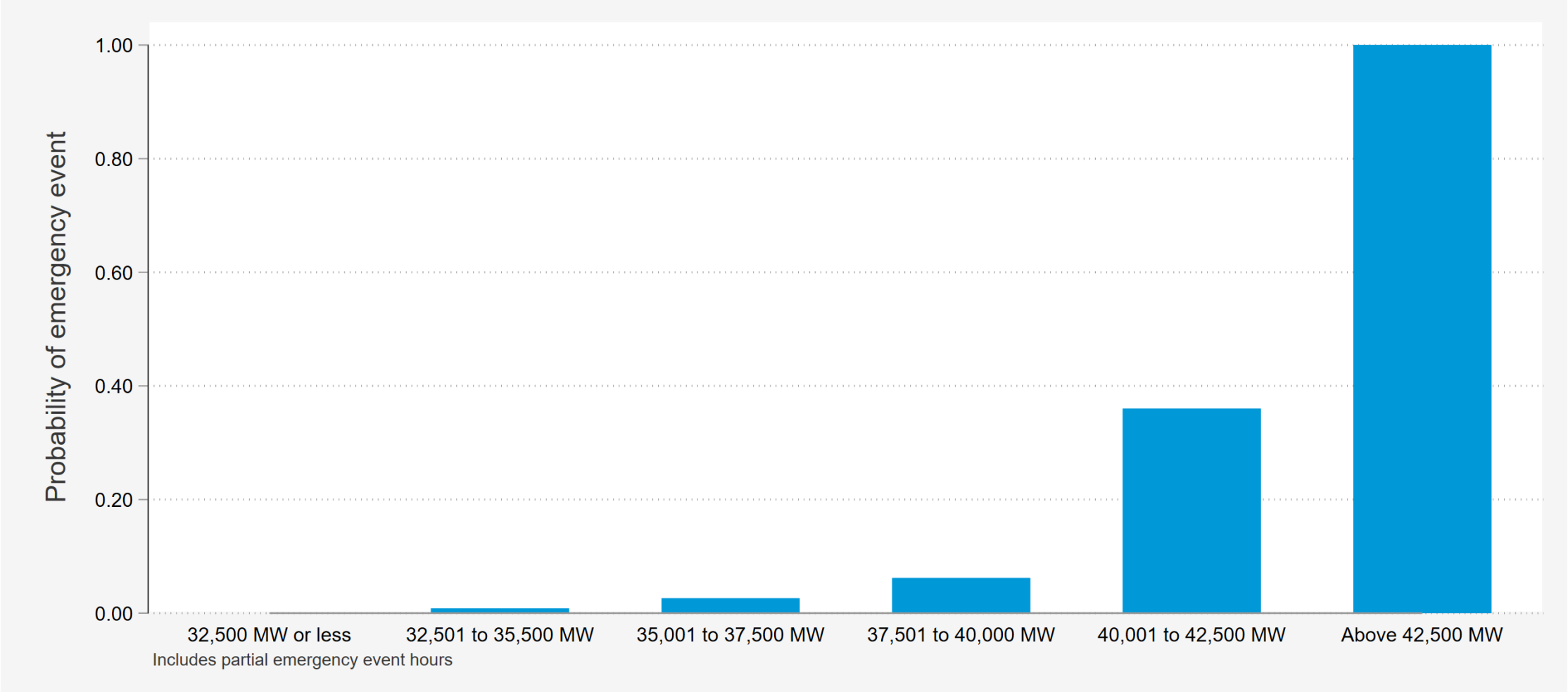
THE EMPIRICAL DATA SHOWS THAT NET LOADS ARE CLOSELY RELATED TO CAISO EMERGENCIES (INDICATING SHORTAGES)



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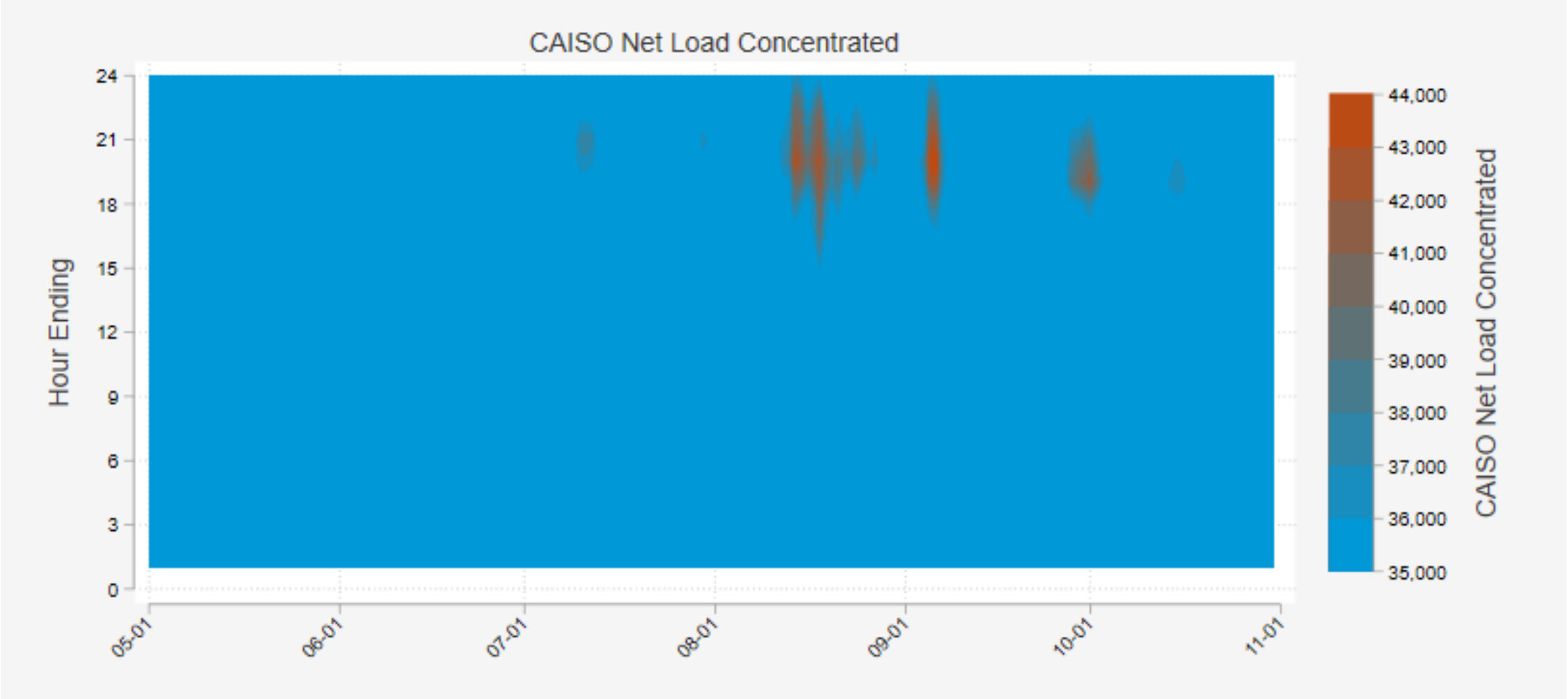
THE HIGH LOAD HOURS ARE HIGHLY CONCENTRATED IN SPECIFIC HOURS AND DRIVEN BY HEAT WAVES



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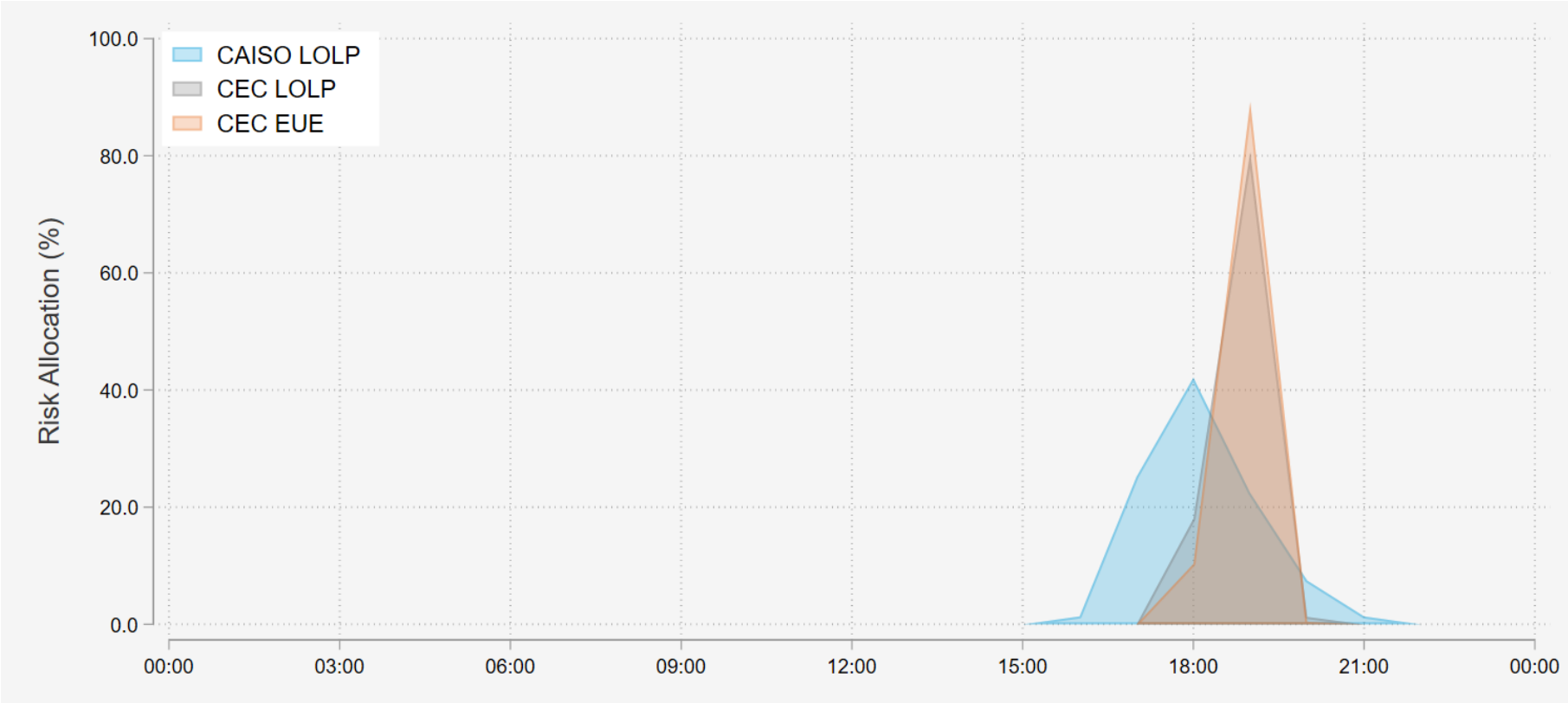
THE LOLP MODELS ALSO SHOW THE RISK OF RESOURCE SHORTAGES IS HIGHLY CONCENTRATED



- Different metrics produce different results (EUE versus LOLP)
- The different models don't always align
  - CAISO/E3
  - CEC midterm reliability
- Models are highly sensitive to multiple input assumptions
- All of the models produce odd results across months

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HOW MUCH A RESOURCE CONTRIBUTES TO RELIABILITY DEPENDS ON ITS CHARACTERISTICS AND HOW WELL IT COINCIDES WITH THE NEED FOR RESOURCES

KEY QUESTION	CONSTRAINT	DEFINITION
Is the DER tied to a specific load shape?	Load profile	Structural shape of load reductions deliverable by a resource. For example, energy efficiency will deliver loads aligned with underlying consumption patterns (e.g., lighting or HVAC); solar PV will deliver loads varying by time of day, peaking in early afternoon; batteries of fuel based generation have no such limits.
	Seasonal availability	Availability year round versus summer only.
Is the resource flexible?	Availability window (start and end hours)	Hours of the day during which the resource is available. May be longer than the duration category. If duration category is shorter than the availability window, optimal window is used (e.g., the window with the most peak load).
	Ramp speed	Length of time it takes for resource to achieve maximum load reduction.
	Dispatch delay	Advance notice which must be given for resource to be dispatched.
Are there specific operating constraints?	Dispatch duration	Maximum number of consecutive hours during which a resource is able to deliver load reduction. May be limited by technology constraints (battery discharge time) or program limits (demand response event window).
	Max dispatch hours per year	Limit to total number of dispatchable hours in a year.
	Max events per year	Limit to total number of dispatch events (days) in a year.
	Max consecutive	Limit to total number of consecutive dispatch events (days) in a year.
	Events per year	(Days) in a year.

Source: Bode, Lemarchand and Schellenberg (2015). Addressing the Locational Valuation Challenge for Distributed Energy Resources. Available at: https://sepapower.org/resource/beyond-the-meter-addressing-the-locational-valuation-challenge-for-distributed-energy-resources/

CURRENT PROCESS

Component	Detail
What are demand reductions delivered under the conditions called (ex-post impacts)?	The goal is to provide the most accurate estimate of the delivered demand reductions. Most evaluations conduct accuracy tournaments testing different models, and many rely on matched control groups with difference-in-differences using smart meter data. The protocols require producing hourly results for each event in a standardized format, including information about the number participants called, event start, and end times, weather conditions and confidence intervals.
What is the magnitude of program resources available under standard planning conditions (ex-ante impacts)?	Ex-ante impacts rely on developing a predictive model using hourly reductions from historical events, typically the most recent three years. The objective is to model how reductions vary as a function of weather, hour-of-day, hours into the event, and other factors (e.g., cycling strategy, location, etc.). This model is then used to predict demand reduction capability for each hour under 1-in-2 and 1-in-10 weather conditions and standardized dispatch hours that align with resource adequacy planning (currently 4-9 PM).The results are hourly tables with the load reduction capability for each month for 1-in-2 and 1-in-10 weather years
What value is used to determine the qualifying capacity?	The CPUC currently uses the average for the 4-9 pm time period under 1-in-2 utility peak conditions to determine the qualifying capacity for each month. The CPUC also specifies minimums a DR resource must meet in order to qualify for capacity. DR resource must be available Monday through Saturday, for 4 consecutive hours between 4 PM and 9 PM, and at least 24 hours per month from May to September.

LIMITATIONS OF CURRENT FRAMEWORK

Limitation	Explanation
It does not incorporate the hourly capability of the resources	The current approach uses the average hourly load impacts from 4-9 PM under 1-in-2 peaking conditions for each month. It does not reflect the hourly load reduction capability, even though ex-ante values are produced on hourly basis.
It does not fully factor in the coincidence of the resource shape with the risk of capacity shortages	The risk of capacity shortages is highly concentrated on specific hours when net loads are high, as shown by the recent CAISO and CEC reliability studies. Not all hours between 4-9 pm are equal. Thus, the coincidence of the DR resources with the hours when the risk is highest should be a critical component.
Is difficult to assess if performance during operations and bids into CAISO and align with the planning values	▪ Actual events reflect on-the-ground decisions and do not always align with planning conditions. ▪ Because of the format of the outputs, it can be difficult to directly compare the resource capability under planning conditions to bids or to compare them to the performance during actual events. ▪ Comparisons are sometimes inconsistent about whether the behind-the-meter demand reduction are scaled up to account for transmission and distribution line losses or the planning reserve margin. ▪ Evaluation results are often used to assess performance, which do not always match the CAISO settlement.
It lacks the flexibility needed for the 24-hour slice of day resource adequacy framework	▪ The existing framework which requires hourly impacts by month and hour for system peaking conditions align well with the new 24-hour slice of day resource adequacy framework. ▪ However, DR providers will need the flexibility to target the hours that maximize value and coincide with need. ▪ Slice of day stack resources by hour of day

PROPOSAL

KEY ELEMENTS

1

The Load Impact Protocols (LIP) should be retained but modified to address the 24-hour slice-of-day framework

2

Modifications to the Load Impact Protocols should include:

- Aligning weather conditions with the worst day of the month
- Allowing DR providers flexibility to target the hours that coincide with need
- Ensuring the load impacts for the worst day of the month is an output of the ex-ante impacts
- Production of a Time-Temperature Matrix for weather-sensitive resources

3

The long-term DR qualifying capacity methodology should be applicable to both supply-side and load-modifying DR resources

4

A single entity (CPUC, CEC, CAISO) should produce the reliability risk heatmap in advance (e.g., 18 months before the RA compliance year)

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KEY ELEMENTS

5

The ex-post load impact from evaluations should be used as the basis for performance

6

Allow evaluation results to be used for settlement if:

- The evaluation plan is produced in advance of the season
- The results are produced within the settlement period
- The statistical analysis code to produce the results is made available to CAISO for replication

7

Develop a standardized performance alignment metric and a standardized bid alignment metric. Metrics should both be tested before the methodology is finalized.

8

Work out the methodology for the monthly qualifying capacity value in the Resource Adequacy Working group

LIP MODIFICATIONS

SINGLE ENTITY PRODUCES RISK ALLOCATION (LOLP/EUE/PROXY) BY MONTH AND HOUR IN ADVANCE

LOLP 2023 (Produced in 2021-22)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	0.000098	-	-	-
18	-	-	-	-	-	-	-	-	0.001814	-	-	-
19	-	-	-	-	-	-	-	0.000190	0.002843	-	-	-
20	-	-	-	-	-	-	-	0.000047	0.001569	-	-	-
21	-	-	-	-	-	-	-	-	0.000539	-	-	-
22	-	-	-	-	-	-	-	-	0.000098	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

TOTAL LOLP 0.007198

- Used to inform (not dictate) DR slice of day table
- Must be provided in advance to allow DR providers to adjust programs/rules
- A single entity provided the heatmap (e.g., CPUC, CEC, or CAISO)
- Output can be:
  - ✓ LOLP
  - ✓ EUE
  - ✓ LOLP proxy
  - ✓ EUE proxy
- Team is providing an open data, open code option as a backup.

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PRODUCE A SLICE OF DAY TABLE

Hour	January	February	March	April	May	June	July	August	September	October	November	December
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	46.44	86.60	89.22	91.81	89.57	82.31	65.14	0.00
18	0.00	0.00	16.84	52.53	36.20	74.64	80.02	84.14	79.52	74.41	47.92	0.00
19	0.00	0.00	15.13	39.60	24.94	66.29	71.19	77.54	69.96	65.96	22.69	0.00
20	0.00	0.00	9.50	18.11	11.44	44.24	53.00	59.54	49.12	38.86	5.29	0.00
21	0.00	0.00	0.44	5.29	2.30	23.76	34.99	37.54	31.93	18.11	1.29	0.00
22	0.00	0.00	0.00	4.49	0.00	24.70	41.44	40.84	39.15	19.94	8.29	0.00
23	0.00	0.00	0.00	-0.06	0.00	-7.40	-14.44	-10.95	-13.50	-5.95	-4.68	0.00
24	0.00	0.00	0.00	0.00	0.00	-1.66	-4.31	-4.56	-6.64	-2.80	-1.75	0.00

- Table must be produced by hour and month for the worst day of each month as defined in RA working group
- DR providers need flexibility to target the hours that to maximize the coincidence with need
- Slice of day must factor in:
  - ✓ Resource shape
  - ✓ Maximum event duration
  - ✓ Spillover effects, including pre-cooling, snapback, and/or persistence of impacts beyond dispatch
  - ✓ Resource decay based on event duration (e.g., reductions are lower in hour 3 of event)
- Ex-ante impacts are modified so the hourly load impacts for the worst day of the month is and output (and aligns with slice of day)

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TIME TEMPERATURE MATRIX

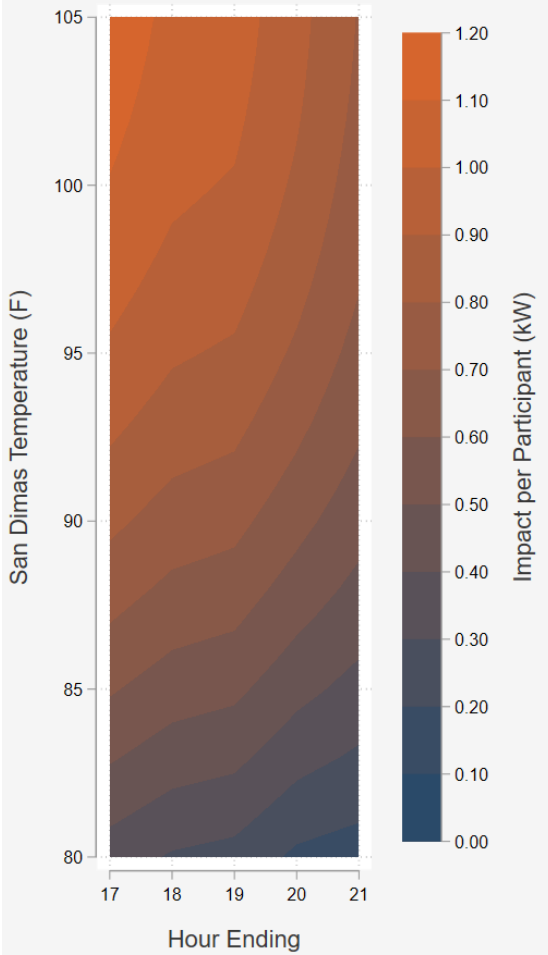
WHAT IS IT?

- Answers the question: What is the full range of resource capability under different weather conditions, dispatch times, and event durations?
- Use ex-post results to predict the relationship between demand reductions, temperature conditions, hour of the day, event start times, and hours into an event
- Based on the same model as the ex-ante impacts

WHY IS IT NEEDED?

- Shows the full range of the resource not covered by a single planning value
- A time-temperature matrix can be used to:
  - ✓ compare the historical ex-ante forecasts to the bids submitted
  - ✓ compare the historical event forecasts to the actual event performance.
  - ✓ Simulate the resource availability for different weather years

Example



Temp	Hour Ending				
	17	18	19	20	21
105	1.16	1.08	1.05	0.93	0.79
104	1.15	1.07	1.04	0.93	0.79
103	1.14	1.06	1.03	0.92	0.78
102	1.13	1.05	1.02	0.91	0.77
101	1.11	1.04	1.01	0.90	0.76
100	1.09	1.02	0.99	0.88	0.75
99	1.08	1.00	0.97	0.87	0.74
98	1.06	0.98	0.95	0.85	0.72
97	1.03	0.96	0.93	0.83	0.70
96	1.01	0.94	0.91	0.81	0.69
95	0.98	0.91	0.89	0.78	0.66
94	0.96	0.89	0.86	0.76	0.64
93	0.93	0.86	0.83	0.73	0.62
92	0.89	0.82	0.80	0.70	0.59
91	0.86	0.79	0.76	0.67	0.57
90	0.82	0.76	0.73	0.63	0.54
89	0.78	0.72	0.69	0.60	0.51
88	0.74	0.68	0.65	0.56	0.47
87	0.70	0.64	0.61	0.52	0.44
86	0.66	0.59	0.57	0.48	0.40
85	0.61	0.55	0.52	0.43	0.37
84	0.56	0.50	0.48	0.38	0.33
83	0.51	0.45	0.43	0.34	0.29
82	0.46	0.40	0.38	0.29	0.24
81	0.41	0.35	0.32	0.23	0.20
80	0.35	0.29	0.27	0.18	0.15

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TTM STANDARD OUTPUT FORMAT

Resource Name	Location (Sub-LAP)	Hour of Day	Start Time	Avg. Temperature	Event Duration	Forecasted per Unit Impact (kW)
Resource A	SCEC	19	6 pm	90	4	5.00
Resource A	SCEC	20	6 pm	90	4	4.72
Resource A	SCEC	21	6 pm	90	4	7.28
Resource A	SCEC	22	6 pm	90	4	1.11
Resource A	SCEC	20	7 pm	90	4	1.09
Resource A	SCEC	21	7 pm	90	4	2.81
Resource A	SCEC	22	7 pm	90	4	9.76
Resource A	SCEC	23	7 pm	90	4	4.97

ASSESSING DR PERFORMANCE

USE THE EX-POST LOAD IMPACT FROM EVALUATIONS AS THE BASIS FOR PERFORMANCE

- The impacts are more accurate and typically rely on an accuracy tournament and matched control groups with diff-in-diff
- Need some flexibility. A one size fits all approach does not work.
- Process already produces inputs needed for slice of day
- Long history of the load reductions in a standard template (since 2008)

ALLOW EVALUATION RESULTS TO BE USED FOR SETTLEMENT

HOW WOULD IT WORK?

- Option in addition to existing baselines
- The evaluation plan is produced in advance of the season
- The results are produced within the settlement period
- The statistical analysis code to produce the results is made available to CAISO for replication

WHY IS IT NEEDED?

- The impacts are more accurate
- Provides alignment between evaluation and settlement

Southern California Edison

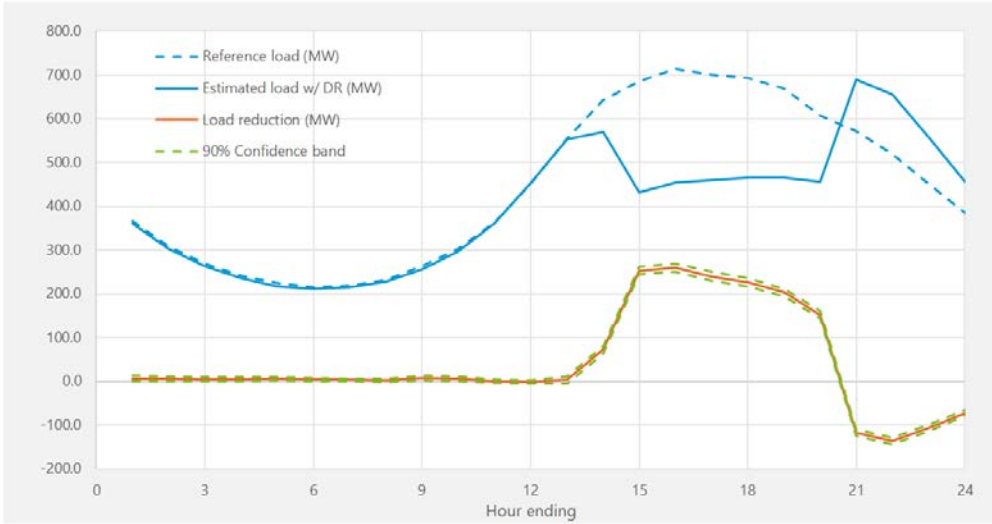
2020 Ex Post Load Impacts - SDPR

Table 1: Menu options

Program	SDP-R
Type of result	Aggregate
Category	ALL
Subcategory	All
Event date and hours	2020-08-18 (13:40-19:48 PM)

Table 2: Event day information

Event start	1:40 PM
Event end	7:48 PM
Total sites	199,557
Total devices	232,734
Total AC tonnage	846,367
Event window temperature (F)	100.6
Full event hours load reduction (MW)	236.82
Full event hours % load reduction	34.2%
All event hours load reduction (MW)	201.29
All event hours % load reduction	29.9%



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EXAMPLE PERFORMANCE ALIGNMENT METRIC

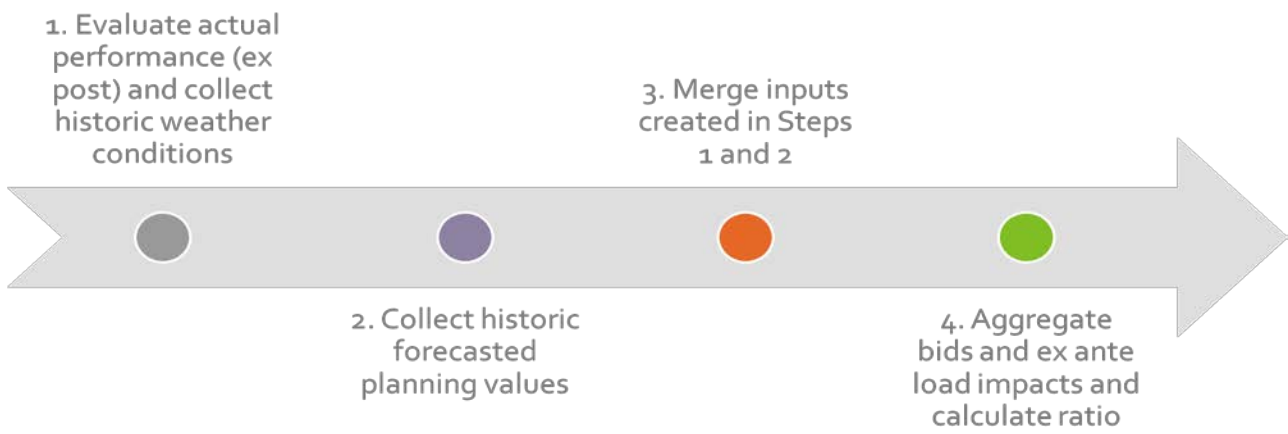
WHAT IS IT?

- Answers the question: Does actual performance during operations align with the forecasted capability used for planning (ex-ante impacts)?
- Ratio of actual reductions, as measured by evaluation, to the historical ex-ante impacts per unit used for planning
- Centered on 1.00, with higher values indicating over-performance and lower values indicating underperformance.

WHY IS IT NEEDED?

- Need a standard metric of whether DR qualifying capacity is performing as expected when dispatched.
- Actual dispatch operations do not often match the 1-in-2 and 1-in-10 weather conditions or the current 4-9pm window
- Need to take into account actual conditions as defined by weather, event start, event duration, and share of resources dispatched.

EXAMPLE



$$Performance\ Aligment\ Metric = \frac{\sum Actual\ Performance\ kW}{\sum Forecasted\ Ex\ Ante\ kW}$$

	Average Actual Performance (kW)	Average Forecasted Planning TTM Value (kW)
TOTAL	4.68	4.49
RATIO	1.04	

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EXAMPLE BID ALIGNMENT METRIC

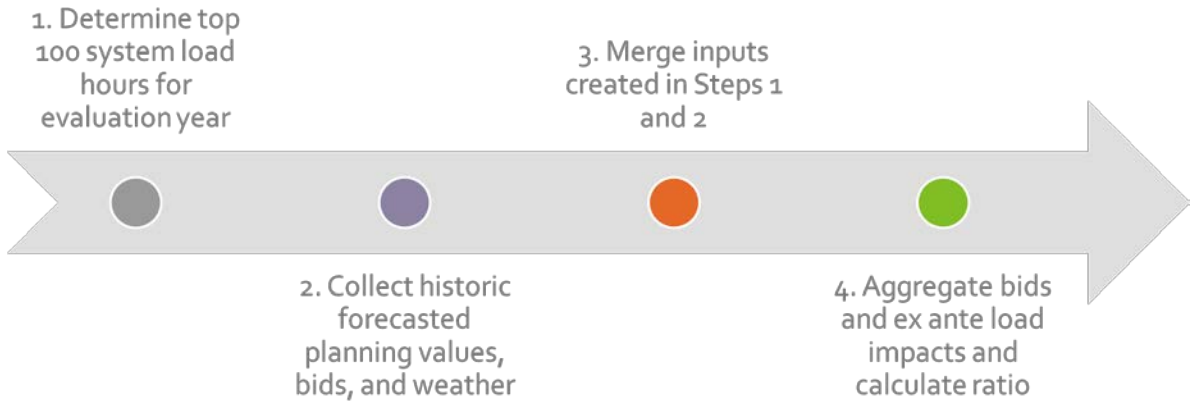
WHAT IS IT?

- Answers the question: Do bids into CAISO align with the historical forecasted capability used for planning (ex-ante impacts), given actual conditions?
- Ratio of the MW bid into CAISO to the historical forecasted capability used for planning (ex-ante impacts)
- Centered on 1.00, with higher values indicating higher than expected bids and lower values indicating lower than expected bids

WHY IS IT NEEDED?

- Need a standard metric for CAISO visibility into DR resources.
- Actual day-to-day conditions do not often match the 1-in-2 and 1-in-10 weather conditions or the current 4-9pm window
- Need to take into account actual conditions as defined by weather and hour of day

EXAMPLE



$$Bid\ Aligment\ Metric = \frac{\sum Historic\ Bid\ MW_{date,hour}}{\sum Forecasted\ Planning\ MW_{date,hour}}$$

	Bid Value (MW)	Ex Ante TTM Value (MW)
TOTAL	4,882	4,629
RATIO	1.05	

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QUESTIONS?

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