California ISO

EIM Resource Sufficiency Evaluation Metrics Report covering July and August 2021

September 23, 2021

Prepared by: Department of Market Monitoring

California Independent System Operator

1 Report overview

As part of the Energy Impact Market (EIM) resource sufficiency evaluation stakeholder initiative, DMM has agreed to provide additional information and analysis about resource sufficiency evaluation performance, accuracy, and impacts in regular reports.[1] This report highlights existing metrics and analysis covering July and August 2021. Future reports will provide additional metrics and analysis on a monthly basis.

This report is organized as follows:

- Section 2 provides an overview of the flexible ramping sufficiency and bid-range capacity tests.
- Section 3 provides existing summary metrics.
- Section 4 provides existing metrics for key time periods.

DMM is seeking feedback on existing or additional metrics and analysis that EIM entities and other stakeholders would find most helpful. Comments and questions may be submitted to DMM via email at DMM@caiso.com.

[1] *EIM Resource Sufficiency Evaluation Enhancements Straw Proposal*, August 16, 2021. http://www.caiso.com/InitiativeDocuments/StrawProposal-ResourceSufficiencyEvaluationEnhancements.pdf

2 Overview of the flex ramp sufficiency and capacity tests

As part of the energy imbalance market, each area, including the California ISO, is subject to a resource sufficiency evaluation. The evaluation is performed prior to each hour to ensure that generation in each area is sufficient without relying on transfers from other balancing areas. The evaluation is made up of four tests: the power flow feasibility test, the balancing test, the flexible ramping sufficiency test, and the bid range capacity test. Two of these tests have the same outcome of constraining transfer capability following a failure:

- **The flexible ramping sufficiency test (sufficiency test)** requires that each balancing area has enough ramping flexibility over an hour to meet the forecasted change in demand as well as uncertainty.
- **The bid range capacity test (capacity test)** requires that each area provide incremental bid-in capacity to meet the imbalance between load, intertie, and generation base schedules.

If an area fails either the flexible ramping sufficiency test or bid range capacity test in the upward direction, energy imbalance market transfers into that area cannot be increased.[2] Similarly, if an area fails either test in the downward direction, transfers out of that area cannot be increased.

Flexible ramping sufficiency test

The flexible ramping sufficiency test requires that each area has enough ramping resources to meet expected upward and downward ramping needs in the real-time market without relying on transfers from other balancing areas. Each area must show sufficient ramping capability from the start of the hour to each of the four 15-minute intervals within the hour.

Equation 1 shows the different components and mathematical formulation of the flexible ramping sufficiency test. As shown in Equation 1, the requirement for the flexible ramping sufficiency test is calculated as the *forecasted change in load* plus the *uncertainty component* minus two components: (1) the *diversity benefit* and (2*) flexible ramping credits*.

Equation 1. Flexible Ramping Sufficiency Test Formulation

$$Up\ Requirement = \Delta Load + Up\ uncertainty - \min\begin{bmatrix} Net\ import\ capability, \\ Diversity\ benefit + Up\ credit \end{bmatrix}$$

$$Down\ Requirement = -\Delta Load + Down\ uncertainty - \min\begin{bmatrix} Net\ export\ capability, \\ Diversity\ benefit + Down\ credit \end{bmatrix}$$

Change in load forecast

Net load uncertainty

Discounts: diversity benefit and credit reduction capped by transfer capability

The diversity benefit reflects that system-level flexible ramping needs are typically smaller than the sum of the individual balancing area flexible ramping needs because of reduced uncertainty across a larger

2 If an area fails either test in the upward direction, net EIM imports during the hour cannot exceed the more lenient of either the base transfer or optimal transfer from the last 15-minute interval prior to the hour.

footprint. As a result, balancing areas receive a prorated diversity benefit discount based on this proportion.

The flexible ramping credits reflect the ability to reduce exports to increase upward ramping capability or reduce imports to increase downward ramping capability.

Finally, as shown in Equation 1, the reduction in the sufficiency test requirement because of any diversity benefit or flexible ramping credit is capped by the area's net import capability for the upward direction, or net export capability for the downward direction.

The uncertainty component currently used in the flexible ramping sufficiency test is calculated from the historical net load error observation. The 2.5th percentile of historical net load error observations is used for the downward requirement and the 97.5th percentile if used for the upward requirement.[3] As part of the flexible ramping product refinements stakeholder initiative, the uncertainty component is expected to be enhanced in Spring 2022 to scale and account for net load currently in the system.[4]

Bid range capacity test

The bid range capacity test requires that each area provide incremental (or decremental) bid-in capacity to meet the imbalance between load, intertie, and generation base schedules. Equation 2 shows the different components and mathematical formulation of the bid range capacity test. As shown in Equation 2, the requirement for the bid range capacity test is calculated as the *load forecast* plus *export base schedules* minus *import and generation base schedules*.

Equation 2. Bid Range Capacity Test Formulation

$$Requirement = \underbrace{Load}_{\text{Load forecast}} + \underbrace{Export_{base} - Import_{base} - Generation_{base}}_{\text{Intertie and generation base schedules}} + \underbrace{Intertie\ Deviation}_{\text{Additional requirement to account for historical intertie deviation}} + \underbrace{Uncertainty}_{\text{Net load uncertainty, net diversity benefit (effective June 16, 2021)}}$$

As also shown in Equation 2, two additional components are added to the requirement in order to account for both (1) historical intertie deviations and (2) net load uncertainty (beginning June 16).[5]

If the requirement is positive, then the area must show sufficient incremental bid range capacity to meet the requirement and if the requirement is negative, then sufficient decremental bid range capacity must be shown.

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[3] Net load error in the 15-minute market is calculated from the difference between binding net load forecasts in the 5-minute market and the advisory net load forecast in the 15-minute market. Weekdays use data for the same hour from the last 40 weekdays. For weekends, the last 20 weekend days are used.

[4] Flexible Ramping Product Refinements Final Proposal, August 31, 2020. http://www.caiso.com/InitiativeDocuments/FinalProposal-FlexibleRampingProductRefinements.pdf

[5] Net load uncertainty is reduced by the diversity benefit similar to the sufficiency test. Unlike the sufficiency test, credits (net EIM exports in the upward test and net EIM imports in the downward test) are not used in the capacity test. This is to prevent double counting of internal capacity. For example, net EIM exports are supported by internal capacity, which is already accounted for in the capacity test by the generation base schedules and bid range.

The bid range capacity used to the meet the requirement is calculated relative to the base schedules. For the ISO, the “base” schedules used in the requirement are the advisory schedules from the last binding 15-minute market run. For all other energy imbalance market areas, the export, import, and generation schedules used in the requirement are the base schedules submitted as part of the hourly resource plan.

Since the bid range capacity is calculated relative to the base schedules, the upward capacity test can generally be expressed as follows:[6]

$$\underbrace{Generation_{maximum} + Net\ Import_{maximum}}_{\text{Upward capacity}} \geq \underbrace{Load + Intertie\ Deviation + Uncertainty}_{\text{Requirement}}$$

Incremental bid-in generation capacity is calculated as the range between the generation base schedule and the economic maximum, accounting for upward ancillary services and any de-rates (outages). Other resource constraints including start-times and ramp rates are not considered in the capacity test. 15-minute dispatchable imports and exports are included as bid range capacity.

[6] DMM has identified cases when the existing incremental approach for the capacity test relative to base schedules does not equal maximum capacity expected under a total approach. The incremental bid-range capacity can be positive only. If maximum capacity at the time of the test run is below base schedules, this difference will not be accounted for in the test. For more information see DMM’s comments on EIM resource sufficiency evaluation enhancements straw proposal: https://stakeholdercenter.caiso.com/Common/DownloadFile/25df1561-236b-4a47-9b1c-717b4a9cf9f0

3 Summary metrics

This section provides existing summary metrics on the resource sufficiency evaluation.[7] DMM is in the process of developing additional metrics including coverage of the uncertainty component used in the tests, analysis of unloaded capacity, test comparisons to actual availability, and counterfactual analysis of changes proposed in the resource sufficiency evaluation enhancements initiative.

Frequency and size of bid-range capacity test and flexible ramping sufficiency test failure

Figure 1 through Figure 4 shows the percent of intervals in which each EIM area failed the upward capacity or sufficiency tests as well as the average shortfall of those test failures. Figure 5 through Figure 8 provides the same information for the downward direction. The dash indicates the area did not fail the test during the month. The flexible ramping sufficiency test and bid-range capacity test failures reported below reflect results independent of the other test.

Figure 9 summarizes the overlap between failure of the upward capacity and sufficiency tests between July and August. The black horizontal line (right axis) shows the number of 15-minute intervals with either a capacity or sufficiency test failure for each energy imbalance market area. The areas are shown in descending number of failure intervals. The bars (left axis) show the percent of the failure intervals that meet the condition.

Figure 10 shows the same information for the downward direction. Areas that did not fail either the capacity or sufficiency test during this period were omitted from the figure.

[7] Results in this section exclude known invalid test failures. These can occur because of a market disruption, software defect, or other errors. Data on invalid test failures may be included in future reports if sufficient interest exists.

Figure 1. Frequency of upward capacity test failures (percent of intervals)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	0.0	—	—	—	—	—	0.3	0.2	0.4	—	—	0.3	—	0.2	0.3
BANC	—	0.0	0.0	—	0.1	0.0	—	—	—	0.1	—	—	—	0.2	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.2	0.0
Idaho Power	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	0.8
LADWP											—	—	0.1	—	—
NorthWestern													0.6	1.2	0.6
NV Energy	—	—	—	—	0.1	0.2	—	—	0.3	—	0.0	0.5	0.8	0.5	0.2
PacifiCorp East	—	—	—	—	—	0.1	—	—	—	—	—	—	0.3	0.3	0.1
PacifiCorp West	—	—	—	—	—	0.1	—	—	—	0.1	—	0.0	0.1	0.2	0.1
Portland GE	—	—	—	—	—	—	—	—	0.1	—	0.4	—	0.7	0.8	1.0
Powerex	—	—	—	0.1	0.1	0.1	—	0.1	0.0	—	—	—	0.0	0.0	—
PSC New Mexico											—	—	—	0.4	—
Puget Sound En	—	—	—	—	—	—	—	—	0.1	0.6	1.0	0.6	1.6	0.5	0.7
Salt River Proj.	—	—	—	—	0.1	0.1	—	—	8.0	—	0.1	0.1	0.7	3.0	2.6
Seattle City Light	—	0.2	0.1	—	—	—	—	—	—	—	—	—	—	—	0.0
Turlock ID										—	—	0.0	—	—	1.1

Figure 2. Average shortfall of upward capacity test failures (MW)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	60	—	—	—	—	—	1387	2325	1443	—	—	48	—	92	45
BANC	—	6	3	—	20	5	—	—	—	13	—	—	—	53	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	405	601	274
Idaho Power	—	—	—	—	—	—	—	—	—	—	—	—	—	17	34
LADWP											—	—	46	—	—
NorthWestern													25	24	61
NV Energy	—	—	—	—	23	15	—	—	26	—	15	27	82	55	25
PacifiCorp East	—	—	—	—	—	1214	—	—	—	—	—	—	73	40	38
PacifiCorp West	—	—	—	—	—	2228	—	—	—	12	—	4	10	26	16
Portland GE	—	—	—	—	—	—	—	—	268	—	42	—	34	46	36
Powerex	—	—	—	85	79	258	—	41	32	—	—	—	63	3	—
PSC New Mexico											—	—	—	129	—
Puget Sound En	—	—	—	—	—	—	—	—	21	68	28	49	50	58	74
Salt River Proj.	—	—	—	—	26	72	—	—	54	—	25	38	30	75	121
Seattle City Light	—	131	2	—	—	—	—	—	—	—	—	—	—	—	4
Turlock ID										—	—	1	—	—	7

Figure 3. Frequency of upward sufficiency test failures (percent of intervals)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	0.3	0.8	0.7	0.6	0.5	0.5	0.2	—	0.6	—	0.0	—
BANC	—	—	0.2	0.0	0.1	—	0.1	—	—	—	—	—	—	—	—
California ISO	—	0.1	1.1	0.5	0.4	0.5	—	—	—	—	—	—	0.0	0.3	0.1
Idaho Power	0.3	0.1	0.2	—	—	—	—	—	0.1	—	—	—	—	—	—
LADWP											0.0	0.1	—	0.1	—
NorthWestern													1.3	3.6	0.7
NV Energy	2.3	4.5	7.1	2.6	1.4	0.8	—	0.1	0.5	0.4	0.4	0.7	0.9	0.4	0.5
PacifiCorp East	0.1	0.2	0.2	0.1	0.5	0.0	—	0.1	0.1	0.1	0.1	0.0	0.1	0.0	—
PacifiCorp West	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.2	0.1	0.1	0.0	—	0.0	0.1
Portland GE	0.0	0.2	0.2	0.6	0.1	0.1	0.2	0.3	0.6	0.1	0.2	0.2	0.3	0.5	0.2
Powerex	0.2	0.2	0.1	0.3	0.1	0.6	0.2	0.2	0.1	0.1	0.1	—	0.1	0.5	—
PSC New Mexico											0.4	0.0	0.1	0.5	—
Puget Sound En	0.3	0.6	0.4	—	0.2	—	—	—	—	—	—	0.1	0.1	0.0	0.0
Salt River Proj.	0.5	0.7	1.8	1.1	1.7	0.9	0.3	0.2	7.1	0.3	0.5	0.2	0.9	1.9	1.7
Seattle City Light	—	0.1	—	0.1	0.2	0.2	0.1	—	—	—	—	—	—	0.0	—
Turlock ID										—	—	0.3	—	—	—

Figure 4. Average shortfall of upward sufficiency test failures (MW)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	232	56	60	716	913	1140	57	—	33	—	38	—
BANC	—	—	52	8	15	—	18	—	—	—	—	—	—	—	—
California ISO	—	111	710	1031	872	516	—	—	—	—	—	—	404	585	400
Idaho Power	17	5	19	—	—	—	—	—	8	—	—	—	—	—	—
LADWP											32	59	—	70	—
NorthWestern													45	36	18
NV Energy	52	65	77	94	82	99	—	87	56	59	60	47	39	45	36
PacifiCorp East	4	38	33	95	64	20	—	62	26	61	67	47	53	44	—
PacifiCorp West	31	28	74	38	58	17	15	27	20	21	18	8	—	2	33
Portland GE	4	13	20	20	11	31	27	30	33	77	105	20	36	33	19
Powerex	54	30	664	48	64	115	65	82	64	26	69	—	137	111	—
PSC New Mexico											21	58	19	112	—
Puget Sound En	15	38	31	—	27	—	—	—	—	—	—	47	24	6	24
Salt River Proj.	32	66	69	46	56	49	52	20	64	27	75	27	69	61	53
Seattle City Light	—	11	—	10	9	6	4	—	—	—	—	—	—	7	—
Turlock ID										—	—	6	—	—	—

Figure 5. Frequency of downward capacity test failures (percent of intervals)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	—	—	—	—	—	—	—	—	0.0	—	—	—
BANC	—	—	—	—	0.1	0.1	—	—	0.0	0.1	—	—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
LADWP											—	—	0.1	—	—
NorthWestern													—	—	—
NV Energy	—	—	—	—	—	—	—	—	—	—	—	—	0.0	—	—
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Powerex	—	0.0	0.0	—	0.0	—	—	—	—	—	0.0	—	0.3	0.1	—
PSC New Mexico											—	—	—	—	—
Puget Sound En	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt River Proj.	0.0	—	—	—	—	—	—	—	—	—	0.0	—	0.0	—	—
Seattle City Light	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.0
Turlock ID										—	—	0.3	0.2	0.0	0.2

Figure 6. Average shortfall of downward capacity test failures (MW)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—
BANC	—	—	—	—	831	341	—	—	1	6	—	—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
LADWP											—	—	16	—	—
NorthWestern													—	—	—
NV Energy	—	—	—	—	—	—	—	—	—	—	—	—	26	—	—
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Powerex	—	15	29	—	13	—	—	—	—	—	8	—	350	33	—
PSC New Mexico											—	—	—	—	—
Puget Sound En	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt River Proj.	27	—	—	—	—	—	—	—	—	—	11	—	29	—	—
Seattle City Light	—	—	—	—	—	—	—	—	—	—	—	—	—	8	8
Turlock ID										—	—	4	4	3	8

Figure 7. Frequency of downward sufficiency test failures (percent of intervals)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	2.3	0.1	—	0.1	1.9	0.9	2.5	2.2	2.3	4.3	1.9	0.3	0.1	—	0.1
BANC	0.3	—	—	—	0.1	0.3	—	—	0.6	0.4	—	—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	0.0	—	—	0.0	0.0	—	—	—	—	—	0.0	—	—	—
LADWP											—	—	0.1	—	—
NorthWestern													0.7	0.6	0.4
NV Energy	5.1	0.7	0.8	2.2	0.5	1.4	1.1	0.2	6.1	1.4	0.5	4.3	2.0	3.0	2.5
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	0.1	—	—	0.1	—	—
Portland GE	0.1	—	—	—	—	—	—	0.0	—	—	—	—	—	—	—
Powerex	—	0.0	0.1	0.1	0.1	—	—	0.4	—	1.4	0.2	0.9	1.3	0.4	0.2
PSC New Mexico											1.4	—	0.0	—	—
Puget Sound En	0.8	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt River Proj.	0.1	—	0.0	0.1	0.1	0.2	0.8	1.1	1.6	1.2	0.2	0.1	0.2	—	0.1
Seattle City Light	—	0.1	0.2	0.2	0.1	0.1	0.1	—	—	—	—	—	—	0.2	—
Turlock ID										0.4	0.1	0.5	—	—	0.0

Figure 8. Average shortfall of downward sufficiency test failures (MW)

	2020							2021							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	126	51	—	36	73	44	55	63	94	52	73	38	26	—	50
BANC	17	—	—	—	63	98	—	—	16	13	—	—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	45	—	—	5	10	—	—	—	—	—	9	—	—	—
LADWP											—	—	14	—	—
NorthWestern													259	14	29
NV Energy	88	55	71	87	30	31	32	150	49	56	64	74	65	141	70
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	9	—	—	140	—	—
Portland GE	24	—	—	—	—	—	—	10	—	—	—	—	—	—	—
Powerex	—	19	54	47	71	—	—	95	—	64	26	38	199	83	44
PSC New Mexico											124	—	12	—	—
Puget Sound En	41	43	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt River Proj.	99	—	118	92	58	26	33	57	45	55	47	65	44	—	25
Seattle City Light	—	10	8	7	25	20	88	—	—	—	—	—	—	2	—
Turlock ID										2	6	7	—	—	4

Figure 9. Upward capacity/sufficiency test failure intervals by concurrence (July – August, 2021)

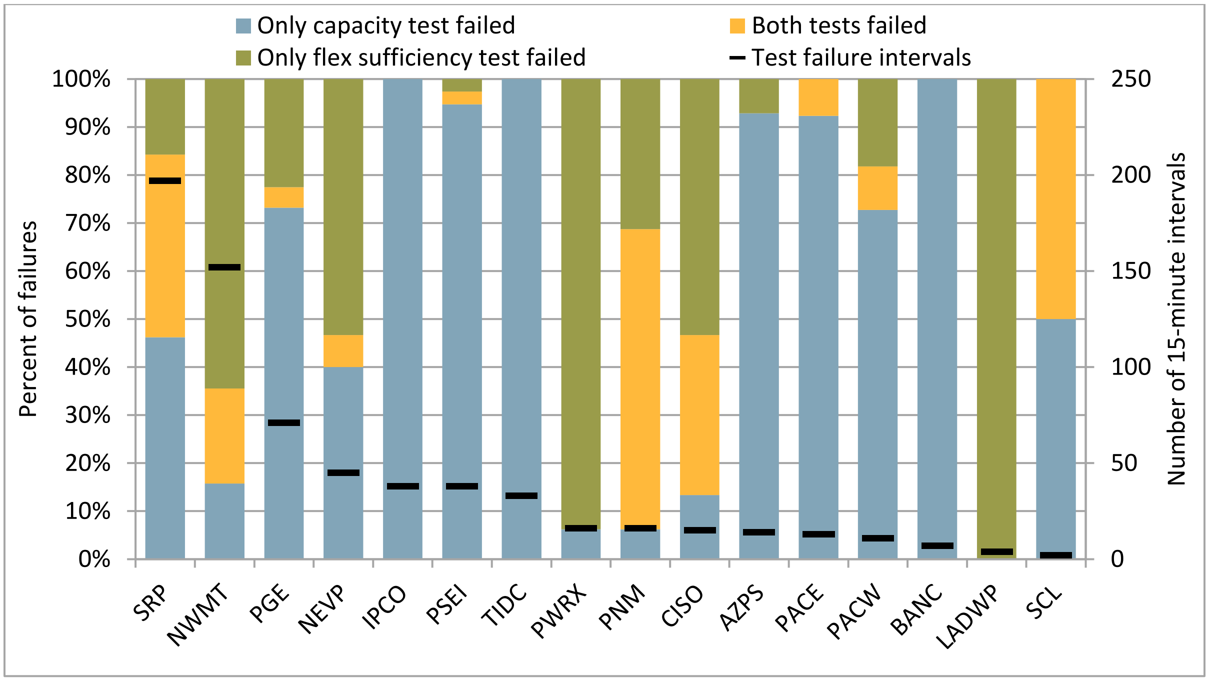
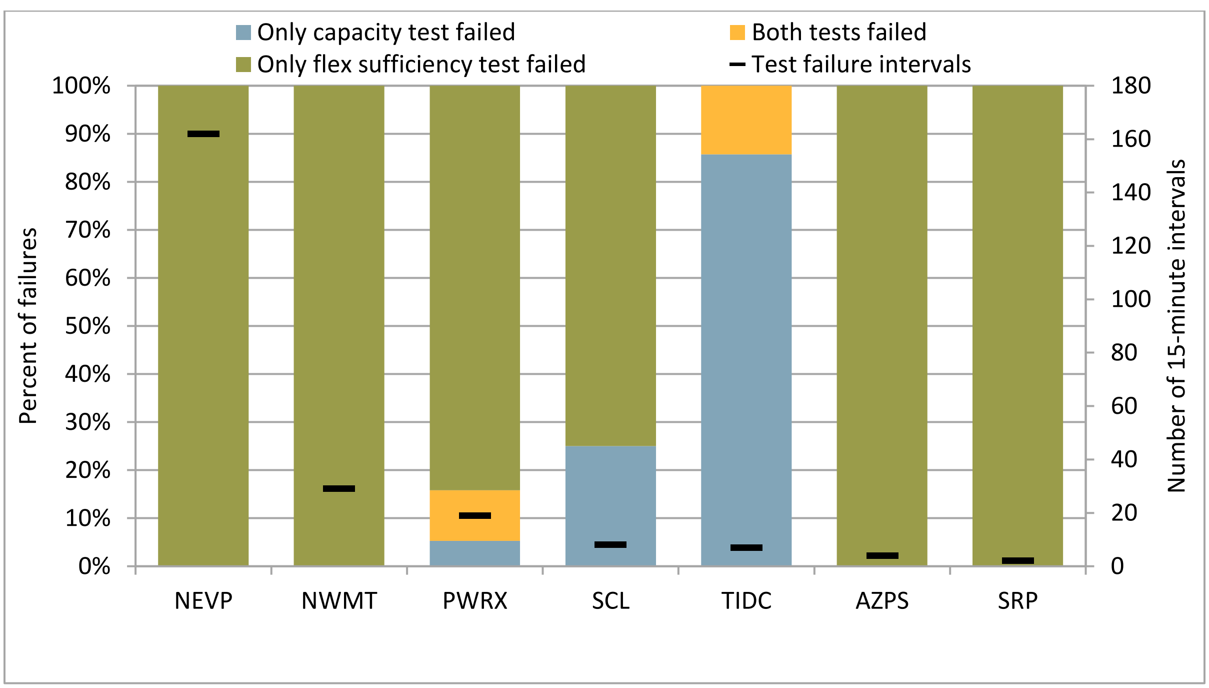


Figure 10. Downward capacity/sufficiency test failure intervals by concurrence (July – August, 2021)



Impact of adding uncertainty to the capacity test

On June 16, the ISO added net load uncertainty to the requirement of the bid range capacity test as part of a package of market enhancements for Summer 2021 readiness. The uncertainty component is net of the diversity benefit, similar to that already in effect for the flexible ramping sufficiency test.[8]

Figure 11 shows the impact of this change by showing actual capacity test failure intervals that would have passed the test without the additional uncertainty component. Figure 12 shows the same information, except without intervals in which the sufficiency test also failed in that interval. Since the outcome of failing either the capacity or the sufficiency test is the same, this figure therefore summarizes additional intervals in which energy imbalance market transfers were capped.

Figure 11. Additional capacity test failures with implemented uncertainty (15-minute intervals)

	Upward capacity test			Downward capacity test		
	Jun*	Jul	Aug	Jun*	Jul	Aug
Arizona PS	—	3	7	—	—	—
BANC	—	3	—	—	—	—
California ISO	3	2	1	—	—	—
Idaho Power	—	13	21	—	—	—
LADWP	—	—	—	—	—	—
NorthWestern	4	30	12	—	—	—
NV Energy	3	9	6	—	—	—
PacifiCorp East	7	9	4	—	—	—
PacifiCorp West	4	7	2	—	—	—
Portland GE	17	20	25	—	—	—
Powerex	1	1	—	4	3	—
PSC New Mexico	—	3	—	—	—	—
Puget Sound En	7	8	10	—	—	—
Salt River Proj.	8	49	19	—	—	—
Seattle City Light	—	—	1	—	—	—
Turlock ID	—	—	9	4	—	1

*June 16-30, 2021 only (implementation of uncertainty in the capacity test)

8 The diversity benefit reflects that system-level flexible ramping needs are typically smaller than the sum of the individual balancing area flexible ramping needs because of reduced uncertainty across a larger footprint. The diversity benefit is a prorated discounted based on this proportion.

Figure 12. Additional capacity test failures with implemented uncertainty <u>excluding</u> sufficiency test failures (15-minute intervals)

	Upward capacity test			Downward capacity test		
	Jun*	Jul	Aug	Jun*	Jul	Aug
Arizona PS	—	3	7	—	—	—
BANC	—	3	—	—	—	—
California ISO	3	2	—	—	—	—
Idaho Power	—	13	21	—	—	—
LADWP	—	—	—	—	—	—
NorthWestern	2	9	9	—	—	—
NV Energy	2	9	6	—	—	—
PacifiCorp East	7	8	4	—	—	—
PacifiCorp West	4	6	2	—	—	—
Portland GE	17	19	25	—	—	—
Powerex	1	1	—	3	1	—
PSC New Mexico	—	1	—	—	—	—
Puget Sound En	7	8	10	—	—	—
Salt River Proj.	5	34	15	—	—	—
Seattle City Light	—	—	1	—	—	—
Turlock ID	—	—	9	4	—	1

*June 16-30, 2021 only (implementation of uncertainty in the capacity test)

Transfer consequences of failing resource sufficiency evaluation

This section summarizes current consequences of failing the bid-range capacity or flexible ramping sufficiency tests in terms of the import limit that is imposed when a balancing area fails either of these tests in the upward direction. As part of the stakeholder initiative on resource sufficiency evaluation enhancements, the ISO is considering additional or alternative consequences for failing these tests.

When either test is failed in the upward direction, imports will be capped at the greater of (1) the base transfer or (2) the optimal transfer from the last 15-minute market interval. If both the base transfer and the last 15-minute transfer are in a net export position, the cap will be imposed on the export side (i.e. the balancing area cannot export less than the cap).

Figure 13 summarizes the import limits that were imposed after failing either test by balancing area and cap position (i.e. import or export). The black horizontal line (right axis) shows the number of 15-minute intervals with either a capacity or sufficiency test failure. The energy imbalance market areas are shown in descending number of failure intervals. The bars (left axis) show the percent of the failure intervals that meet the condition. Figure 14 summarizes the same information with the import limit categorized by various levels of import limits.

Figure 15 summarizes whether the import limit that was imposed after failing either test in the upward direction ultimately impacted market transfers. It shows the percent of failure intervals in which the resulting transfers are right up against the limit imposed after failing the test. These results are separated between energy imbalance market transfers in the 15-minute (FMM) and 5-minute (RTD) markets.

Figure 13. Upward capacity/sufficiency test failure intervals by import limit position (July – August, 2021)

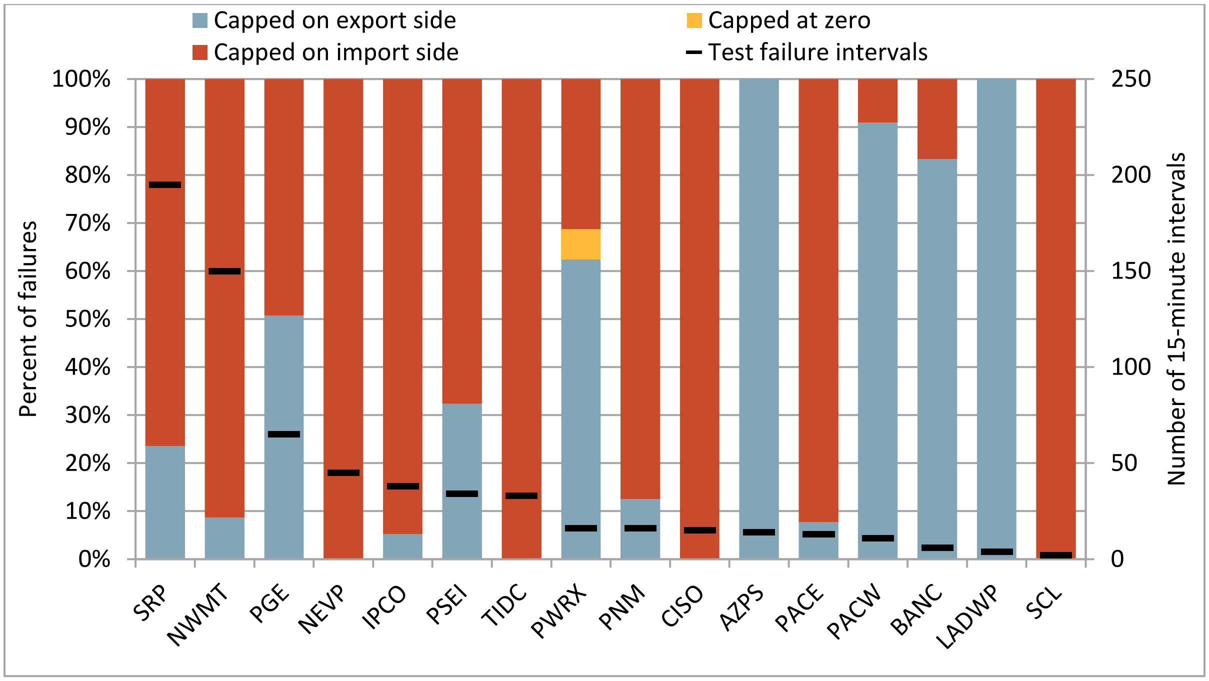


Figure 14. Upward capacity/sufficiency test failure intervals by import limit amount (July – August, 2021)

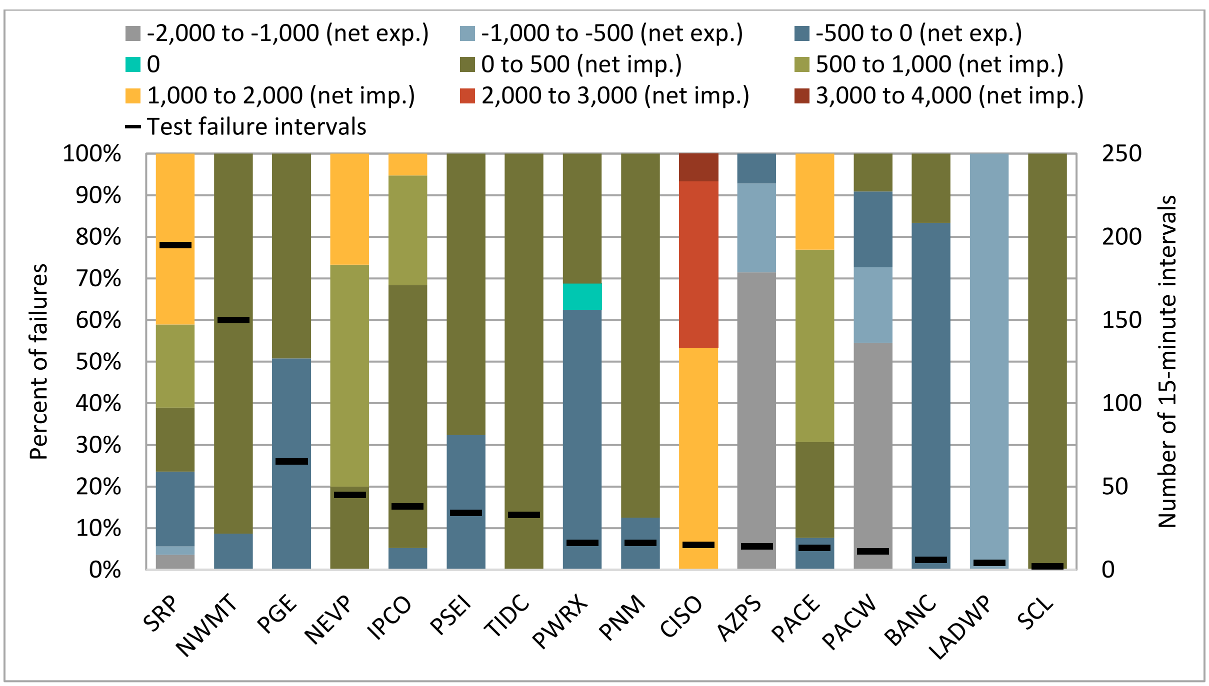
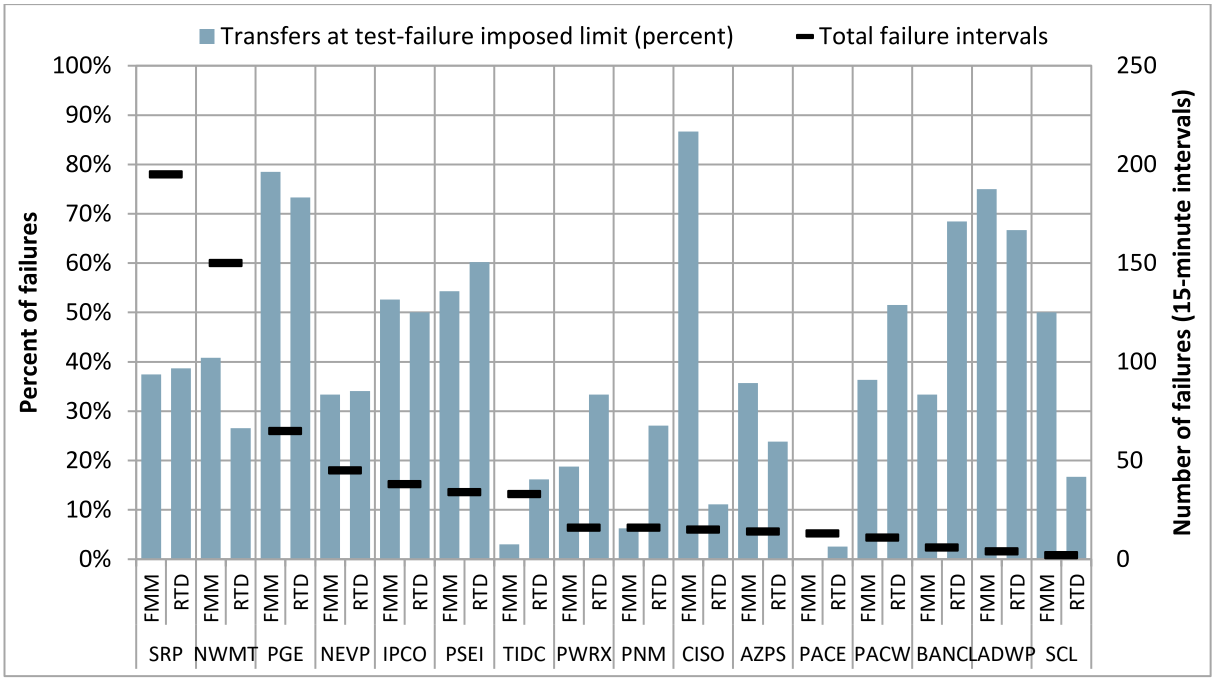


Figure 15. Percent of upward test failure intervals with market transfers at the imposed cap (July – August, 2021)



Balancing test failures and penalty

The resource sufficiency evaluation includes a balancing test applied each hour to all non-ISO energy imbalance market areas. Here, areas that elect to use the ISO-generated load forecast must show base schedules to be within 1 percent of the forecast. Areas that fail the balancing test are subject to potential over-scheduling or under-scheduling penalties. The penalty is then applied if the final area metered load is 5 percent more or less than the base schedules. There are then two tiers of penalty prices depending on whether the under/over scheduling is above 5 percent or above 10 percent.

Figure 16 and Figure 17 show under-scheduling and over-scheduling balancing test failures by area for April 2021. The failure amounts are shown both as a number of hours (left axis) and a percent of hours (right axis). The categories summarize the final calculation between base schedules and metered load and whether the penalty is ultimately applied. Results are based on ISO settlement data, and are lagged to include only the most recent month beyond the last required statement.[9]

Powerex is not included in these charts because they do not use the ISO-generated load forecast. EIM entities that elect to use their own forecast are not subjected to the initial balancing test but are instead subject to potential under-scheduling or over-scheduling penalties in *all* hours.

[9] Market Settlements Timeline Transformation, Rashele Wiltzius, Manager, Customer Readiness, July 20, 2020: https://www.caiso.com/Documents/Presentation-MarketSettlementsTimelineTransformationTraining.pdf

Figure 16. Under-scheduling balancing test failures (April 2021)

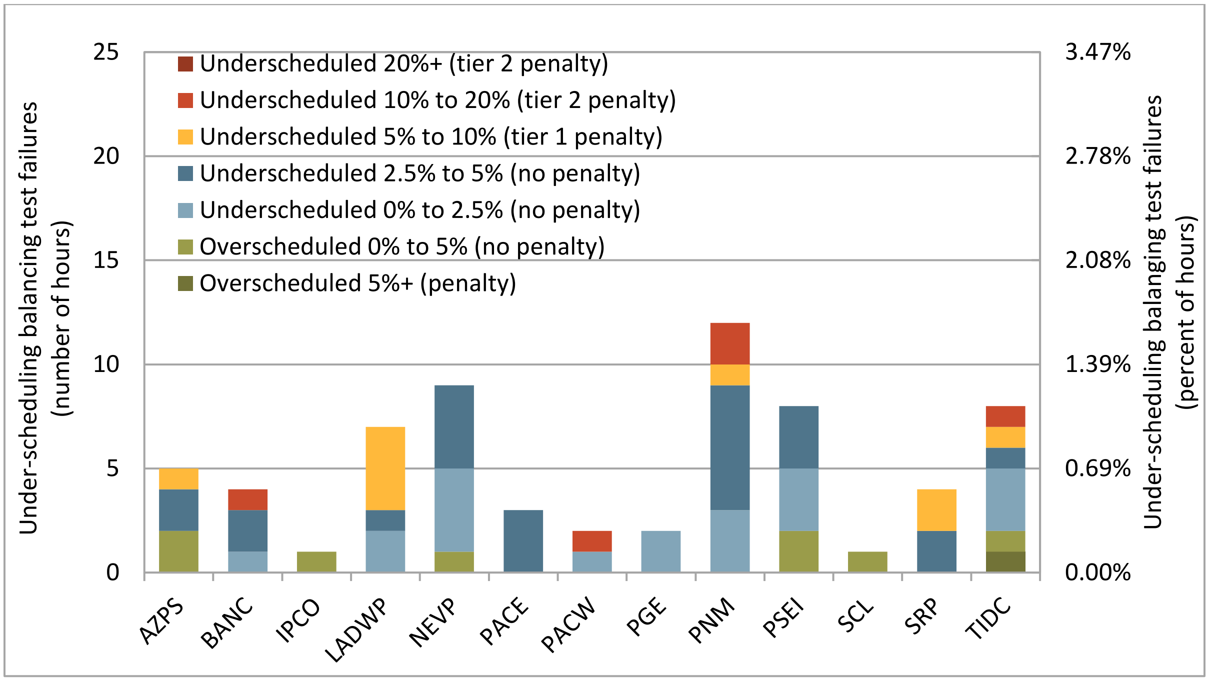
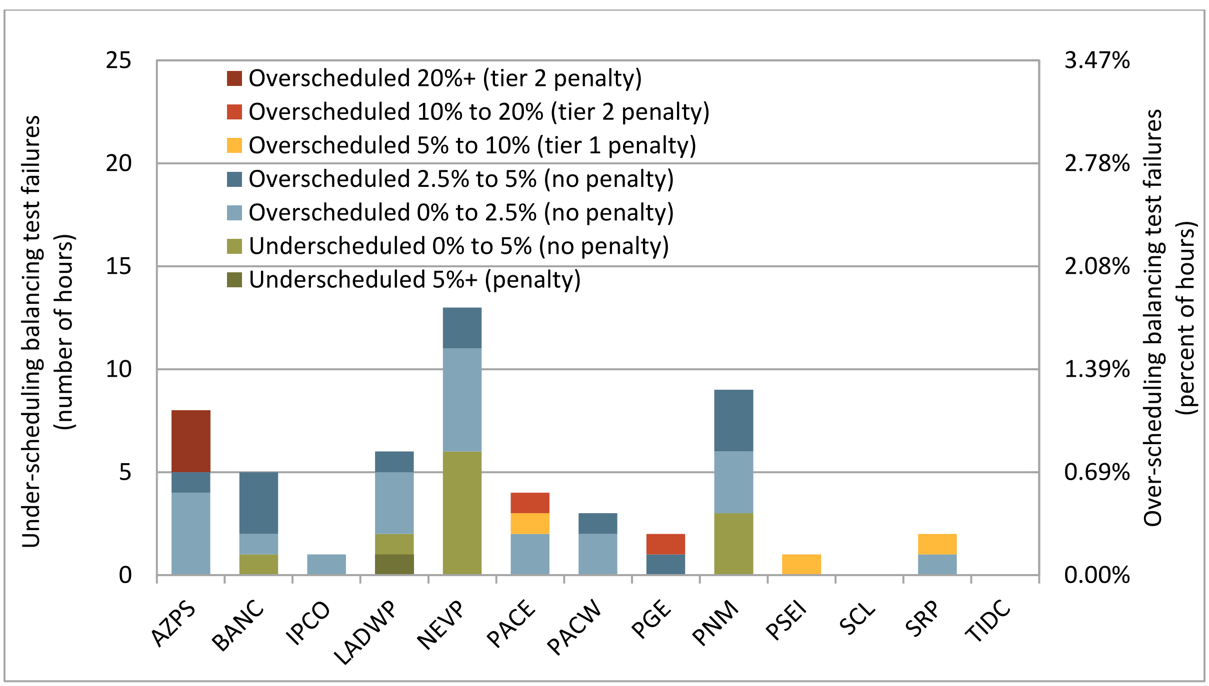


Figure 17. Over-scheduling balancing test failures (April 2021)



Imbalance conformance in the energy imbalance market

Operators in every EIM balancing area, including the California ISO, can manually adjust the load through imbalance conformance adjustments. These adjustments are not used directly in either the bid range capacity or flexible ramping sufficiency tests. However, they can impact test results indirectly in at least two ways.

- The flexible ramping sufficiency test measures ramping capacity from the start of the hour (i.e. last binding 15-minute interval) against the load forecast. Here, imbalance conformance adjustments entered prior to the test hour can impact internal generation at the initial reference point and ramping capacity measured from that point.
- Further, the penalty for failing either the upward capacity or sufficiency test is that EIM transfers are capped by the greater of the optimal transfer in the last 15-minute interval prior to the hour or base EIM transfers. Due to this, a higher imbalance conformance adjustment entered prior to the hour can increase EIM transfers into the balancing area resulting in higher transfer limits following a failure than would have occurred otherwise.

In the EIM resource sufficiency evaluation enhancements initiative, the ISO does not propose to incorporate load conformance into the tests but plans to revisit this in a second phase.[10]

Figure 18 summarizes average 15-minute market imbalance conformance entered by operators in the ISO between July and August. Figure 19 shows the same information for each of the EIM entities with substantial imbalance conformance.[11] Table 1 summarizes the average frequency and size of 15-minute and 5-minute market imbalance conformance for all balancing authority areas.

10 *EIM Resource Sufficiency Evaluation Enhancements Straw Proposal*, August 16, 2021. http://www.caiso.com/InitiativeDocuments/StrawProposal-ResourceSufficiencyEvaluationEnhancements.pdf

11 EIM entities with an average absolute 15-minute market imbalance conformance of less than 1 MW were omitted from the chart.

Figure 18. Average hourly ISO 15-minute market imbalance conformance (July – August)

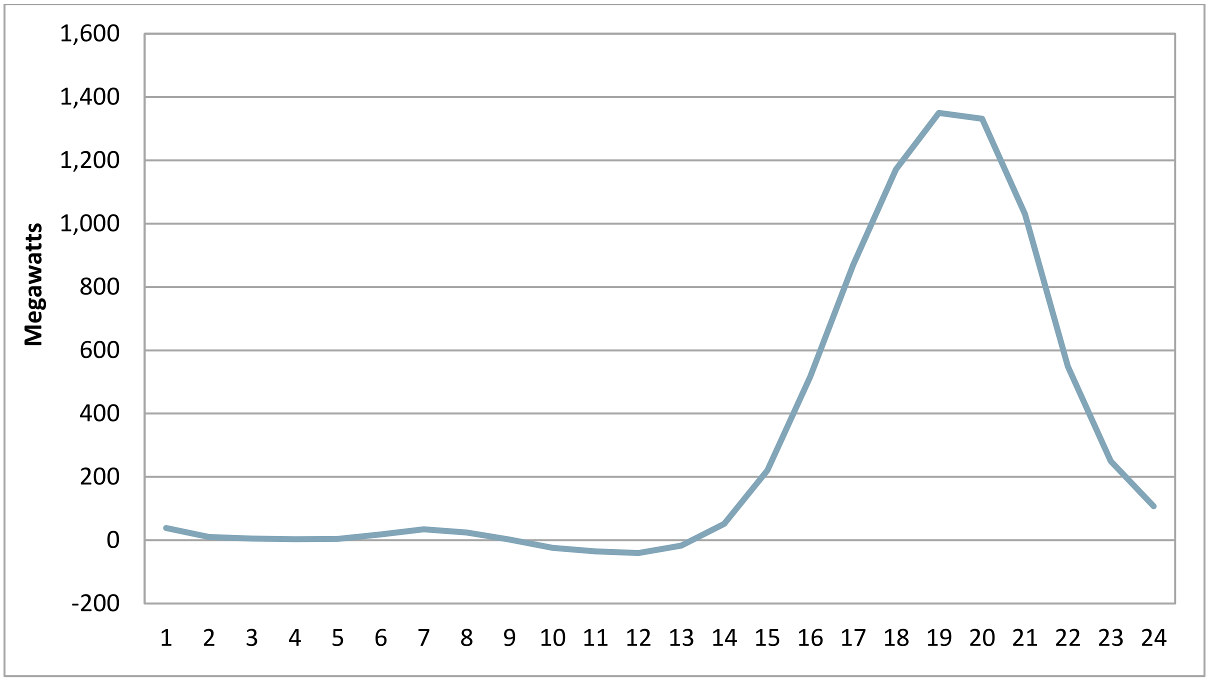


Figure 19. Average hourly non-ISO 15-minute market imbalance conformance (July – August)

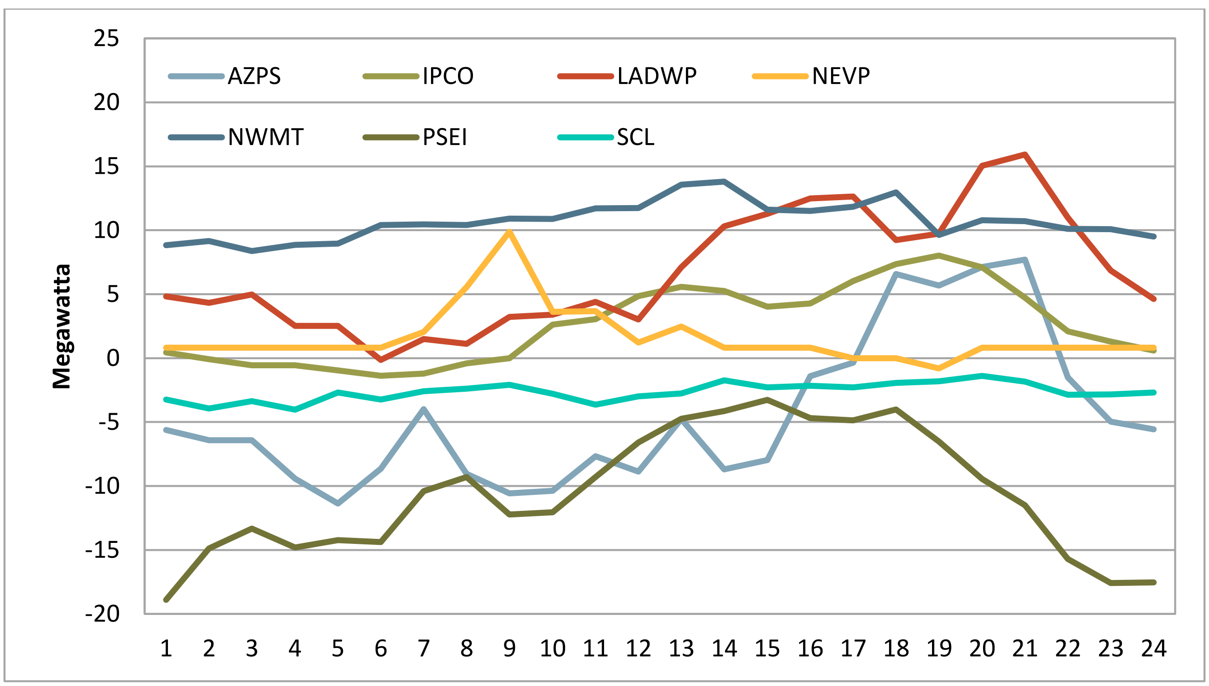


Table 1. Average frequency and size of imbalance conformance (July – August)

	Positive imbalance conformance			Negative imbalance conformance			Average hourly adjustment MW
	Percent of intervals	Average MW	Percent of total load	Percent of intervals	Average MW	Percent of total load	
Arizona Public Service							
15-minute market	3%	81	1.4%	10%	-69	1.6%	-4
5-minute market	16%	94	1.8%	50%	-74	1.7%	-23
BANC							
15-minute market	1%	36	1.4%	0.5%	-39	1.9%	0
5-minute market	3%	37	1.3%	1%	-43	2.2%	1
California ISO							
15-minute market	34%	928	2.6%	2%	-306	1.2%	312
5-minute market	28%	247	0.7%	46%	-227	0.8%	-35
Idaho Power							
15-minute market	7%	50	1.7%	2%	-46	2.0%	3
5-minute market	16.0%	48	1.6%	7%	-51	2.0%	4
Los Angeles Dept. of Water and Power							
15-minute market	11%	68	1.9%	0.9%	-62	1.9%	7
5-minute market	33%	60	1.8%	4%	-54	1.7%	18
NorthWestern Energy							
15-minute market	77%	14	1.1%	2%	-16	1.3%	11
5-minute market	77%	16	1.2%	2%	-27	2.2%	12
NV Energy							
15-minute market	2%	78	1.3%	0.1%	-100	1.3%	2
5-minute market	10%	90	1.2%	8%	-97	1.8%	1
PacifiCorp East							
15-minute market	0.3%	67	1.1%	0.1%	-374	7.0%	0
5-minute market	21%	121	1.8%	22%	-124	2.0%	-2
PacifiCorp West							
15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
5-minute market	2%	67	2.5%	20%	-52	2.1%	-9
Portland General Electric							
15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
5-minute market	18%	25	0.9%	1%	-41	1.4%	4
Public Service Company of New Mexico							
15-minute market	0%	N/A	N/A	0%	-29	1.6%	0
5-minute market	1%	88	4.4%	1%	-122	7.6%	0
Puget Sound Energy							
15-minute market	0%	24	0.7%	27%	-40	1.7%	-11
5-minute market	2%	28	0.8%	50%	-38	1.6%	-18
Salt River Project							
15-minute market	0%	40	0.7%	0%	-85	2.2%	0
5-minute market	4%	57	1.0%	9%	-70	1.7%	-4
Seattle City Light							
15-minute market	0%	31	3.0%	13%	-21	2.4%	-3
5-minute market	2%	25	2.5%	67%	-23	2.6%	-15
Turlock Irrigation District							
15-minute market	0%	21	4.5%	0%	N/A	N/A	0
5-minute market	0%	17	3.5%	0%	-25	7.8%	0

4 Metrics for key time periods

The following section highlights test results and outcomes during specific periods of interest. The metrics below shows resource sufficiency evaluation results and outcomes for the California ISO on July 9, around the Stage 2 Energy Emergency. As previously noted, DMM is seeking input on (1) thresholds to produce similar period specific and area specific metrics and (2) additional metrics to include.

Figure 20 shows 15-minute and 5-minute market energy imbalance market imports coming into the California ISO during peak hours on July 9. The red and green lines shows the intervals in which the ISO failed the sufficiency or capacity test, limiting transfers to the transfer level of the last binding 15-minute interval.

Figure 21 summarizes the bid-range capacity test for the California ISO in the same period. The red line shows the actual capacity test requirement including the recent addition of uncertainty. The gray line shows the requirement without uncertainty. The bars show the bid range capacity that was used to meet capacity test requirements. The blue and yellow bars are for 15-minute dispatchable incremental imports and decremental exports. The green bars reflect incremental generation capacity above base schedules. The dark green bars reflect capacity that was considered available for the bid range capacity test but unavailable for the flexible ramping sufficiency test because of resource constraints. For example, start-up times, transition times, ramp rates and other intertemporal constraints. Figure 22 provides the same information except with the total incremental generation capacity broken out by fuel type.

Figure 23 shows the requirement components in the ISO's upward flexible ramping sufficiency test against total ramping capacity. The requirement is calculated as the *forecasted change in load* plus *uncertainty* minus two discounts, *diversity benefit and flexible ramping credits*. Upward credits are net EIM exports prior to the hour, reflecting the ability to reduce exports to increase internal upward ramping capability. For this peak period on July 9, the ISO was importing on net in every 15-minute interval so no credits were applied to the upward sufficiency test.

Figure 24 instead shows total ramping capacity by fuel type against the requirement. Ramping capacity accounts for both economic energy bids (constrained by unit limitations such as ramp rates) as well as fixed changes in schedules or renewable forecasts from the previous hour to the next. Thus, an increase in imports (or decrease in exports) will contribute to positive ramping capacity.

Figure 20. Limits on EIM imports into CAISO due to resource sufficiency evaluation failure (July 9, 2021)

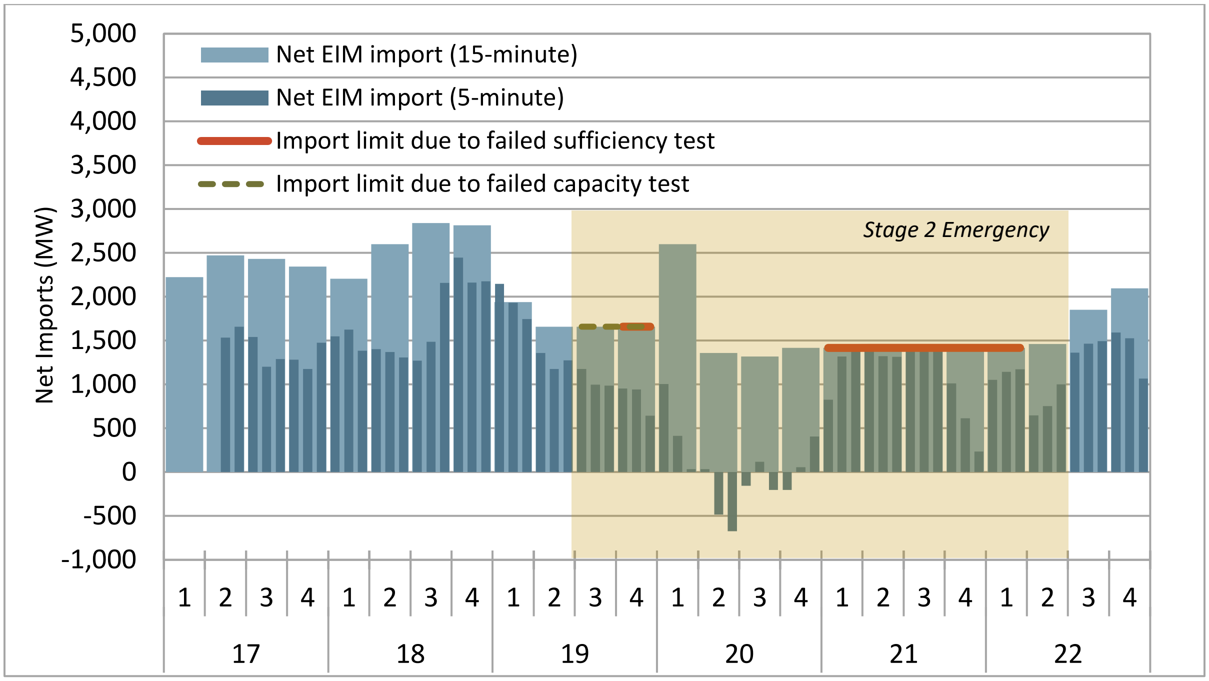


Figure 21. CAISO upward bid range capacity test requirement and capacity (July 9, 2021)

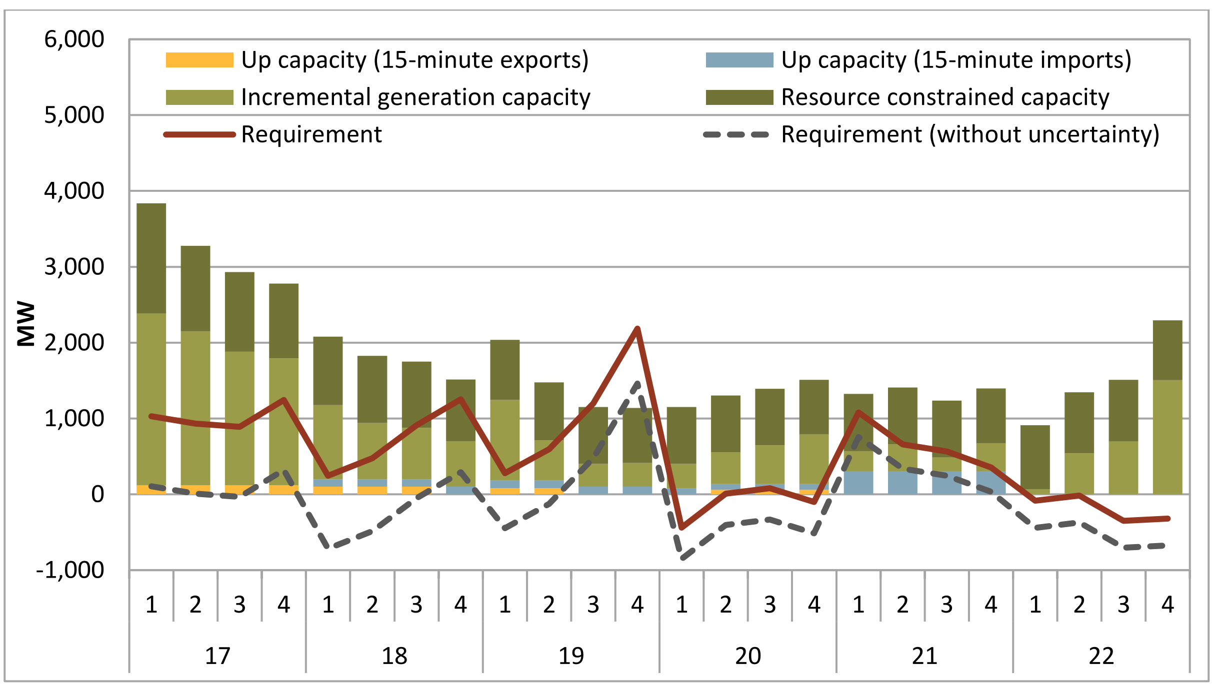


Figure 22. CAISO Upward bid range capacity test requirement and capacity by fuel type (July 9, 2021)

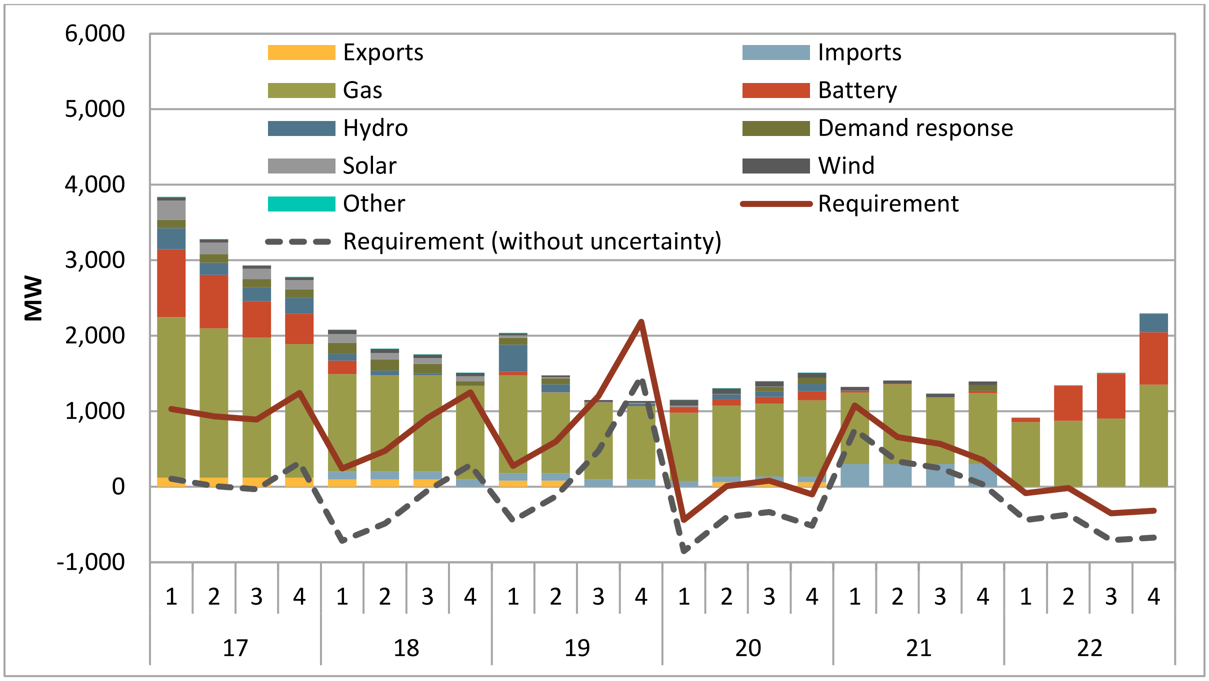


Figure 23. CAISO upward flexible ramping sufficiency test requirement by component (July 9, 2021)

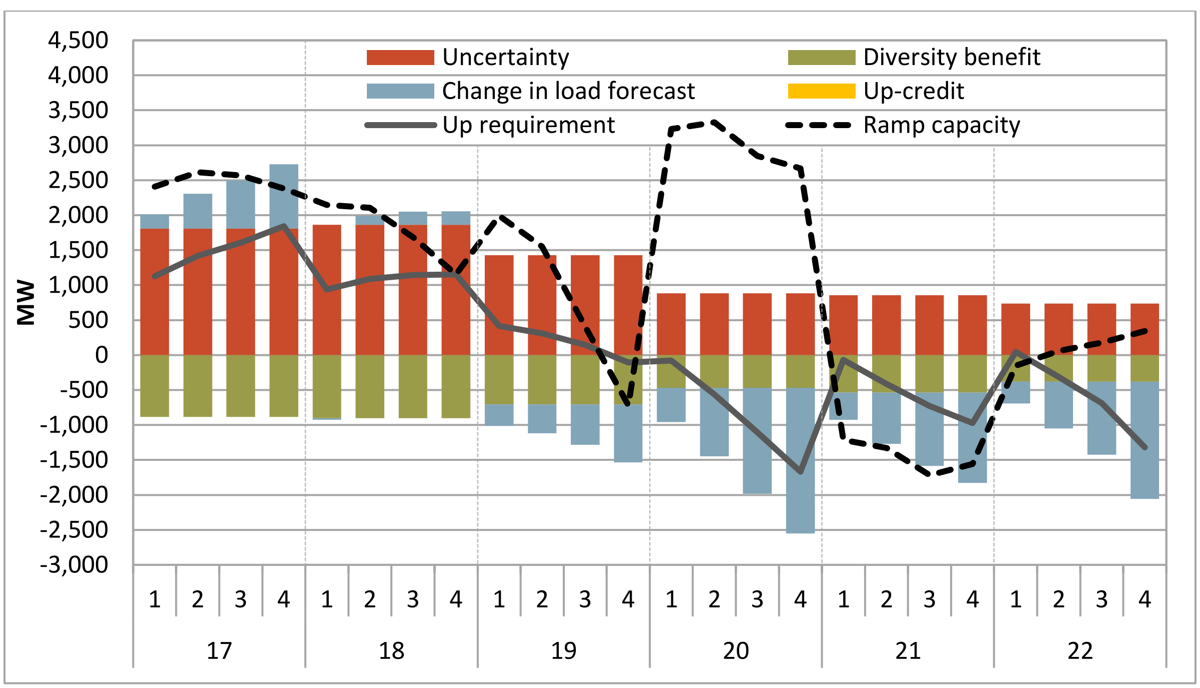


Figure 24. CAISO upward flexible ramping sufficiency test ramping capacity by type (July 9, 2021)