Western Energy Imbalance Market Resource Sufficiency Evaluation Metrics Report covering August 2022

September 20, 2022

Prepared by: Department of Market Monitoring

California Independent System Operator

1 Report overview

As part of the Western Energy Imbalance Market (WEIM) resource sufficiency evaluation enhancements stakeholder initiative, DMM is providing additional information and analysis about resource sufficiency evaluation performance, accuracy, and impacts in regular monthly reports.[1] This report highlights existing metrics and analysis covering August 2022 and is organized as follows:

- Section 2 provides an overview of the flexible ramp sufficiency and bid-range capacity tests.
- Section 3 provides an overview of the changes implemented as part of phase 1 of resource sufficiency evaluation enhancements.
- Section 4 summarizes the frequency and size of resource sufficiency evaluation failures.
- Section 5 provides metrics for key time periods during the month.
- Section 6 summarizes WEIM import limits and transfers following a resource sufficiency evaluation failure.
- Section 7 summarizes imbalance conformance adjustments and provides some context with how it interacts with the resource sufficiency evaluation.
- Section 8 summarizes input differences between the resource sufficiency evaluation and latest 15-minute market run.
- Section 9 provides a discussion and metrics on net load uncertainty used in the tests.
- Section 10 summarizes current issues identified by DMM or the California ISO. This section includes a new issue related to the counting of battery storage available capacity as well as two new issues with considering outages and exceptional dispatches.

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

[1] California ISO, *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 Western Energy Imbalance Market (WEIM) design, each balancing 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 ramp sufficiency test, and the bid range capacity test.

The market software automatically limits transfers into a balancing area from other WEIM areas if a balancing area fails either of the following two tests:

- **The flexible ramp sufficiency test (flexibility test)** requires that each balancing area have 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 ramp sufficiency test or bid range capacity test in the upward direction, WEIM 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 ramp sufficiency test

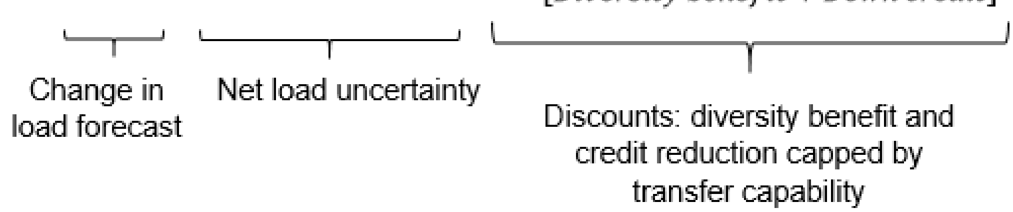
The flexible ramp sufficiency test requires that each balancing area have enough ramping resources to meet expected upward and downward ramping needs in the real-time market without relying on transfers from other balancing areas. Each area must show sufficient ramping capability from the start of the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

Equation 1 shows the different components and mathematical formulation of the flexible ramp sufficiency test. As shown in Equation 1, the requirement for the flexible ramp 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 Ramp Sufficiency Test Formulation

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

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



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

The diversity benefit reflects that system-level flexible ramping needs are typically smaller than the sum of the needs of individual balancing areas because of reduced uncertainty across a larger 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 from a balancing area to increase upward ramping capability or to reduce imports to increase downward ramping capability.

Finally, as shown in Equation 1, the reduction in the flexibility 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 ramp sufficiency test is calculated from the historical net load error observation. The 2.5 percentile of historical net load error observations is used for the downward requirement and the 97.5 percentile if used for the upward requirement.[3] The uncertainty component is expected to be enhanced in fall 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*. Intertie uncertainty was removed on June 1, 2022.

Equation 2. Bid Range Capacity Test Formulation

$$Requirement = \underbrace{Load}_{\text{Load forecast}} + \underbrace{Export_{base} - Import_{base} - Generation_{base}}_{\text{Intertie and generation base schedules}}$$

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.

The bid range capacity used to the meet the requirement is calculated relative to the base schedules. For the California ISO (CAISO), the "base" schedules used in the requirement are the advisory schedules from the last binding 15-minute market run. For all other WEIM areas, the export, import, and

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 California ISO, *Flexible Ramping Product Refinements Final Proposal*, August 31, 2020. http://www.caiso.com/InitiativeDocuments/FinalProposal-FlexibleRampingProductRefinements.pdf

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:[5]

$$\underbrace{Generation_{maximum} + Net\ Import_{maximum}}_{\text{Upward capacity}} \geq \underbrace{Load}_{\substack{\text{Load forecast} \\ \text{(requirement)}}}$$

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.

[5] 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 Issue Paper,* September 8, 2021: https://stakeholdercenter.caiso.com/Common/DownloadFile/25df1561-236b-4a47-9b1c-717b4a9cf9f0

3 Resource sufficiency evaluation enhancements phase 1

Phase 1 of resource sufficiency evaluation enhancements was implemented on June 1, 2022. This includes the following enhancements:

- **Consideration of offline resources in the capacity test.** The capacity test will now omit offline long-start capacity from the bid-range capacity test.[6] Short-start units which failed-to-start per the unit's telemetry will also be excluded.
- **Accounting for CAISO interchange awards that have not submitted Transmission Profile e-Tag.** The CAISO hour-ahead import and export schedules that have not been tagged by 40 minutes prior to the test hour are expected to be removed from both the capacity and flexibility tests.
- **Adjustment to initial reference point used in the flexibility test.** The flexibility test requirement will now consider any power balance constraint shortage that is present in the interval immediately prior to the test hour.
- **Accounting for storage resource's state of charge in the resource sufficiency evaluation.** The capacity and flexibility test will now consider the state-of-charge from the market run immediately prior to the test hour.
- **Submission of load forecast adjustments to reflect non-participating demand response schedules.** Demand response programs, which cannot be accounted for otherwise in the real-time market, can be submitted as a load forecast adjustment to be accounted for in the resource sufficiency evaluation.
- **Suspension of uncertainty in the capacity test.** Intertie uncertainty was removed from the capacity test on June 1. Net load uncertainty was previously removed from the capacity test on February 15, 2022.
- **Exclusion of CAISO from allocation of funds associated with balancing test failure.** CAISO is now excluded from potential revenues from failures of the balancing test. The CAISO is not subject to the balancing test as it does make supply available through the base scheduling process.

Additional changes and details associated with phase 1 implementation can be found in the Business Requirements Specification.[7]

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[6] Capacity for a unit that is offline in the last 15-minute interval prior to the test hour will only be considered for short-start units (start-up time plus minimum up time at or below 255 minutes).

[7] California ISO, *Business Requirements Specification for WEIM Resource Sufficiency Evaluation Enhancements – Phase-1 (RSEE-1),* April 7, 2022: http://www.caiso.com/Documents/Business-Requirements-Specification-WEIM-Resource-Sufficiency-Evaluation-Enhancements-Phase1.pdf

4 Frequency of resource sufficiency evaluation failures

This section summarizes the frequency and shortfall amount for bid-range capacity test and flexible ramping sufficiency test failures.[8] If a balancing area fails either (or both) of these tests, then transfers between that and the rest of the WEIM areas are limited.

Figure 4.1 through Figure 4.4 show the number of 15-minute intervals in which each WEIM area failed the upward capacity or the flexibility tests as well as the average shortfall of those test failures. Figure 4.5 through Figure 4.8 provide the same information for the downward direction. The dash indicates that the area did not fail the test during the month.

Net load uncertainty was removed from the bid-range capacity test on February 15, 2022. Intertie uncertainty was removed on June 1, 2022. Net load uncertainty is proposed to return to the capacity test in the summer of 2023.[9] This is following the introduction of the new quantile regression methodology for calculating uncertainty that will be deployed as part of the flexible ramping product enhancements expected in the fall of 2022. The CAISO is also proposing to permanently remove intertie uncertainty from the capacity test.

Figure 4.9 summarizes the overlap between failure of the upward capacity and the flexibility tests during the month. The black horizontal line (right axis) shows the number of 15-minute intervals with either a capacity or a flexibility test failure for each WEIM 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 4.10 shows the same information for the downward direction. Areas that did not fail either the capacity or the flexibility tests during this period were omitted from the figure.

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8 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.

9 California ISO, *EIM Resource Sufficiency Evaluation Enhancements Phase 2 Straw Proposal*, July 1, 2022. http://www.caiso.com/InitiativeDocuments/StrawProposal-WEIMResourceSufficiencyEvaluationEnhancementsPhase2.pdf

Figure 4.1 Frequency of upward capacity test failures (number of intervals)

	2021							2022							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	5	8	5	—	9	1	—	—	1	1	—	—	—	—
Avista										—	1	—	5	5	1
BANC	—	7	—	1	—	—	—	—	—	—	—	—	—	—	1
BPA												—	3	—	1
California ISO	4	6	1	5	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	13	25	3	—	—	—	—	3	—	—	—	—	—	5
LADWP	2	—	—	—	8	5	2	—	—	—	—	—	—	1	—
NorthWestern	9	36	18	6	253	34	7	9	2	—	1	—	—	—	4
NV Energy	22	15	6	7	8	—	—	—	—	—	5	4	1	3	—
PacifiCorp East	10	9	4	6	4	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	4	7	2	3	2	14	11	8	3	9	1	6	1	29	5
Portland GE	21	25	30	41	13	6	11	3	—	—	—	—	—	—	2
Powerex	1	1	—	2	15	6	6	6	—	—	4	—	—	—	7
PSC New Mexico	—	11	—	5	—	—	—	—	—	—	—	—	—	—	—
Puget Sound En	45	16	21	17	29	18	10	—	—	—	1	1	5	—	—
Salt River Proj.	19	90	76	56	3	20	—	—	—	6	42	30	7	5	13
Seattle City Light	—	—	1	14	4	—	4	—	—	2	—	—	—	5	4
Tacoma Power										—	17	3	1	1	6
Tucson Elec.												—	—	—	2
Turlock ID	—	—	33	22	46	—	—	—	—	—	—	—	4	—	—

Figure 4.2 Average shortfall of upward capacity test failures (MW)

	2021							2022							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	92	45	97	—	80	20	—	—	64	3	—	—	—	—
Avista										—	1	—	6	27	5
BANC	—	53	—	6	—	—	—	—	—	—	—	—	—	—	37
BPA												—	81	—	8
California ISO	405	601	274	125	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	17	34	6	—	—	—	—	3	—	—	—	—	—	60
LADWP	46	—	—	—	95	103	40	—	—	—	—	—	—	0	—
NorthWestern	25	24	61	9	38	31	14	39	3	—	1	—	—	—	86
NV Energy	82	55	25	42	57	—	—	—	—	—	37	67	2	36	—
PacifiCorp East	73	40	38	63	79	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	10	26	16	36	2	15	85	33	41	77	3	11	50	24	36
Portland GE	34	46	36	38	31	32	15	32	—	—	—	—	—	—	1
Powerex	63	3	—	22	78	70	148	216	—	—	364	—	—	—	142
PSC New Mexico	—	129	—	57	—	—	—	—	—	—	—	—	—	—	—
Puget Sound En	50	58	74	46	33	54	39	—	—	—	13	1	27	—	—
Salt River Proj.	30	75	121	74	27	27	—	—	—	28	50	44	51	41	214
Seattle City Light	—	—	4	151	53	—	16	—	—	13	—	—	—	15	9
Tacoma Power										—	77	2	1	3	6
Tucson Elec.												—	—	—	20
Turlock ID	—	—	7	7	8	—	—	—	—	—	—	—	104	—	—

Figure 4.3 Frequency of upward flexibility test failures (number of intervals)

	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022
Arizona PS	—	1	—	7	—	10	1	1	5	2	—	—	—	1	2
Avista										—	7	15	28	14	4
BANC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
BPA												24	90	99	30
California ISO	1	10	3	11	—	3	—	—	—	—	—	—	—	—	2
Idaho Power	—	—	—	—	—	—	1	—	6	—	—	—	—	5	6
LADWP	—	4	—	—	1	1	10	—	—	3	—	—	—	—	—
NorthWestern	18	108	20	46	247	14	14	—	4	4	8	—	4	9	30
NV Energy	27	12	15	4	8	1	1	1	20	11	28	22	6	—	3
PacifiCorp East	2	1	—	4	—	2	1	1	1	—	4	4	3	5	4
PacifiCorp West	—	1	2	—	—	16	7	1	1	2	7	4	1	—	2
Portland GE	8	14	5	—	1	—	5	10	1	—	—	—	1	12	4
Powerex	4	15	—	—	7	5	8	7	1	—	4	—	—	—	10
PSC New Mexico	3	15	—	2	—	2	—	—	—	2	1	4	—	11	—
Puget Sound En	2	1	1	—	—	2	—	—	—	1	2	—	2	13	7
Salt River Proj.	26	57	49	24	5	36	1	5	—	19	14	5	13	19	34
Seattle City Light	—	1	—	4	—	—	—	—	—	2	—	—	—	6	1
Tacoma Power										—	—	4	3	1	2
Tucson Elec.												2	—	—	—
Turlock ID	—	—	—	2	5	—	—	—	—	—	—	—	—	—	—

Figure 4.4 Average shortfall of upward flexibility test failures (MW)

	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022
Arizona PS	—	38	—	42	—	45	33	37	45	120	—	—	—	28	28
Avista										—	18	29	26	19	30
BANC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
BPA												68	71	50	56
California ISO	404	585	400	735	—	540	—	—	—	—	—	—	—	—	684
Idaho Power	—	—	—	—	—	—	5	—	31	—	—	—	—	13	34
LADWP	—	70	—	—	10	11	97	—	—	106	—	—	—	—	—
NorthWestern	45	36	18	25	31	27	12	—	33	59	20	—	10	15	22
NV Energy	39	45	36	94	82	110	31	37	42	55	61	66	89	—	80
PacifiCorp East	53	44	—	21	—	57	10	124	59	—	83	77	9	34	43
PacifiCorp West	—	2	33	—	—	74	67	3	7	33	58	24	5	—	31
Portland GE	36	33	19	—	11	—	18	36	37	—	—	—	8	72	25
Powerex	137	111	—	—	50	88	41	202	26	—	366	—	—	—	318
PSC New Mexico	19	112	—	47	—	69	—	—	—	46	23	33	—	70	—
Puget Sound En	24	6	24	—	—	82	—	—	—	3	32	—	49	46	17
Salt River Proj.	69	61	53	50	32	65	10	43	—	45	36	43	89	45	156
Seattle City Light	—	7	—	14	—	—	—	—	—	8	—	—	—	17	2
Tacoma Power										—	—	206	6	3	5
Tucson Elec.												22	—	—	—
Turlock ID	—	—	—	2	18	—	—	—	—	—	—	—	—	—	—

Figure 4.5 Frequency of downward capacity test failures (number of intervals)

	2021							2022							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	—	—	5	—	10	—	—	—	1	1	—	—
Avista										—	—	—	—	5	—
BANC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
BPA												—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	4	—	—	—	—	—	17	—	—	—
LADWP	2	—	—	—	5	—	—	10	—	—	—	7	—	—	—
NorthWestern	—	—	—	—	29	—	—	—	—	—	—	—	—	—	—
NV Energy	1	—	—	—	—	—	—	—	—	—	—	3	12	—	—
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Powerex	8	3	—	24	9	1	—	4	—	4	—	4	—	—	1
PSC New Mexico	—	—	—	—	7	4	—	—	—	4	—	2	—	—	—
Puget Sound En	—	—	—	—	1	—	—	—	—	—	—	1	20	2	—
Salt River Proj.	1	—	—	—	—	—	1	—	5	10	—	12	15	2	6
Seattle City Light	—	1	1	1	—	7	5	—	—	2	—	—	1	3	—
Tacoma Power										—	22	2	—	19	8
Tucson Elec.												—	1	—	—
Turlock ID	6	1	6	5	20	3	1	2	1	—	4	—	—	—	—

Figure 4.6 Average shortfall of downward capacity test failures (MW)

	2021							2022							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Arizona PS	—	—	—	—	—	63	—	240	—	—	—	33	19	—	—
Avista										—	—	—	—	52	—
BANC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
BPA												—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	38	—	—	—	—	—	7	—	—	—
LADWP	16	—	—	—	30	—	—	33	—	—	—	34	—	—	—
NorthWestern	—	—	—	—	55	—	—	—	—	—	—	—	—	—	—
NV Energy	26	—	—	—	—	—	—	—	—	—	—	53	41	—	—
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	23	—	—
Powerex	350	33	—	144	51	7	—	48	—	90	—	175	—	—	13
PSC New Mexico	—	—	—	—	22	65	—	—	—	40	—	6	—	—	—
Puget Sound En	—	—	—	—	33	—	—	—	—	—	—	61	31	19	—
Salt River Proj.	29	—	—	—	—	—	8	—	12	12	—	41	46	8	72
Seattle City Light	—	8	8	5	—	18	10	—	—	9	—	—	2	7	—
Tacoma Power										—	29	3	—	5	8
Tucson Elec.												—	6	—	—
Turlock ID	4	3	8	2	5	1	3	1	1	—	3	—	—	—	—

Figure 4.7 Frequency of downward flexibility test failures (number of intervals)

	2021 Jun	2021 Jul	2021 Aug	2021 Sep	2021 Oct	2021 Nov	2021 Dec	2022 Jan	2022 Feb	2022 Mar	2022 Apr	2022 May	2022 Jun	2022 Jul	2022 Aug
Arizona PS	4	—	4	2	3	15	11	43	11	25	10	15	6	—	—
Avista										—	—	—	2	—	—
BANC	—	—	—	—	—	—	4	—	—	3	1	2	2	—	—
BPA												4	7	—	1
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	8	1	—	1	—	8	13	—	—	1
LADWP	2	—	—	—	2	—	—	4	—	—	—	—	—	—	—
NorthWestern	10	18	11	33	68	4	1	—	—	—	—	16	56	6	—
NV Energy	58	88	74	48	34	11	13	17	111	50	92	39	52	19	7
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	4	—	—	—	—	1	—	—	—	1	1	3	11	16	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—
Powerex	36	12	6	29	12	1	4	—	1	7	1	9	6	—	4
PSC New Mexico	1	—	—	4	11	20	4	9	1	36	10	53	19	1	1
Puget Sound En	—	—	—	—	—	1	—	—	—	—	—	6	66	2	—
Salt River Proj.	5	—	2	1	2	1	2	2	28	46	6	11	14	6	7
Seattle City Light	—	6	—	—	—	1	1	—	—	2	4	4	9	2	23
Tacoma Power										—	11	8	—	14	6
Tucson Elec.												—	—	—	—
Turlock ID	—	—	1	—	18	3	5	6	—	14	16	4	13	3	2

Figure 4.8 Average shortfall of downward flexibility test failures (MW)

	2021 Jun	2021 Jul	2021 Aug	2021 Sep	2021 Oct	2021 Nov	2021 Dec	2022 Jan	2022 Feb	2022 Mar	2022 Apr	2022 May	2022 Jun	2022 Jul	2022 Aug
Arizona PS	26	—	50	27	36	81	51	69	32	42	54	58	33	—	—
Avista										—	—	—	20	—	—
BANC	—	—	—	—	—	—	71	—	—	18	7	5	15	—	—
BPA												212	55	—	4
California ISO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	31	40	—	43	—	18	55	—	—	13
LADWP	14	—	—	—	5	—	—	43	—	—	—	—	—	—	—
NorthWestern	259	14	29	17	25	21	7	—	—	—	—	12	27	14	—
NV Energy	65	141	70	83	39	34	24	44	92	55	86	49	98	151	59
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	140	—	—	—	—	32	—	—	—	4	15	55	28	11	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—	18	—	—
Powerex	199	83	44	121	101	16	163	—	15	184	3	257	244	—	87
PSC New Mexico	12	—	—	102	56	41	223	77	15	64	40	144	34	3	9
Puget Sound En	—	—	—	—	—	16	—	—	—	—	—	54	33	47	—
Salt River Proj.	44	—	25	100	22	4	11	45	35	49	74	62	34	54	155
Seattle City Light	—	2	—	—	—	2	3	—	—	10	6	7	11	10	21
Tacoma Power										—	5	14	—	5	4
Tucson Elec.												—	—	—	—
Turlock ID	—	—	4	—	16	3	94	9	—	5	20	5	6	3	2

Figure 4.9 Upward capacity/flexibility test failure intervals by concurrence (August 2022)

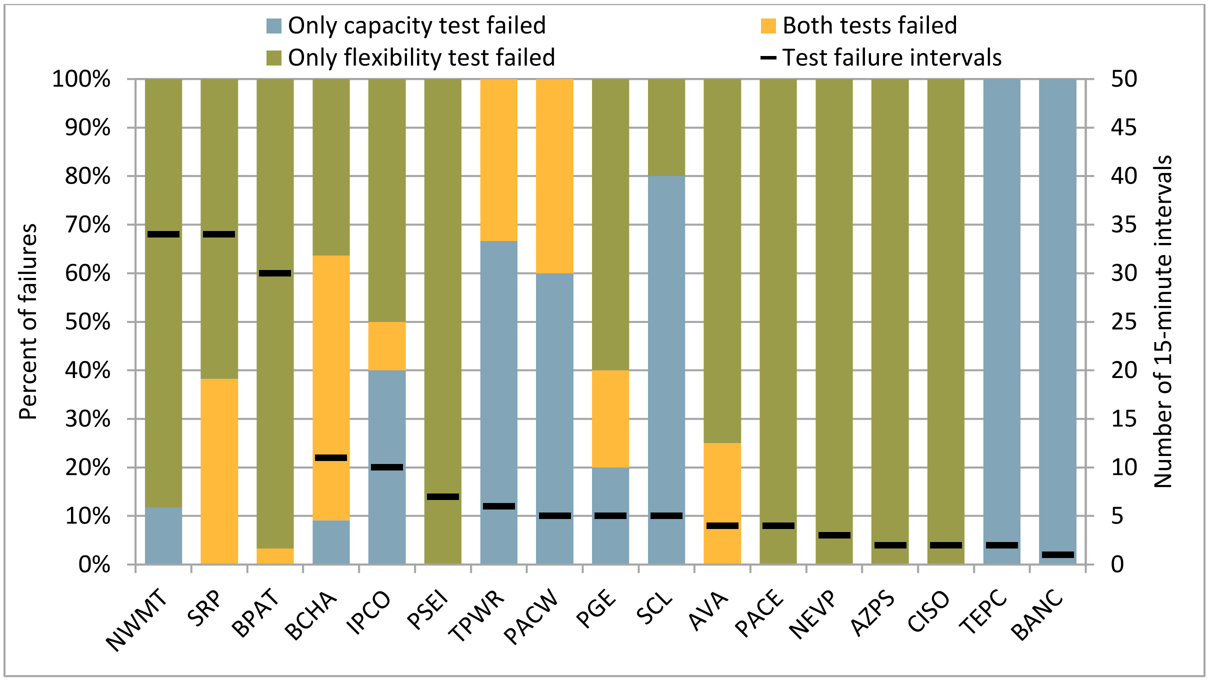
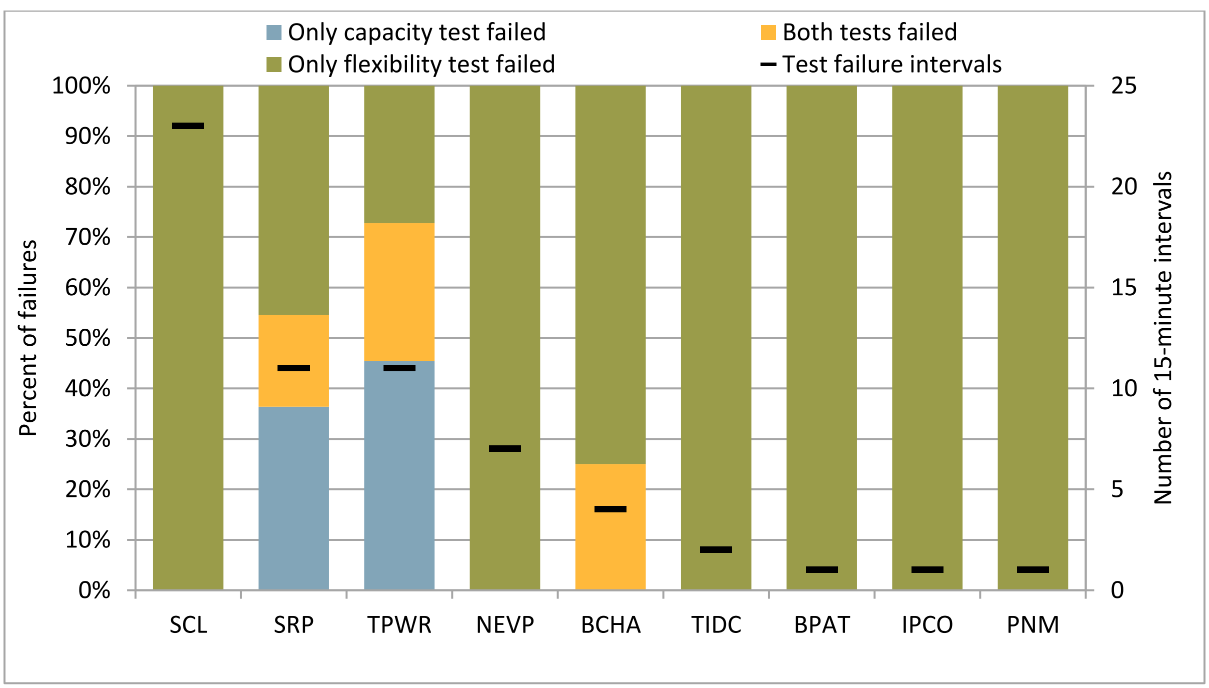


Figure 4.10 Downward capacity/flexibility test failure intervals by concurrence (August 2022)



5 Metrics for key time periods

This section highlights test results and outcomes during specific periods of interest. During August, the CAISO did not fail the bid-range capacity test but did fail the flexibility test during two intervals on August 30. The metrics below show flexibility test requirements and ramping capacity during this period.

Figure 5.1 shows the requirement components in the CAISO upward flexible ramping sufficiency test against total ramping capacity. The requirement is calculated as the forecasted change in load plus net load uncertainty minus two discounts, both diversity benefit and flexible ramping credits. Upward credits are net WEIM exports prior to the hour, reflecting the ability to reduce exports to increase internal upward ramping capability. For this peak period, the CAISO was importing on net in every 15-minute interval so no credits were applied to the upward flexibility test.

Figure 5.2 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 5.1 CAISO upward flexible ramping sufficiency test requirement by component (August 30, 2022)

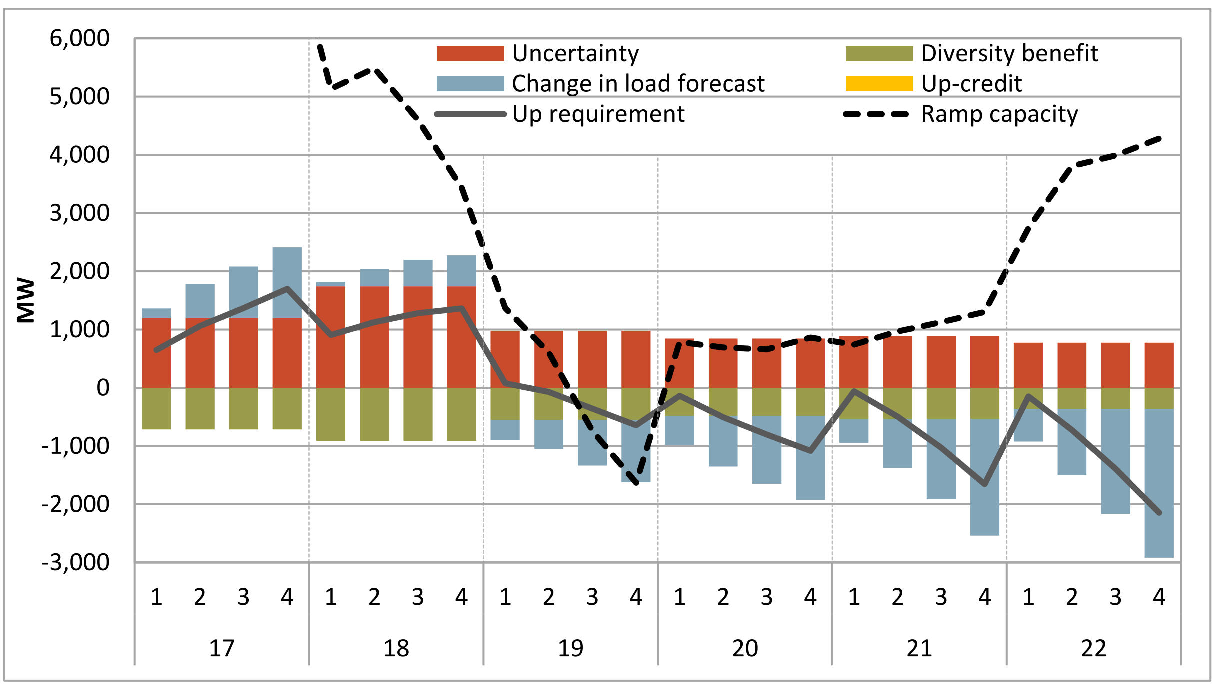
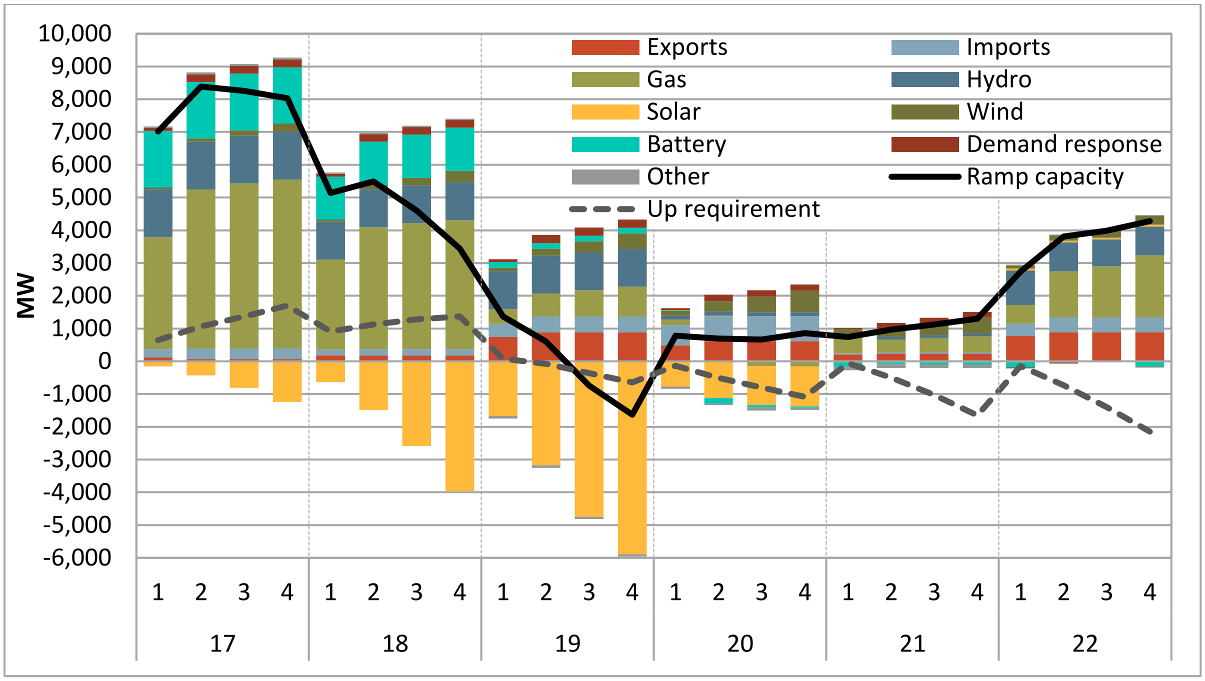


Figure 5.2 CAISO upward flexible ramping sufficiency test ramping capacity by resource type (August 30, 2022)



6 Western Energy Imbalance Market limits and transfers following test failure

This section summarizes the import limits that are imposed when a WEIM entity fails either the bid-range capacity or the flexible ramping sufficiency test in the upward direction. These limits are also compared against actual WEIM transfers during these insufficiency periods.

WEIM import limits following test failure

When either test fails in the upward direction, imports will be capped at the greater of (1) the base transfer or (2) the transfer from the last 15-minute market interval. Figure 6.1 summarizes the import limits after failing either test by the source of the limit. The black horizontal line (right axis) shows the number of 15-minute intervals with either a capacity or a flexibility test failure while the bars (left axis) show the percent of failure intervals in which the WEIM import limit was capped by either the base transfer or the last 15-minute market transfer. In some cases, the import limit after failing the test (i.e. the greater of the base transfer or last 15-minute interval transfer) is at or above the unconstrained total import capacity. In these cases, the import limit imposed after failing the test has no impact.

Figure 6.1 Upward capacity/flexibility test failure intervals by source of import limit (August 2022)

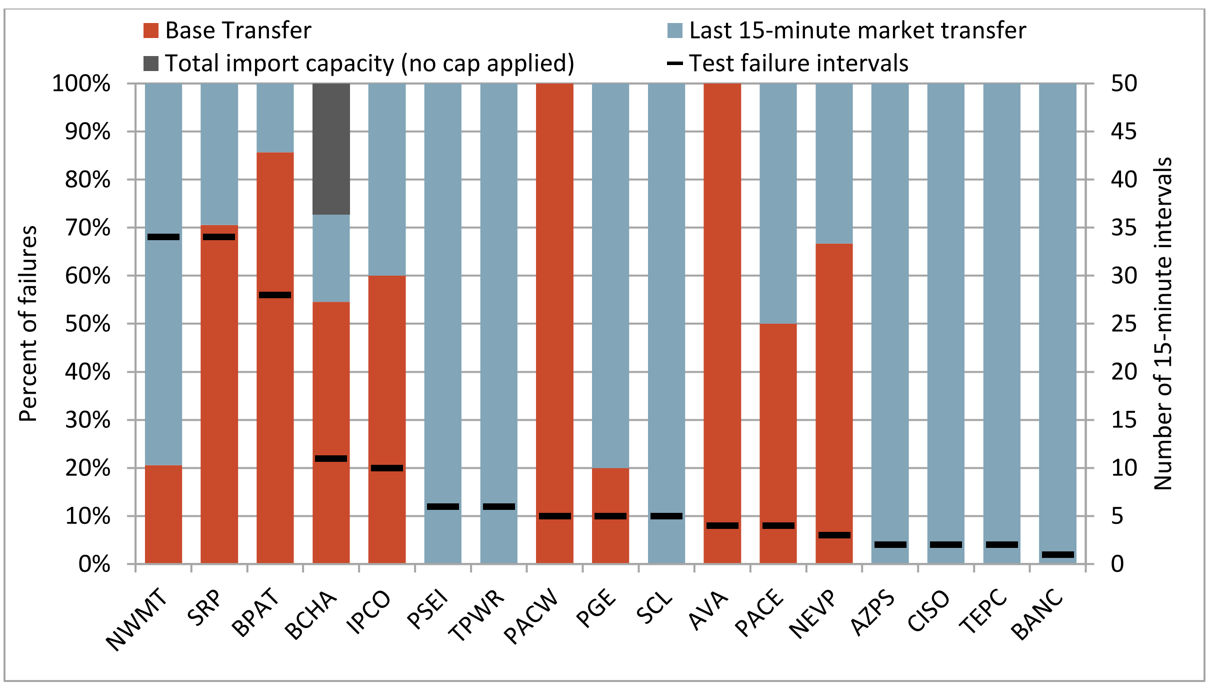
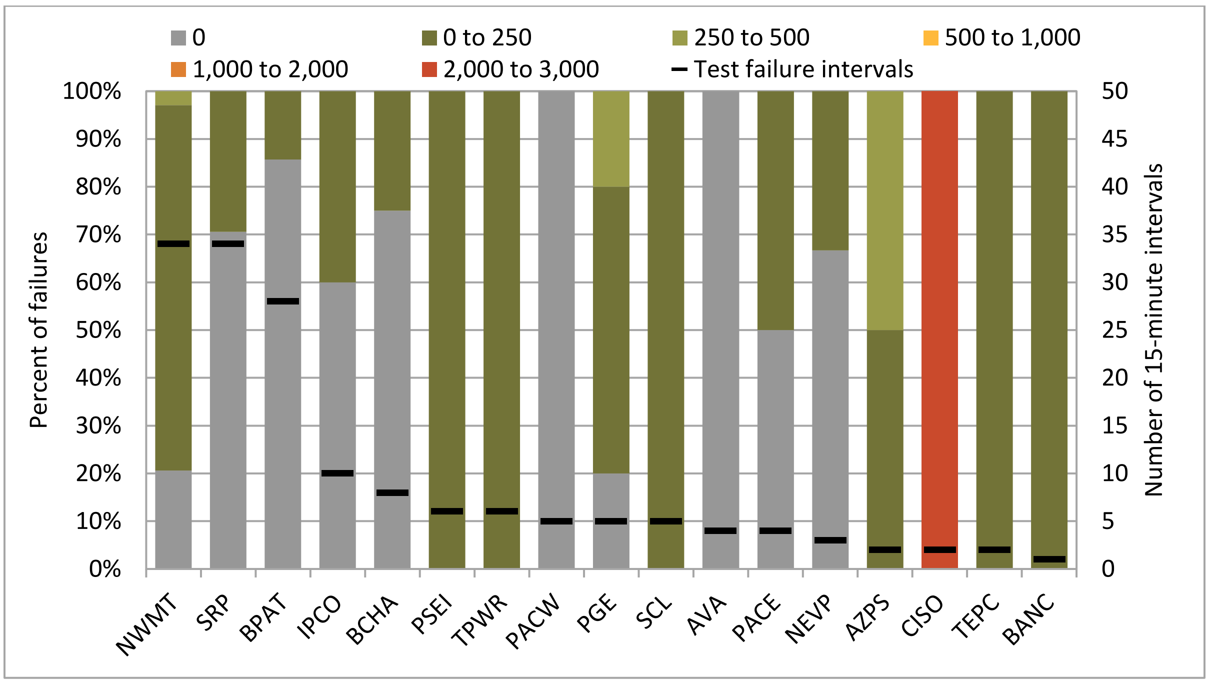


Figure 6.2 summarizes *dynamic* WEIM import limits above base transfers (fixed bilateral transactions between WEIM entities) after failing either test in the upward direction. From this perspective, the incremental WEIM import limit after a test failure is set by the greater of (1) zero or (2) the transfer from the last 15-minute market interval minus the current base transfer. Therefore, the dynamic import limits show the incremental flexibility available through the Western Energy Imbalance Market after a resource sufficiency evaluation failure. The black horizontal line (right axis) shows the number of

15-minute intervals with an import limit imposed after a test failure; areas without any upward test failures or imposed import limits during the month were excluded.[10]

The California ISO failed the resource sufficiency evaluation in two intervals during the month. The import limits here following the resource sufficiency evaluation were almost 3,000 MW. The CAISO does not have base transfers and often has a high volume of dynamic imports prior to any upward test failure, which will set the import limit during the failure interval. Substantial imbalance conformance adjustments entered by the CAISO operators can further contribute to this outcome. Here, the optimal transfer in the last 15-minute interval increases as the optimization solves for load plus imbalance conformance, potentially setting a higher import limit than would have existed otherwise.

Figure 6.2 Upward capacity/flexibility test failure intervals by dynamic import limit (August 2022)



WEIM transfers following a test failure

The previous section looked at WEIM import limits imposed following a resources sufficiency evaluation failure. This section instead summarizes optimized WEIM transfers during these failure periods.

Figure 6.3 summarizes dynamic WEIM transfers (excluding any base transfer) on net for each area during an upward resource sufficiency evaluation failure in the month. Again, the black horizontal line (right axis) shows the number of 15-minute intervals with either a capacity or a flexibility test failure while the bars (left axis) show the percent of failure intervals in which the balancing area was a net importer or net exporter in the corresponding real-time market interval. Figure 6.4 summarizes the same information with the net transfer quantity categorized by various levels.

[10] Test failure intervals in which an import limit was not imposed because it was at or above the unconstrained total import capacity were excluded from this summary.

As shown by Figure 6.3, WEIM balancing areas were commonly optimized as a net exporter during the month despite failing the resource sufficiency evaluation. This result is in part driven from net load uncertainty that is included in the flexibility test. In some cases, the balancing area would fail the resource sufficiency evaluation in part because of the uncertainty component, but then in the real-time market it could then be economically optimal to export if that uncertainty does not materialize.

Other factors can also contribute to this outcome as a net exporter. First, a decrease in the load forecast (or increase in wind or solar forecasts) from the resource sufficiency evaluation to the real-time market run can lead to greater resource sufficiency and WEIM exports. A negative imbalance conformance adjustment entered by WEIM operators can also be included in the market run as effectively lower load, but will not be included in the resource sufficiency evaluation.

Figure 6.5 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 constrained to the limit imposed after failing the test. These results are shown separately for the 15-minute (FMM) and 5-minute (RTD) markets.

Figure 6.3 Upward test failure by dynamic net WEIM transfer status (August 2022)

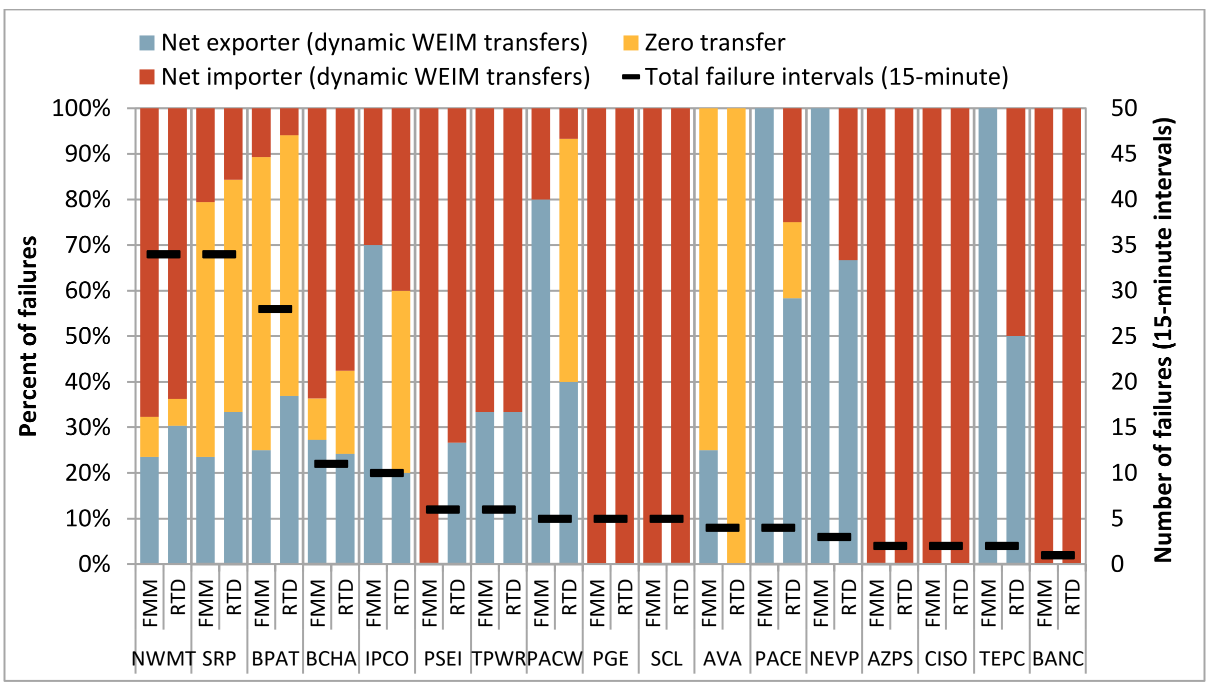


Figure 6.4 Upward test failure by dynamic net WEIM transfer amount (August 2022)

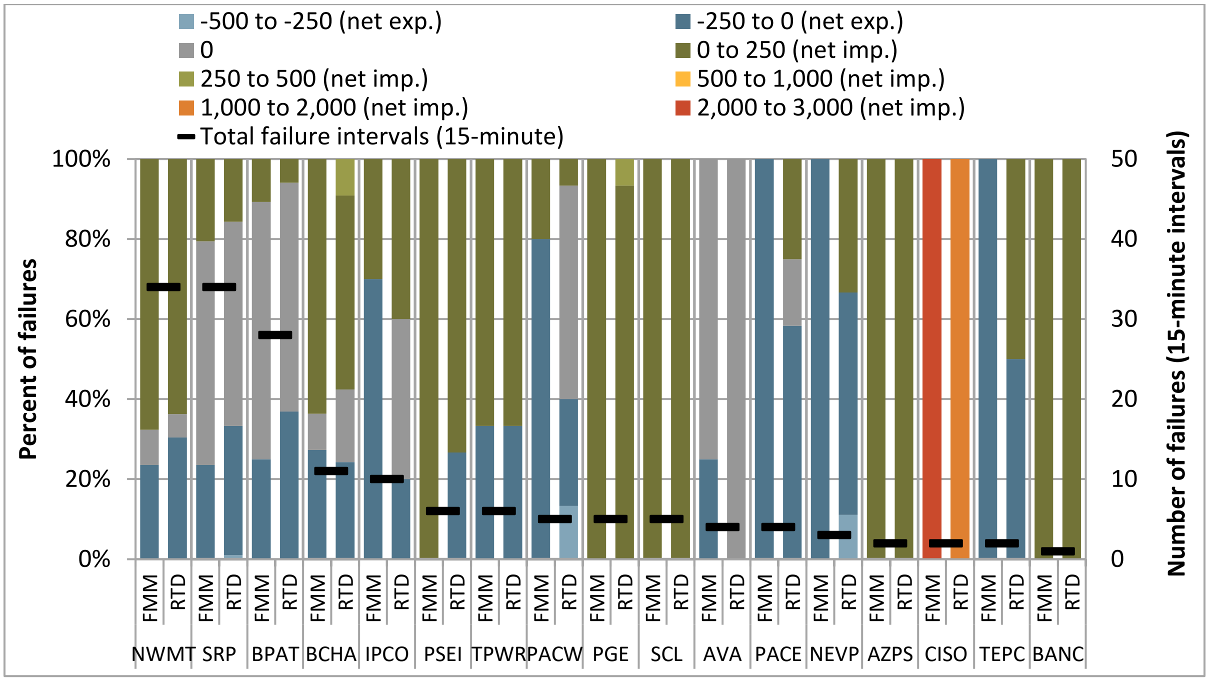
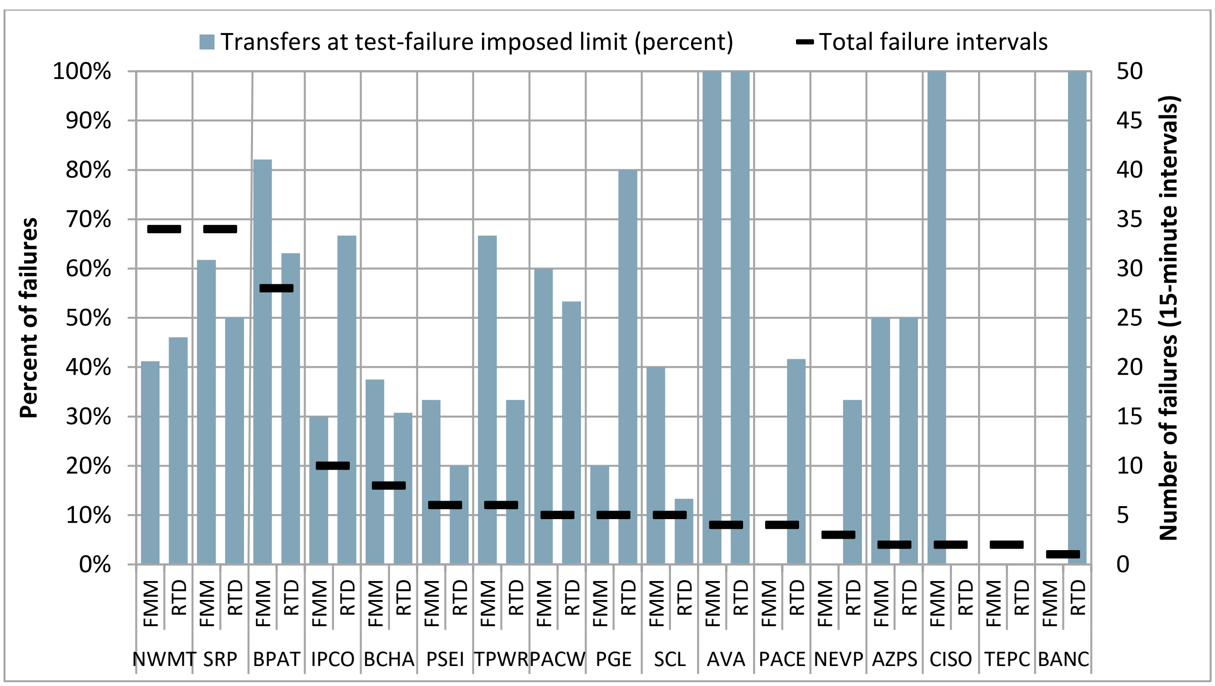


Figure 6.5 Percent of upward test failure intervals with market transfers at the imposed cap (August 2022)



7 Imbalance conformance in the Western Energy Imbalance Market

Operators in every balancing area of the Western Energy Imbalance Market, including the California ISO, can manually adjust the load through imbalance conformance adjustments. These adjustments, sometimes referred to as *load bias,* are not used directly in either the bid range capacity or the flexible ramp sufficiency tests; however, they can indirectly impact test results in several ways.

- The flexible ramp sufficiency test measures ramping capacity from the start of the hour (i.e. last binding 15-minute interval) compared to 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.
- The bid-range capacity test requirement includes all import and export base schedules.[11] Additional imports and exports (relative to these base schedules) that are *15-minute-dispatchabale* are then included as incremental or decremental capacity. Thus, the maximum of 15-minute dispatchable imports would be included in the capacity test regardless of the dispatch. However, imbalance conformance adjustments made by the CAISO operators in the hour-ahead market can impact non-15-minute dispatchable import and export schedules included in the requirement.
- The penalty for failing either the upward capacity or the flexibility test is that WEIM transfers are capped by the greater of the transfer in the last 15-minute interval prior to the hour or base transfers. Due to this, a higher imbalance conformance adjustment entered prior to the hour can increase transfers into the balancing area resulting in higher transfer limits following a failure, than would have occurred otherwise.

The CAISO is not proposing any changes in the WEIM resource sufficiency evaluation to account for operator imbalance conformance.[12]

Figure 7.1 summarizes average hour-ahead and 15-minute market imbalance conformance adjustments entered by the CAISO operators during the month. Between peak hours 17 and 21, 15-minute market imbalance conformance averaged around 1,980 MW. Figure 7.2 shows the hourly distribution of 15-minute market imbalance conformance.

Figure 7.3 shows the same information for Bonneville Power Administration (BPA). 15-minute market imbalance conformance from BPA operators was on average 63 MW between hours 11 and 22. Figure 7.4 shows imbalance conformance adjustments for other WEIM entities with substantial imbalance conformance and Figure 7.5 shows adjustments as a percent of total load.[13]

Table 7.1 summarizes the average frequency and size of 15-minute and 5-minute market imbalance conformance for all balancing authority areas.

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[11] For the CAISO, the base schedules used in the requirement are the advisory schedules from the last 15-minute market run.

[12] California ISO, *EIM Resource Sufficiency Evaluation Enhancements Phase 2 Straw Proposal*, July 1, 2022. http://www.caiso.com/InitiativeDocuments/StrawProposal-WEIMResourceSufficiencyEvaluationEnhancementsPhase2.pdf

[13] WEIM entities with an average absolute 15-minute market imbalance conformance of less than 1 MW or less than 0.1 percent of load were omitted from the chart.

Figure 7.1 Average CAISO hour-ahead and 15-minute market imbalance conformance (August 2022)

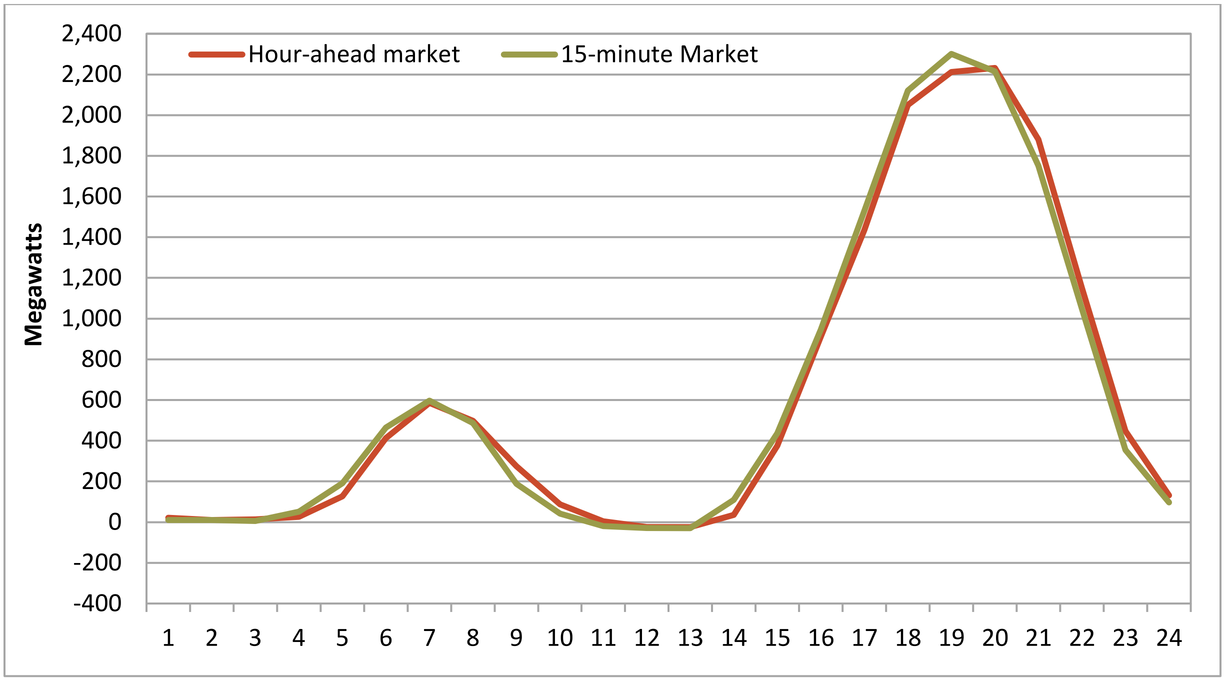


Figure 7.2 Distribution of CAISO 15-minute market imbalance conformance (August 2022)

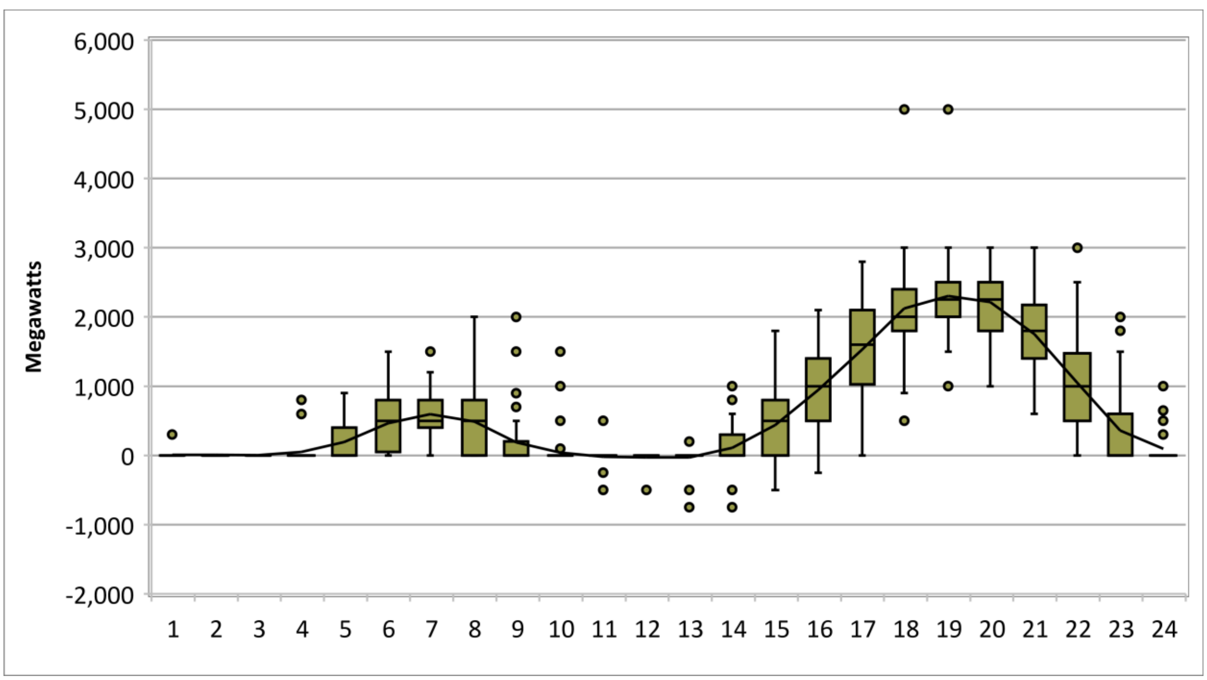


Figure 7.3 Average hourly BPA 15-minute market imbalance conformance (August 2022)

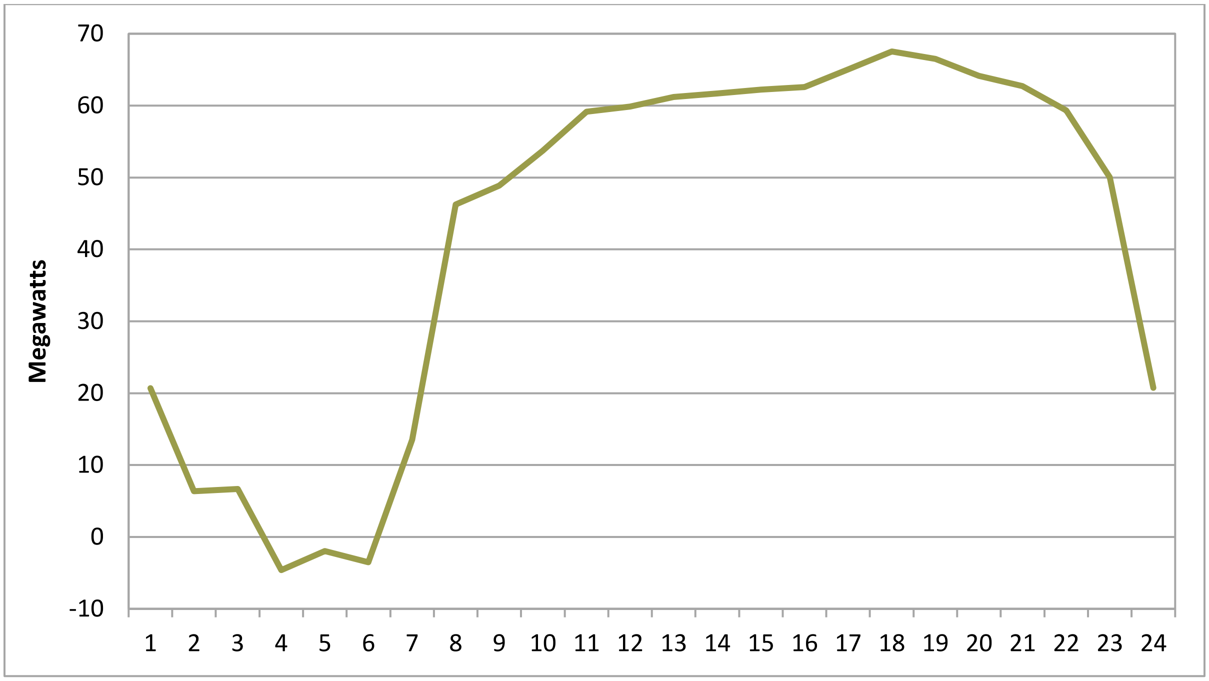


Figure 7.4 Average hourly 15-minute market imbalance conformance (August 2022)

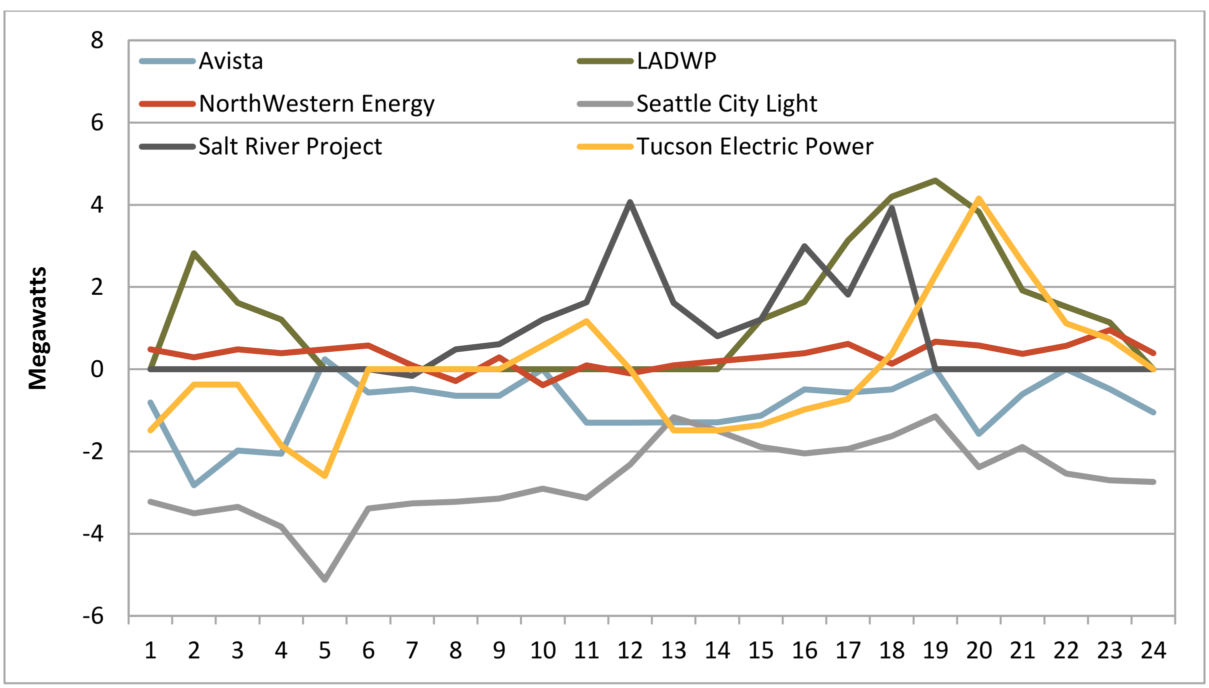


Figure 7.5 Average hourly 15-minute market imbalance conformance *as a percent of load* (August 2022)

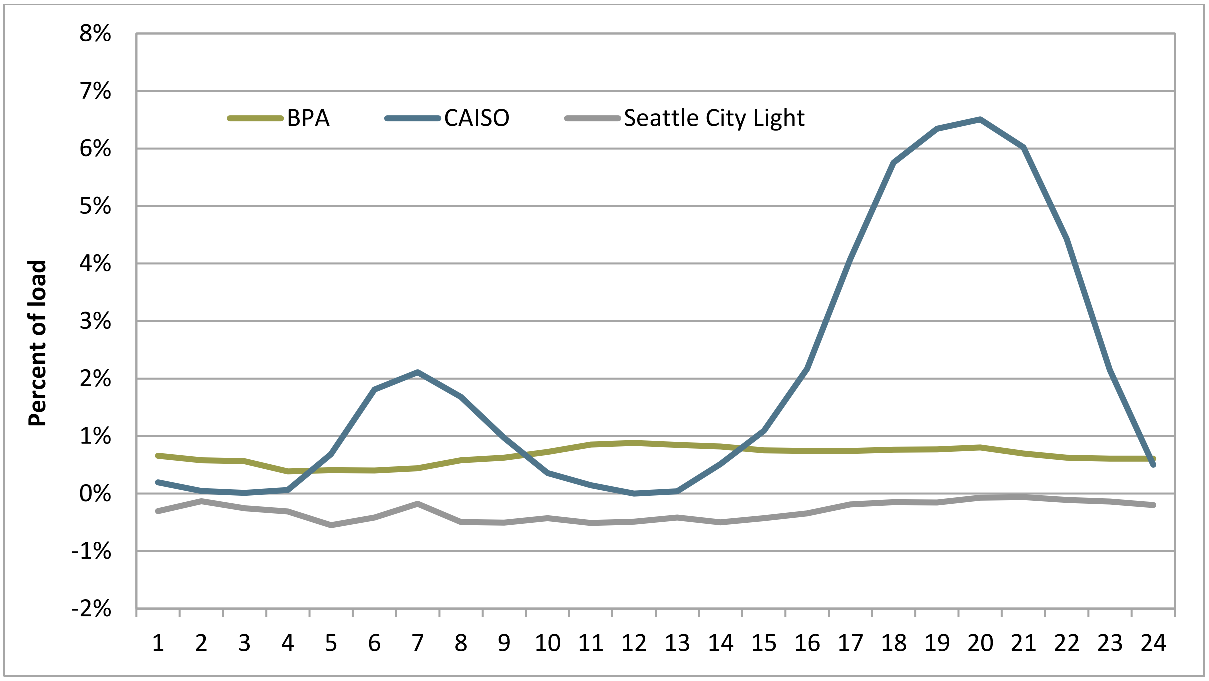


Table 7.1 Average frequency and size of imbalance conformance (August 2022)

		Positive imbalance conformance			Negative imbalance conformance			Average hourly adjustment MW
Balancing area	***Market***	Percent of intervals	Average MW	Percent of total load	Percent of intervals	Average MW	Percent of total load	
Arizona Public Service	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	41%	67	1.4%	22%	-67	1%	13
Avista	15-minute market	0.3%	19	1.6%	3%	-36	3%	-1
	5-minute market	4%	24	2%	43%	-21	2%	-8
Balancing Authority of Northern California	15-minute market	0.2%	33	1.2%	1%	-104	3.5%	-1
	5-minute market	0.8%	34	1.1%	2%	-90	3.0%	-1
Bonneville Power Administration	15-minute market	84%	53	0.9%	15%	-19	0.4%	42
	5-minute market	85%	54	0.9%	15%	-19	0.4%	43
California ISO	15-minute market	48%	1312	3.9%	1%	-460	1.6%	618
	5-minute market	38%	263	0.8%	30%	-378	1.2%	-12
Idaho Power	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	24%	56	1.9%	5%	-51	2.0%	11
Los Angeles Department of Water and Power	15-minute market	2.5%	48	1.3%	0%	N/A	N/A	1
	5-minute market	22%	59	1.7%	7%	-46	1.5%	10
NorthWestern Energy	15-minute market	6%	13	0.9%	3%	-12	0.9%	0
	5-minute market	15%	15	1.0%	8%	-17	1.3%	1
NV Energy	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	51%	139	2.3%	3%	-95	1.7%	69
PacifiCorp East	15-minute market	0%	N/A	N/A	0.1%	-420	6.6%	0
	5-minute market	17%	107	1.6%	24%	-119	1.8%	-10
PacifiCorp West	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	2%	62	2.5%	22%	-55	2.1%	-11
Portland General Electric	15-minute market	0%	N/A	N/A	0.4%	-43	1.1%	0
	5-minute market	12%	30	1.0%	1%	-35	1.2%	3
Public Service Company of New Mexico	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	21%	48	2.9%	2%	-61	3.8%	9
Puget Sound Energy	15-minute market	0.1%	48	1.5%	2%	-51	2.2%	-1
	5-minute market	1%	39	1.2%	47%	-39	1.5%	-18
Salt River Project	15-minute market	2%	62	1.1%	0.3%	-89	1.6%	1
	5-minute market	14%	63	1.1%	0.8%	-90	2.0%	8
Seattle City Light	15-minute market	0.3%	10	0.8%	11%	-24	2.5%	-3
	5-minute market	1%	25	2.2%	77%	-26	2.6%	-19
Tacoma Power	15-minute market	0%	N/A	N/A	0%	N/A	N/A	0
	5-minute market	6%	16	3.4%	5%	-14	3.6%	0
Tucson Electric Power	15-minute market	1%	50	2.6%	1%	-43	2.6%	0
	5-minute market	17%	54	3.0%	10%	-61	3.6%	3
Turlock Irrigation District	15-minute market	0%	N/A	N/A	0.1%	-25	6.0%	0
	5-minute market	0.01%	1	0.2%	0.4%	-22	5.3%	0

8 Input differences between the resource sufficiency evaluation and latest 15-minute market run

DMM reviewed cases in the CAISO balancing area when optimized net WEIM imports in the market significantly exceeded the unloaded capacity calculated by the resource sufficiency evaluation — but the CAISO still passed the test. DMM analysis found that this outcome was driven by differences between inputs in the resource sufficiency evaluation and inputs used in the market.

The bid-range capacity test requires that each area show sufficient incremental bid-in capacity to meet the imbalance between load, intertie, and generation base schedules that exists without WEIM transfers. For the CAISO, the base schedules used in the requirement are from the advisory schedules from the latest 15-minute market run.

Figure 8.1 compares the imbalance requirement in the bid-range capacity test with advisory WEIM transfers from the latest 15-minute market run, on average for the month. The red bars show the imbalance requirement in the capacity test. In other words, the red bars are the *test perspective* for the amount needed to overcome to balance internal supply without WEIM transfers.

The green bars show advisory net WEIM imports in the 15-minute market and reflect the latest market results available at the time of the resource sufficiency evaluation for the upcoming hour.[14] These values can be interpreted as the WEIM imports balancing supply and demand in the advisory interval, or the *market perspective* for the amount needed to replace to balance internal supply without WEIM transfers.[15] Figure 8.1 compares these advisory net WEIM imports (green bars) to the imbalance requirement used in the bid-range capacity test (red bars).

The energy imbalance (without WEIM transfers) used in the bid-range capacity test can differ from the expected net WEIM transfers from the last market run; Figure 8.2 summarizes the source of this difference by input. The figure shows additional net demand in the latest 15-minute market run that is not accounted for by the capacity test, on average for the month. These categories are listed and described further below.

Figure 8.3 shows the comparison between the CAISO capacity test requirements and WEIM imports during peak evening hours of August 30, 2022. The blue line shows the unloaded capacity used in the bid-range capacity test. On this day, CAISO WEIM imports exceeded unloaded capacity calculated by the resource sufficiency evaluation in nine intervals. The CAISO did not fail the capacity test during this period. In particular, imbalance conformance adjustments are included in the market optimization as increases in load (which increases WEIM imports), but are not included in the capacity test load. Without the imbalance conformance, CAISO unloaded capacity exceeded the capacity test requirement.

Analysis by the CAISO has shown that there is no one-to-one relationship between an increase in imbalance conformance and an increase in WEIM transfers.[16] The analysis showed that the use imbalance conformance does not strictly improve the CAISO's ability to pass the test by unloading

[14] The advisory intervals are pulled from the market run binding in interval 4 of the hour immediately prior to the test hour.

[15] If there were a power balance shortage, this insufficiency would also need to be covered to meet load.

[16] California ISO, *WEIM Transfers, Hourly Interties and Load Conformance*, June 21, 2022. http://www.caiso.com/InitiativeDocuments/FinalAnalysisReport-WEIMTransfers-HourlyInterties-Load.pdf

internal resources. Instead, imbalance conformance can also increase the output levels of internal resources resulting in less available capacity and flexibility.

Figure 8.1 Average capacity test imbalance requirement and net WEIM imports to CAISO (August 2022)

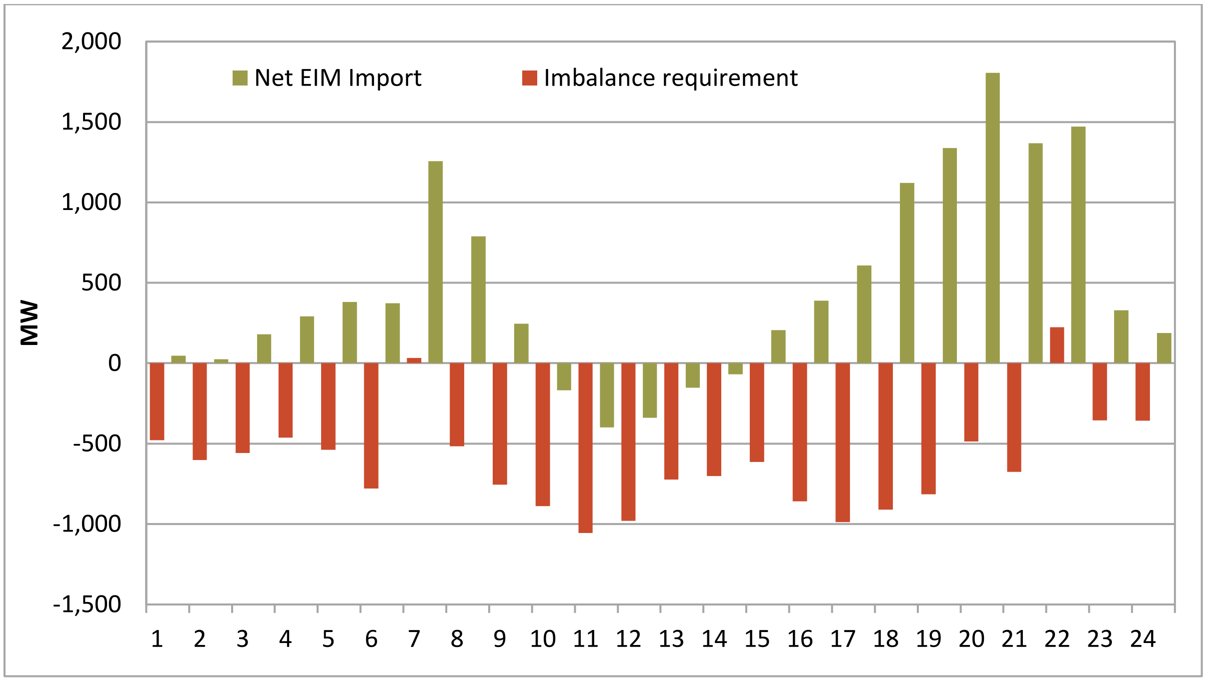


Figure 8.2 Additional CAISO net demand in the latest 15-minute market run not accounted for in the bid-range capacity test (August 2022)

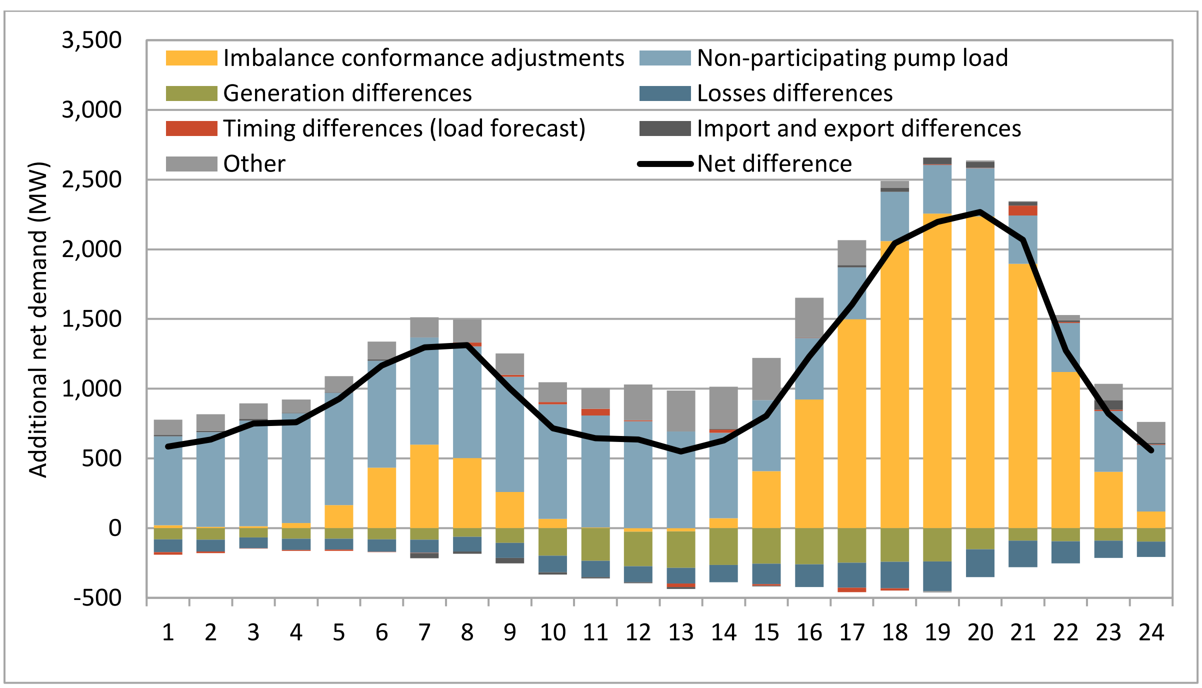
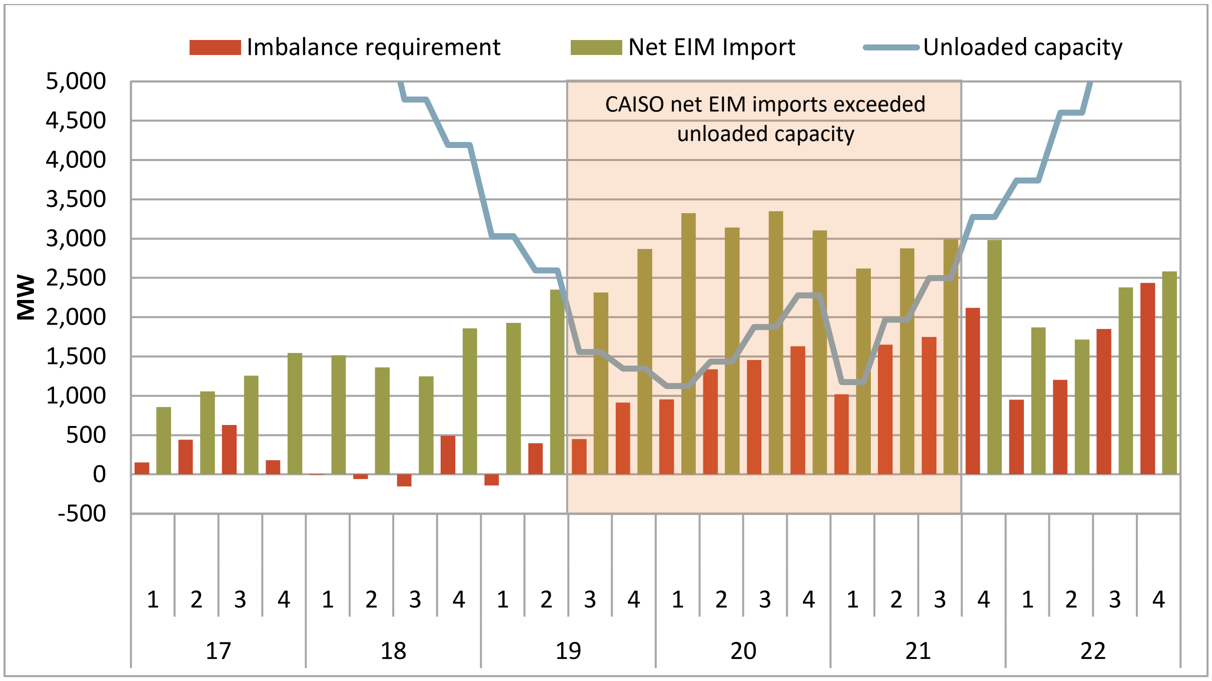


Figure 8.3 Average capacity test imbalance requirement, net WEIM imports, and unloaded capacity (CAISO, August 30, 2022)



The list below summarizes some of the differences identified between inputs in the resource sufficiency evaluation and in the latest 15-minute market run.

- **Imbalance conformance adjustments.** These adjustments are included in the market optimization as changes in load, but are not included in the bid-range capacity test. This accounted for most of the differences.

- **Non-participating pump load.** This is pumping load that is bid and scheduled as non-participating load in the day-ahead market, and is included as a component of total load in the market optimization. This is not included in the bid-range capacity test requirement.

- **Hourly block import schedules versus intertie ramping.** The bid-range capacity test imbalance requirement uses the hourly block schedules for import and export resources. The market optimization uses more granular 15-minute values, which account for intertie ramping between hours. This can create import and export differences at the start and end of the hour.

- **Losses differences.** The bid-range capacity test uses the raw load forecast directly, which already factor in losses. The market optimization uses this, instead, as an input, removes the estimated portion of losses, and allows the market to solve for it. Thus, there can be differences between the estimated losses considered in the bid-range capacity test and the market losses.

- **Timing differences.** There are slight timing differences between the latest 15-minute market run (that produced the net WEIM imports shown in the figure) and the binding resource sufficiency evaluation, which can impact some of the generation and load inputs.

- **Generation differences.** There is a subset of resources that do not have bids and are not receiving energy instructions but are injecting power into the system. This generation is accounted for in the market to balance power but is not included in the bid-range capacity test.

These differences mean that net WEIM imports have previously exceeded unloaded capacity without a test failure. Inspecting the components can also help flag potential accuracy issues. DMM recommends that the CAISO and stakeholders review some of these differences to potentially improve the accuracy of the test.

9 Net load uncertainty in the resource sufficiency evaluation

This section highlights where net load uncertainty currently used in the resource sufficiency evaluation comes from, and how it compares with error between load and variable energy resources (VER) amounts used in the tests and in the real-time market. The uncertainty component currently used in both the flexible ramp sufficiency test and the bid-range capacity test, is pulled from the 15-minute market flexible ramping product uncertainty calculations. As noted in this section, DMM recommends that any uncertainty calculation used in the resource sufficiency evaluation be developed separately from that of the flexible ramping product.

Current load uncertainty calculation

The uncertainty component, currently used in both the flexible ramp sufficiency test and the bid-range capacity test, is pulled from the 15-minute market flexible ramping product uncertainty calculations. These are calculated from historical net load error observations in the same hour based on the error between advisory 15-minute market net load and binding 5-minute market net load.[17] The 2.5 percentile of these observations is used for downward uncertainty and the 97.5 percentile is used for upward uncertainty.

The 95 percent confidence interval for the uncertainty requirement in the flexible ramping product was designed to capture the upper end of uncertainty needs, such that it could be optimally relaxed based on the trade-off between the cost of procuring additional flexible ramping capacity and the expected cost of a power balance violation costs. In the resource sufficiency evaluation, this trade-off is not considered, and the upper end of uncertainty is instead required in full to pass both tests. DMM has asked the CAISO and stakeholders to consider whether the 95 percent confidence interval, or another, is most appropriate for the tests.[18]

Further, the resource sufficiency evaluation occurs in a different timeframe than the 15-minute market. Figure 9.1 illustrates the current uncertainty calculation — based on net load error between an advisory 15-minute market interval and corresponding binding 5-minute market intervals — as well as how it compares with the timeframe of the resource sufficiency evaluation. The current uncertainty calculation captures 45 to 55 minutes of potential uncertainty from the 15-minute market run to three corresponding 5-minute market runs. In contrast, when comparing the VER and load forecast values used in each interval of the resource sufficiency evaluation to corresponding 5-minute intervals, there exist a larger gap for uncertainty to materialize.[19]

In comparing the first 15-minute test interval to corresponding 5-minute market intervals, the timeframe and potential for net load uncertainty is similar to the timeframe of the 15-minute market

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[17] Weekdays use data for the same hour from the last 40 weekdays. For weekends, the last 20 weekend days are used. In comparing the 15-minute observation to the three corresponding 5-minute observations, the minimum and maximum net load errors are used as a separate observation in the distribution.

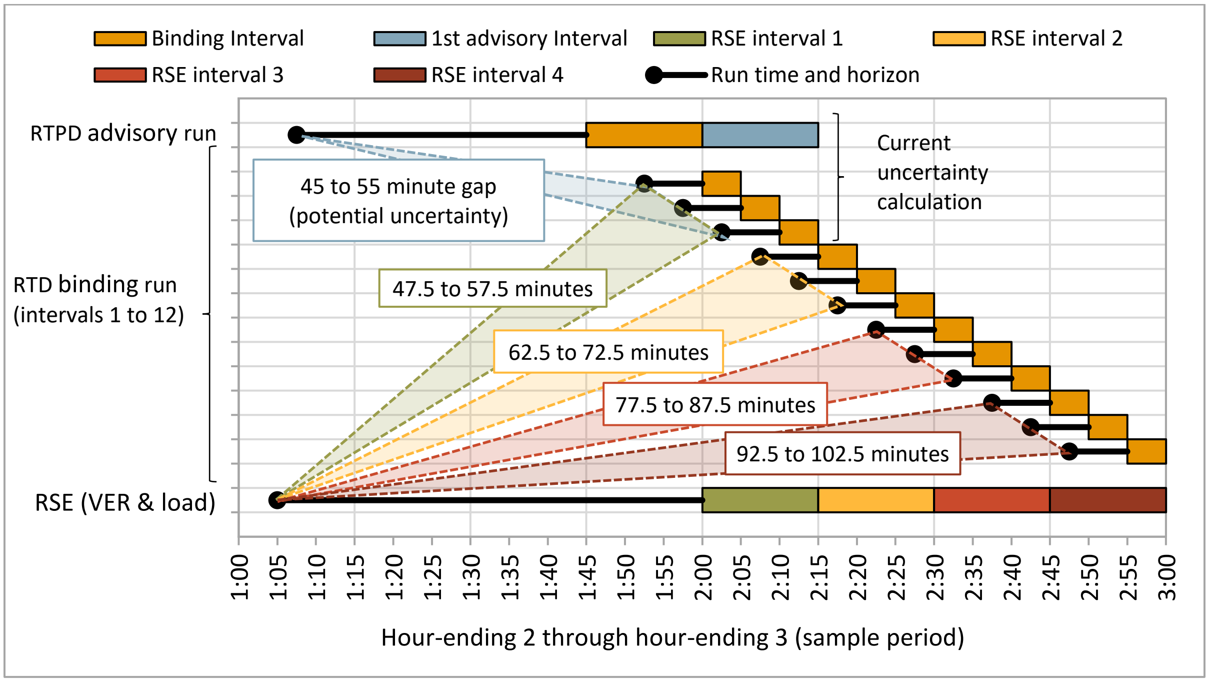
[18] Department of Market Monitoring, *Comments on EIM Resource Sufficiency Evaluation Enhancements Issue Paper*, September 8, 2021. http://www.caiso.com/Documents/DMM-Comments-on-EIM-Resource-Sufficiency-Evaluation-Enhancements-Issue-Paper-Sep-8-2021.pdf

[19] The figure shows the resource sufficiency evaluation run time at 55 minutes prior to the hour. While the financially binding test is run at 40 minutes prior to the hour, the VER and load forecasts used in the final test are pulled from the advisory test performed at T-55.

flexible ramping product uncertainty calculation. In the later test intervals, the gap between the predicted forecasts at the time of the resource sufficiency evaluation and the real-time forecasts widens, reaching above 100 minutes.

As part of the flexible ramping product refinements stakeholder initiative, the uncertainty component is expected to be enhanced to better account for net load uncertainty currently in the system. DMM recommends that any uncertainty used in the resource sufficiency evaluation be developed separately from that of the flexible ramping product.

Figure 9.1 Comparison of current uncertainty calculation to the timeframe of the RSE



Metrics on the uncertainty component and actual real-time net load error

This section provides metrics covering where uncertainty currently used in the tests comes from, and how that compares to error between load and VER amounts used in the tests and in the real-time market.

Figure 9.2 summarizes the current source of net load error from either load, wind, or solar error during the month for the CAISO. The figure shows the average weekday uncertainty during the month (from the 97.5 percentile of net load error observations for upward uncertainty and 2.5 percentile of net load error observations for downward uncertainty) and what contributed to that uncertainty.

Again, uncertainty is derived from the error between predicted 15-minute market net load and actual 5-minute market net load; this metric summarizes each component's contribution to net load error. Here, positive load error reflects an increase in net load in the 5-minute market because of an increase in load while positive VER error reflects an increase in net load in the 5-minute market because of a decrease in wind or solar. In some cases, DMM was not able to replicate the net load error from its components such that the full net load error was marked as 'unknown error' and factored into the average.

In the metric, *measured* uncertainty is from exactly the 2.5 percentile and 97.5 percentile of net load errors, from the same hour of the last 40 weekdays. In the resource sufficiency evaluation (and flexible ramping product), measured uncertainty can be capped by thresholds. The thresholds are based on a higher percentile of historical uncertainty and are designed to help prevent extreme outlier or erroneous net load errors from impacting the uncertainty and associated market outcomes. *RSE uncertainty* summarizes the values that were actually used in the tests, including any threshold caps and rounding.

Figure 9.3 summarizes the difference between net load forecasts used in the bid range capacity test and those used in the 5-minute market for the CAISO during the month. The hourly distributions were created from the difference between 5-minute market net load and net load in the corresponding test interval. Here, a higher net load error reflects higher load (or lower renewables) in real-time, relative to the tests. In comparison, the red lines show the average upward and downward uncertainty used in the tests during the same period. This metric therefore highlights test-horizon net load error and how well it fits within the current construct of uncertainty.

Figure 9.4 provides similar information, splitting out and showing how load and VER forecasts used in the resource sufficiency evaluation each compare to those in the 5-minute market. Again, positive load error reflects higher load in the 5-mintue market, while positive VER error reflects lower wind and solar in the 5-minute market (higher net load).

Figures covering the same information for all WEIM entities are shown below.

Figure 9.2 CAISO average uncertainty by component (weekdays, August 2022)

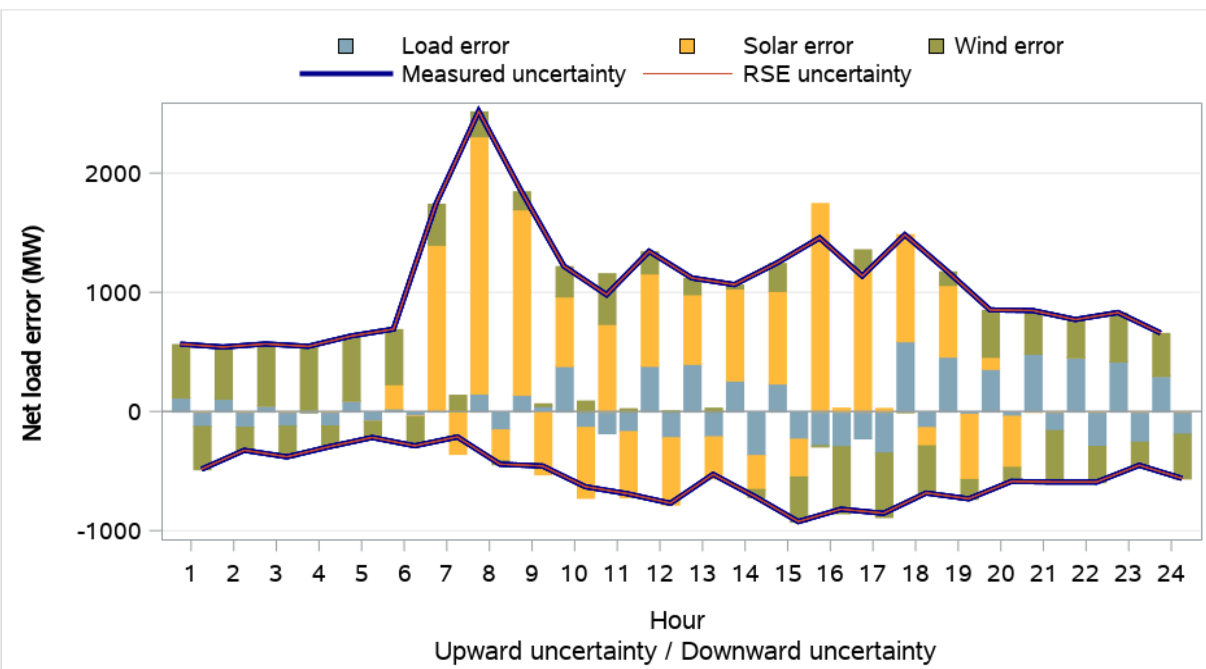


Figure 9.3 CAISO distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

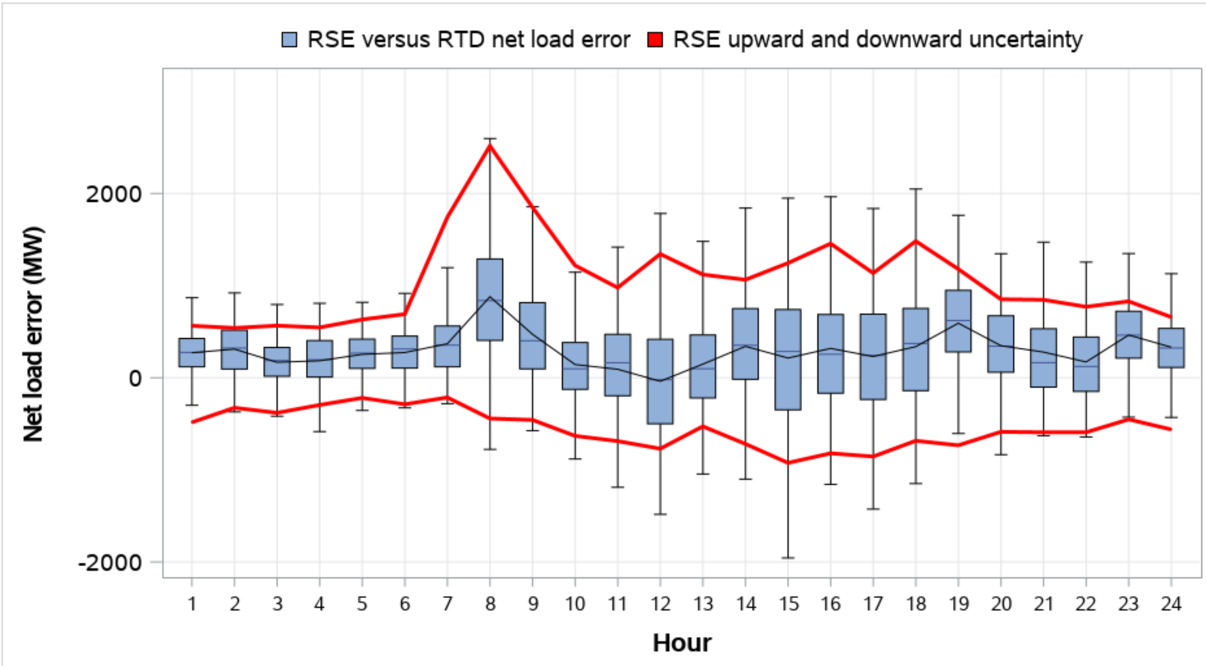


Figure 9.4 CAISO distribution of RSE and RTD load and VER error (weekdays, August 2022)

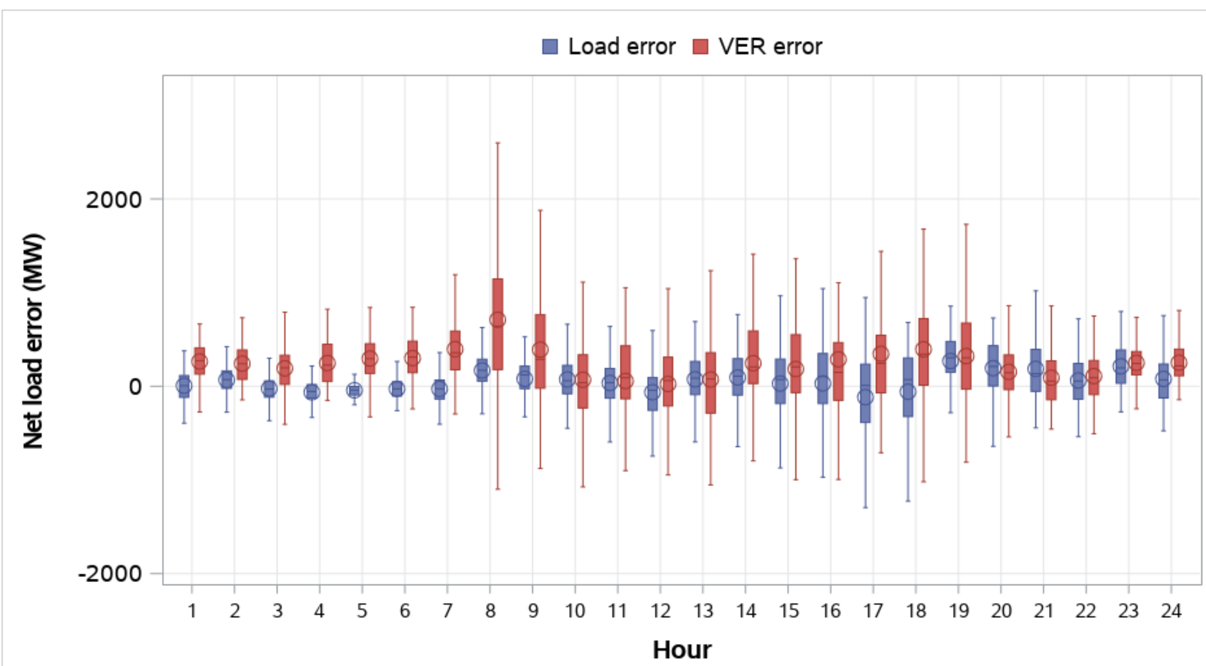


Figure 9.5 Arizona Public Service average uncertainty by component (weekdays, August 2022)

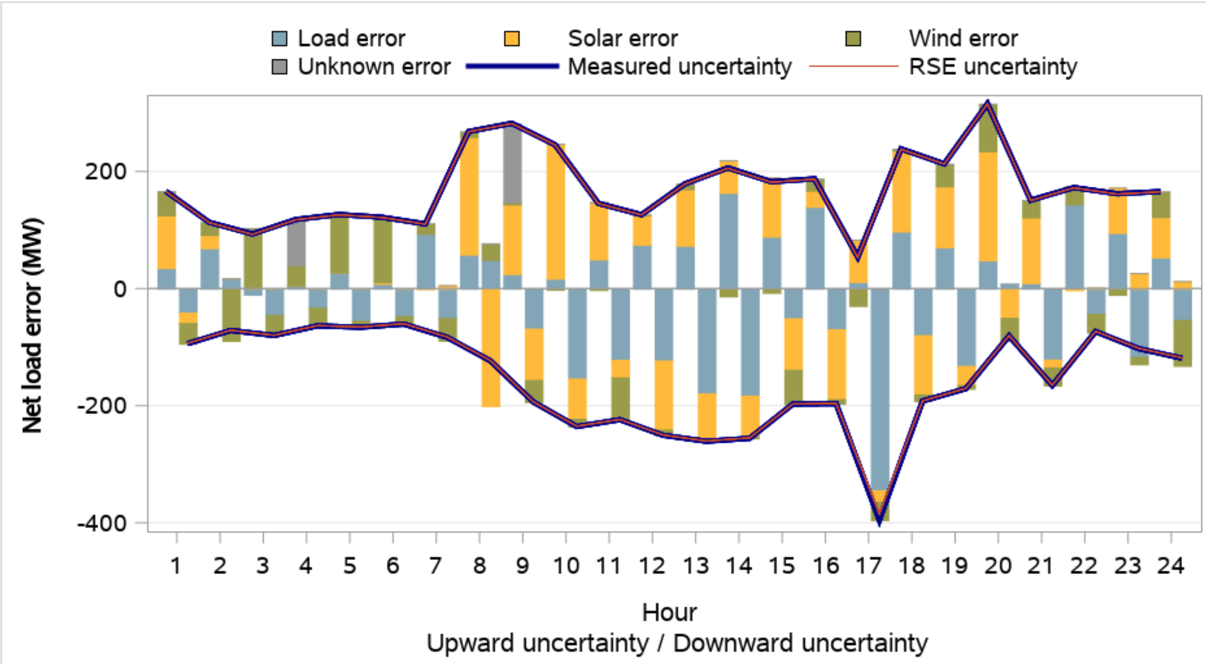


Figure 9.6 Arizona Public Service distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

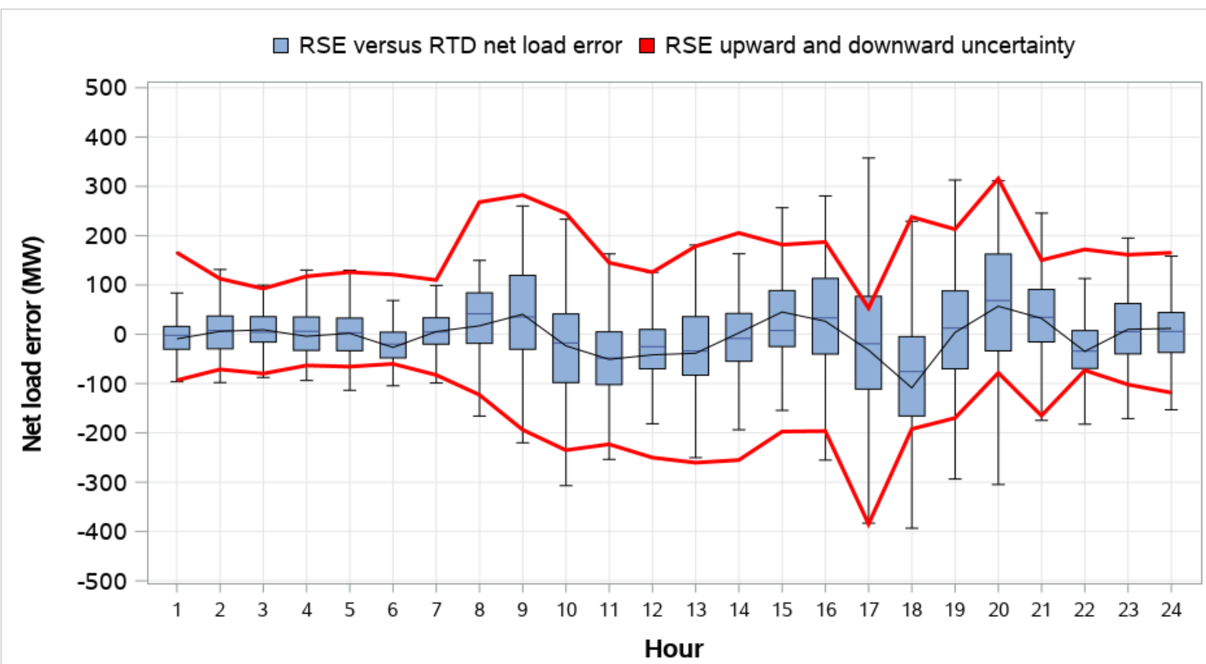


Figure 9.7 Arizona Public Service distribution of RSE and RTD load and VER error (weekdays, August 2022)

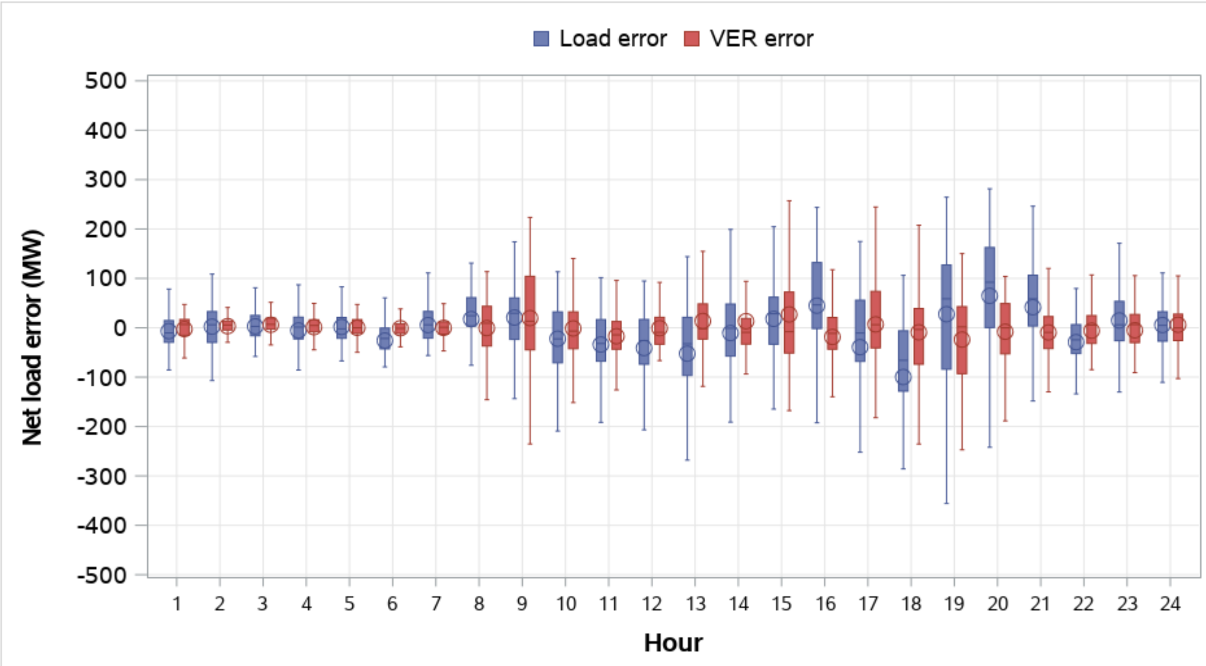


Figure 9.8 Avista average uncertainty by component (weekdays, August 2022)

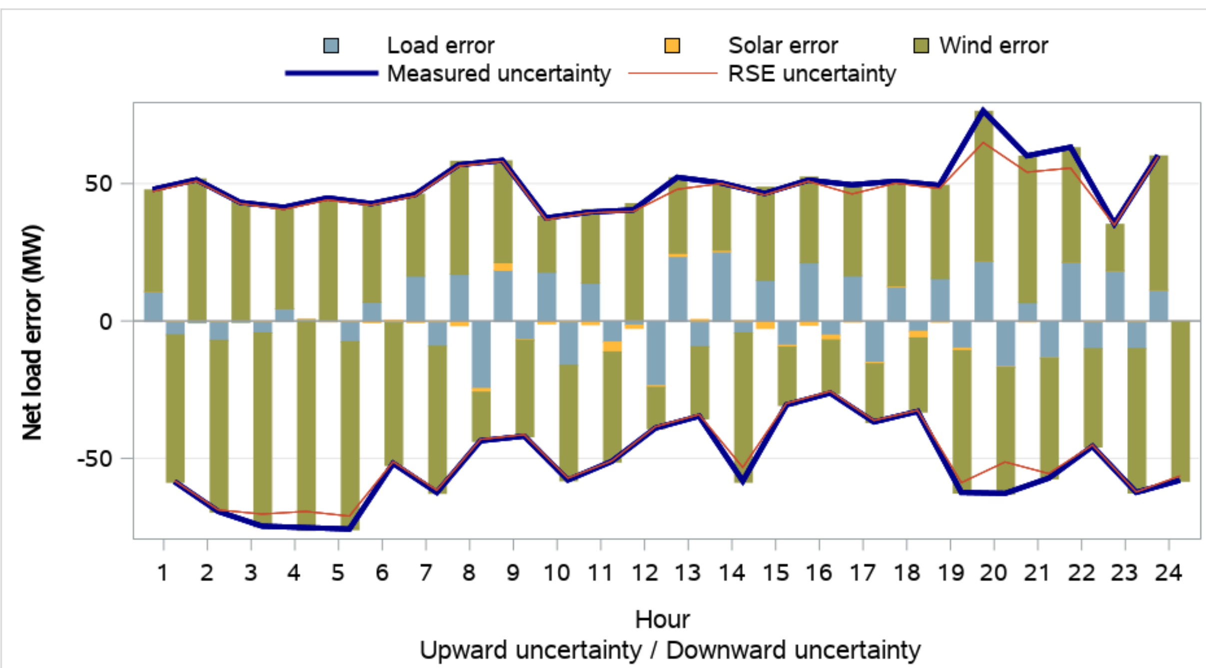


Figure 9.9 Avista distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

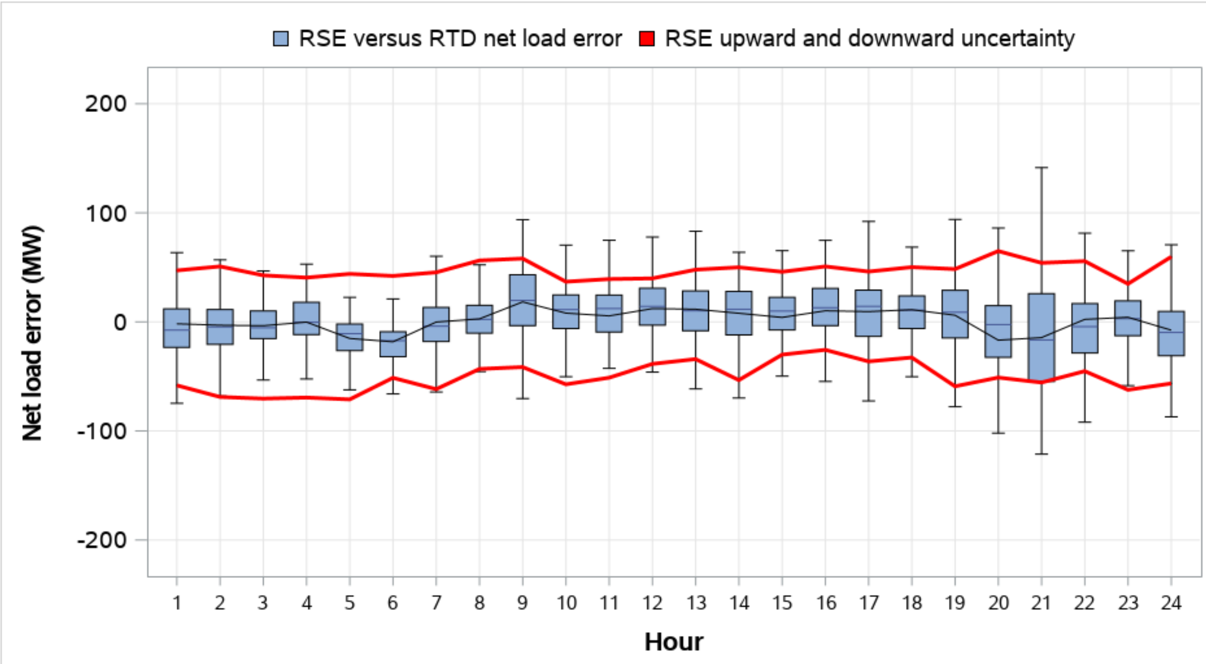


Figure 9.10 Avista distribution of RSE and RTD load and VER error (weekdays, August 2022)

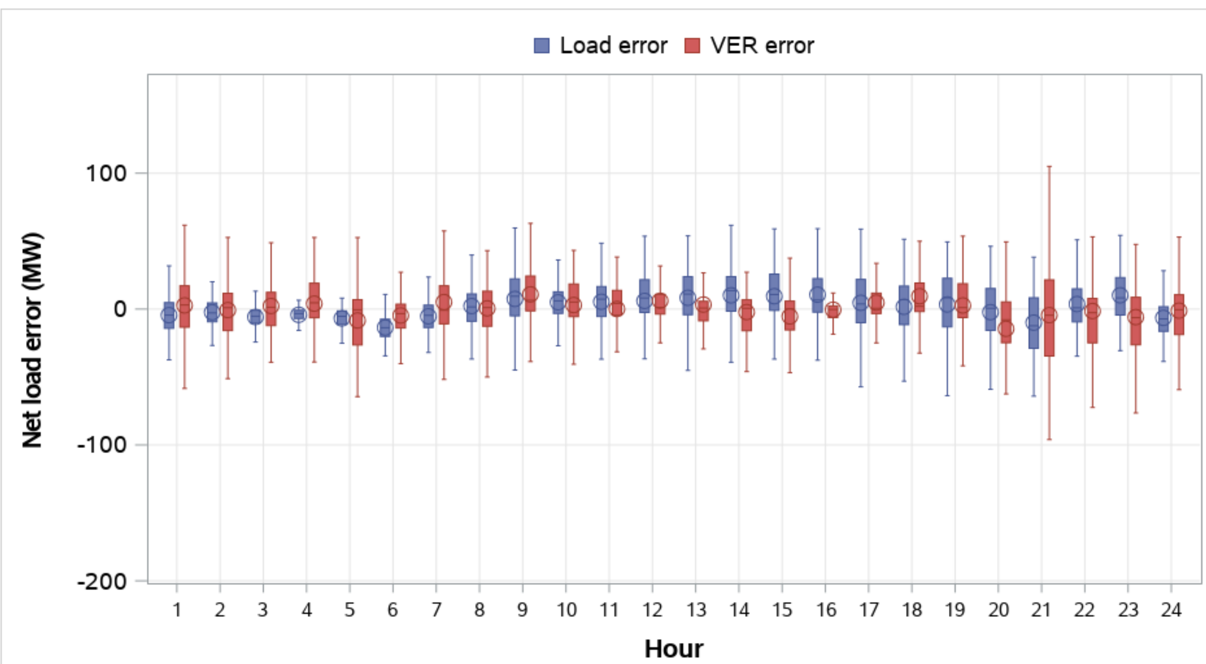


Figure 9.11 BANC average uncertainty by component (weekdays, August 2022)

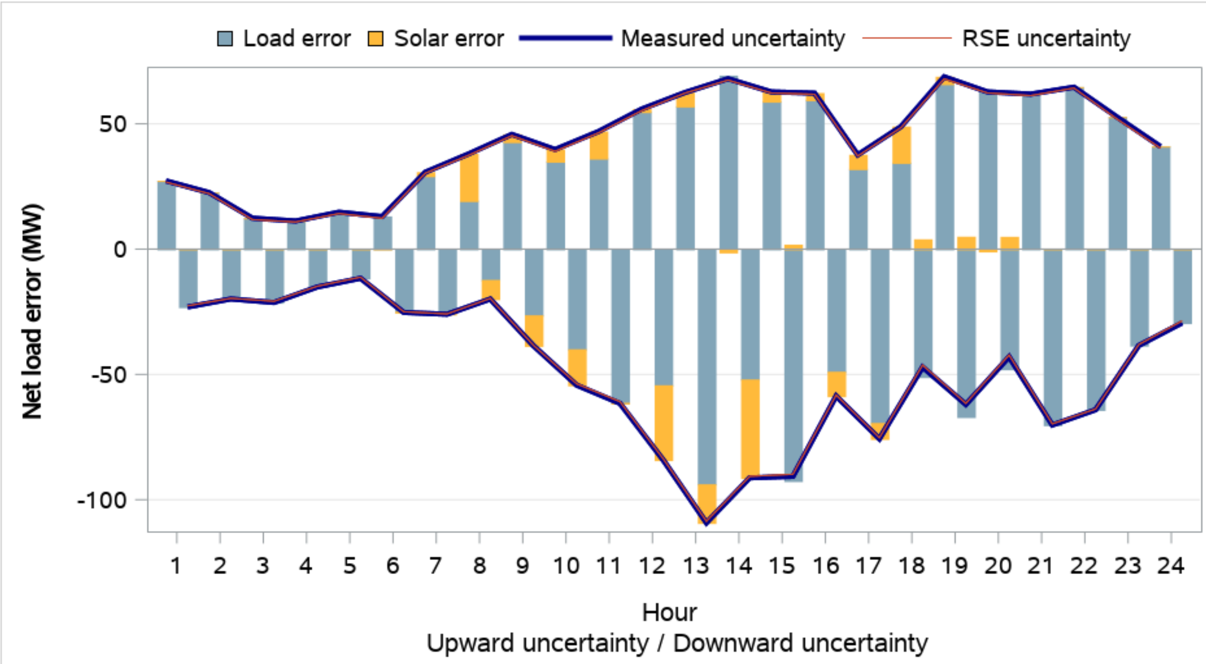


Figure 9.12 BANC distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

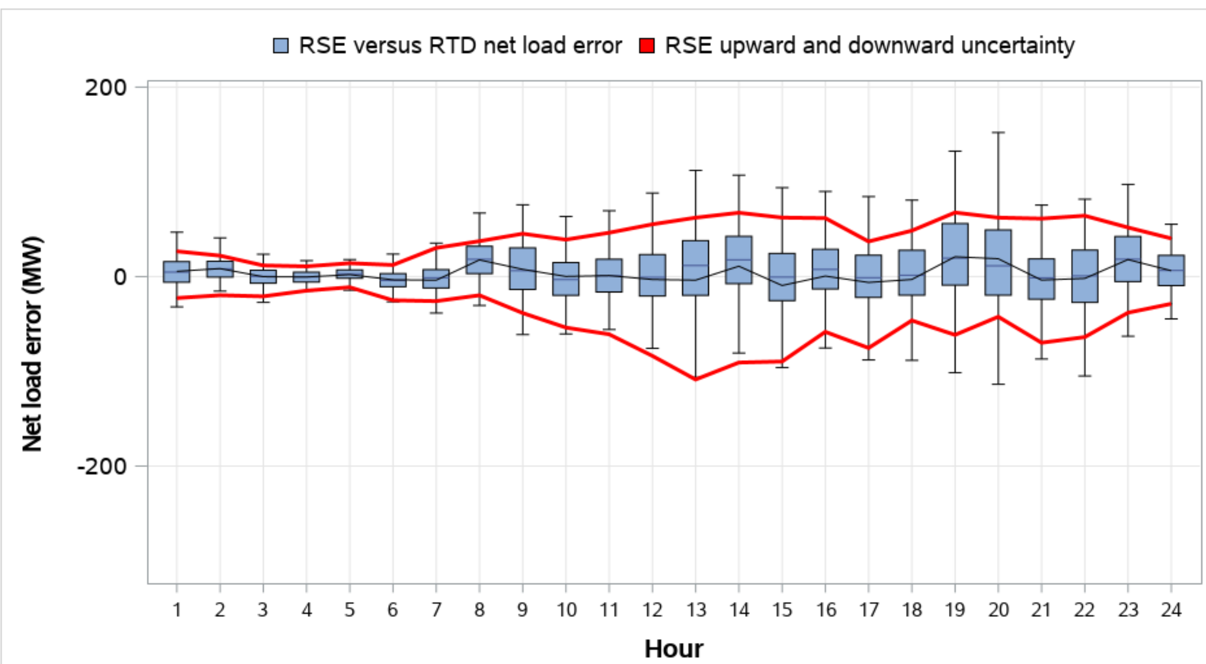


Figure 9.13 BANC distribution of RSE and RTD load and VER error (weekdays, August 2022)

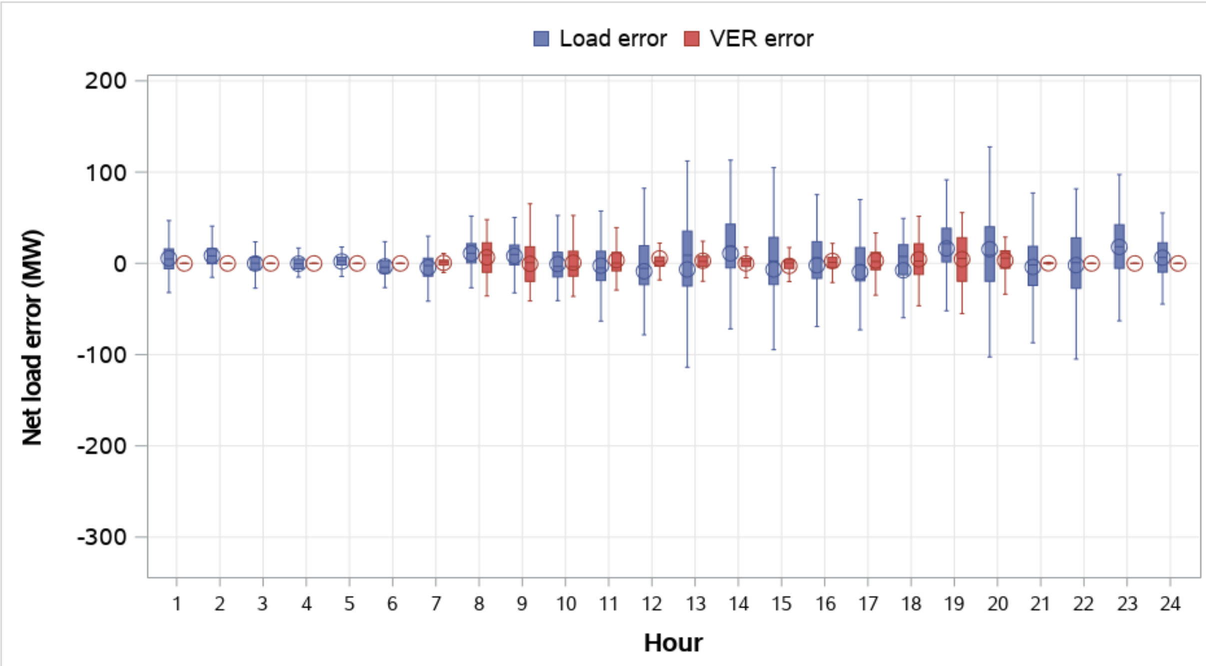


Figure 9.14 BPA average uncertainty by component (weekdays, August 2022)

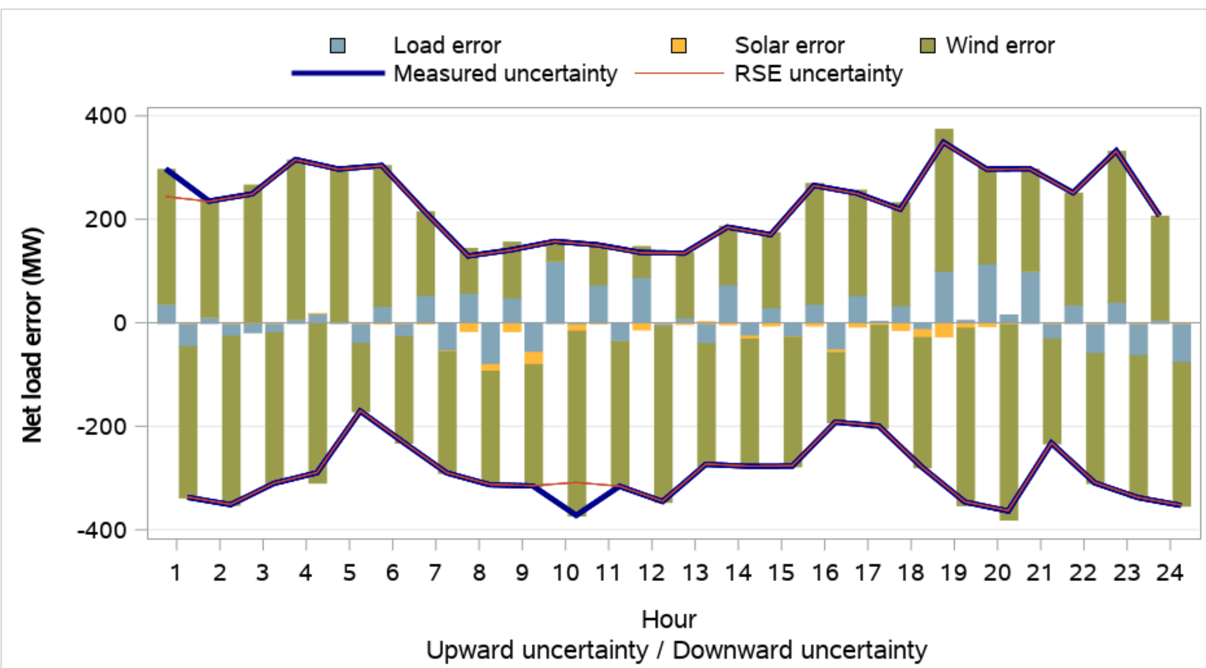


Figure 9.15 BPA distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

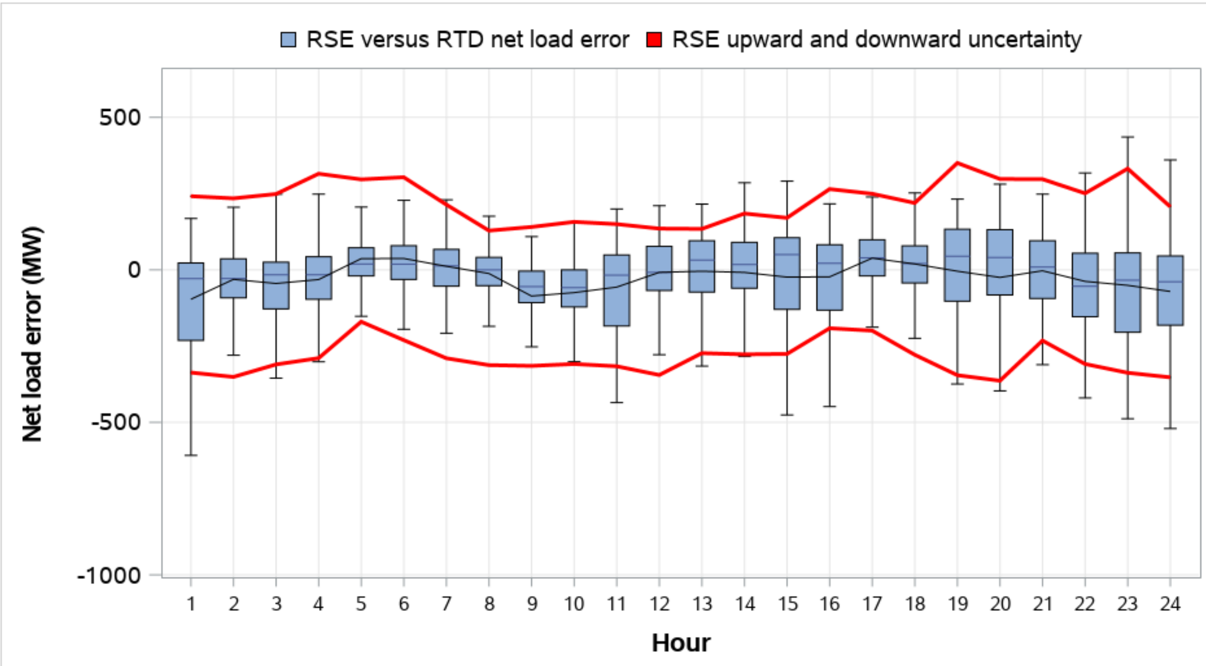


Figure 9.16 BPA distribution of RSE and RTD load and VER error (weekdays, August 2022)

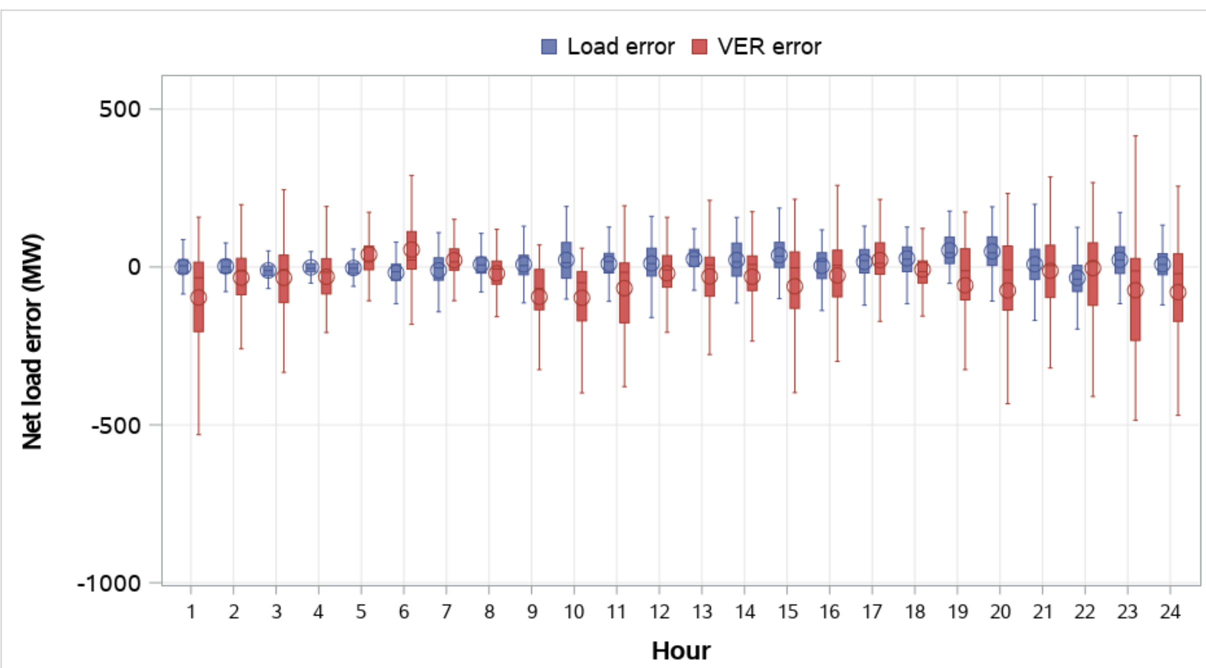


Figure 9.17 Idaho Power average uncertainty by component (weekdays, August 2022)

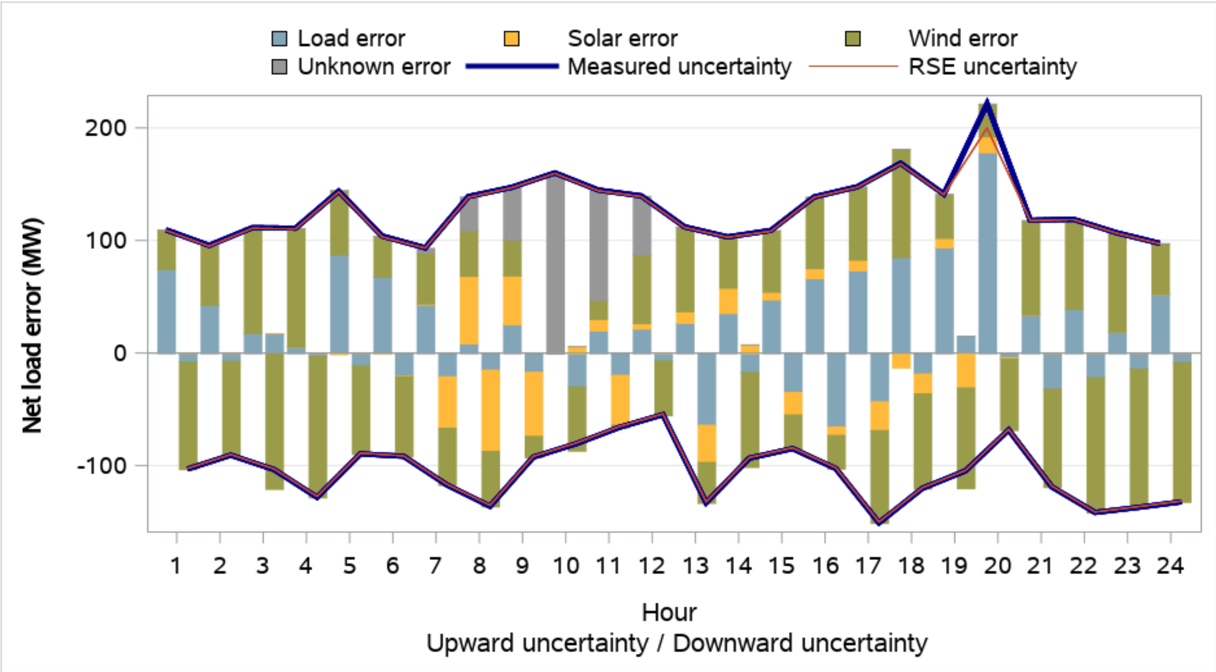


Figure 9.18 Idaho Power distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

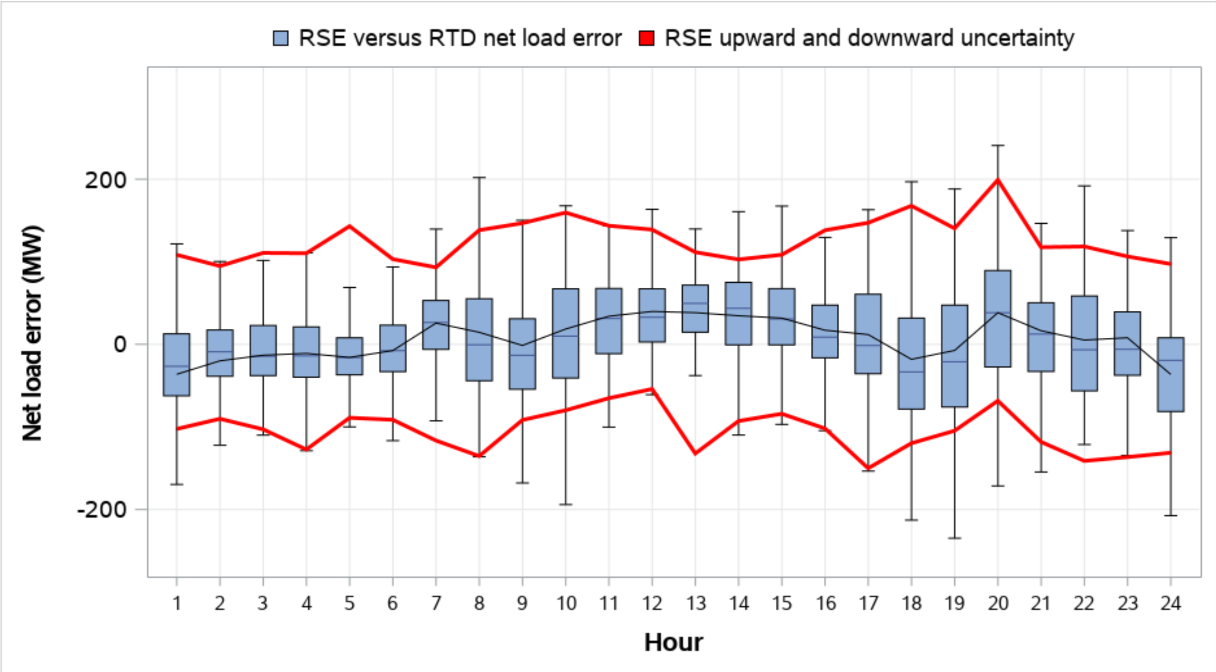


Figure 9.19 Idaho Power distribution of RSE and RTD load and VER error (weekdays, August 2022)

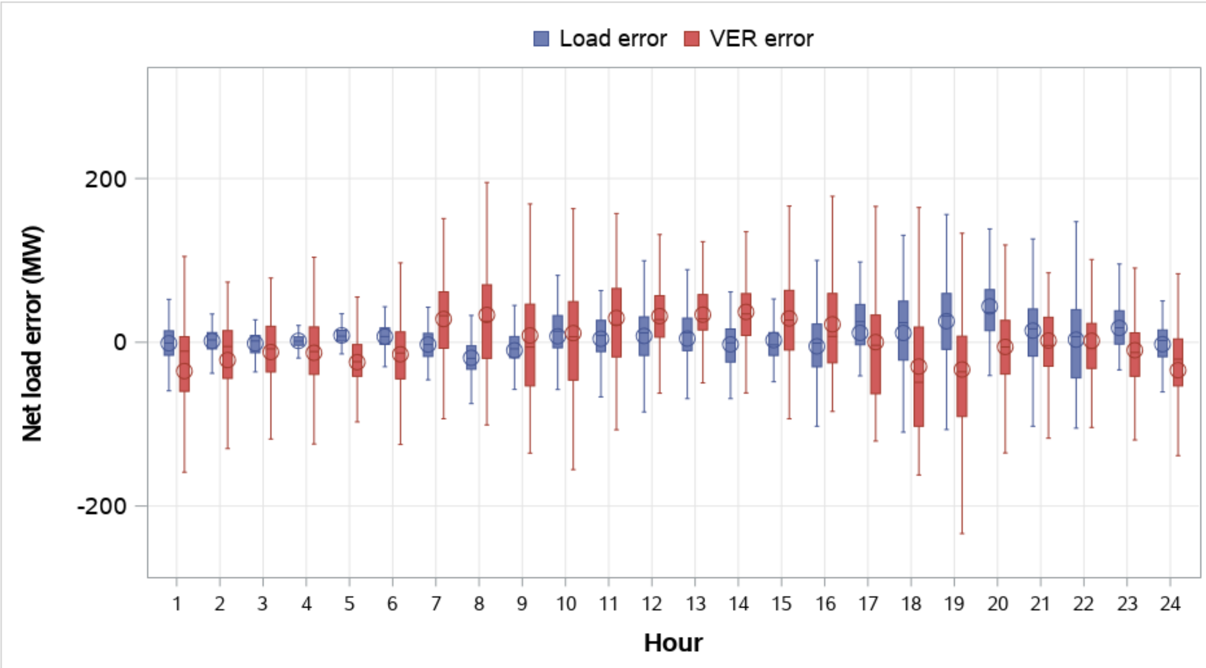


Figure 9.20 LADWP average uncertainty by component (weekdays, August 2022)

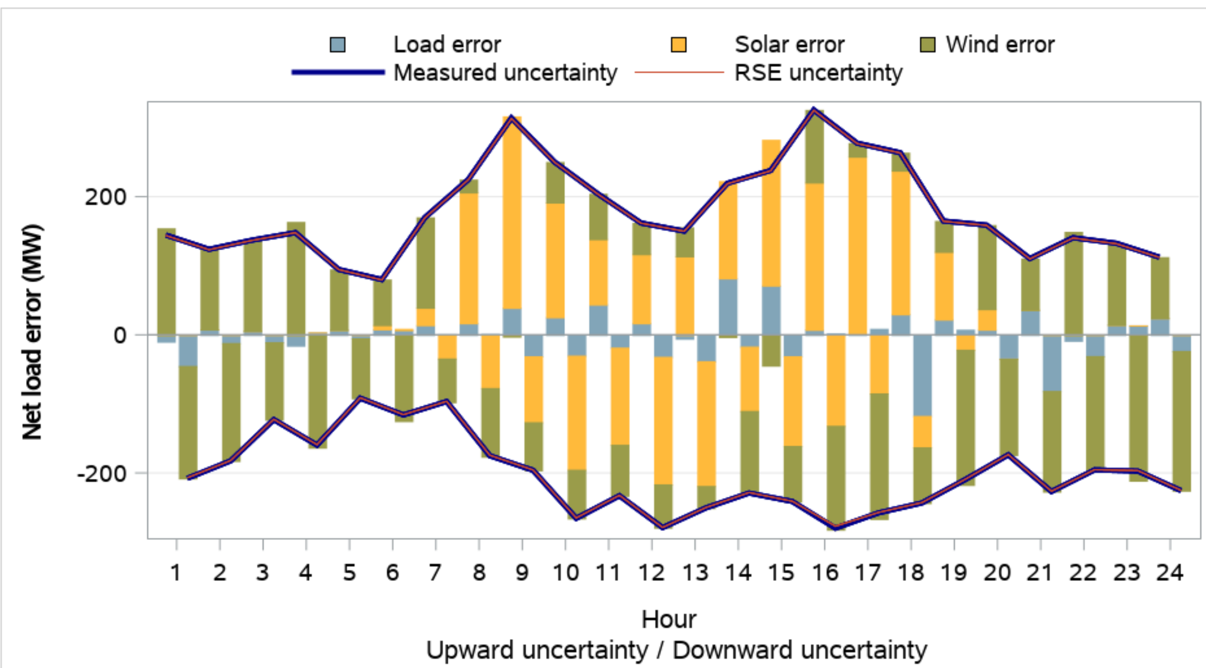


Figure 9.21 LADWP distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

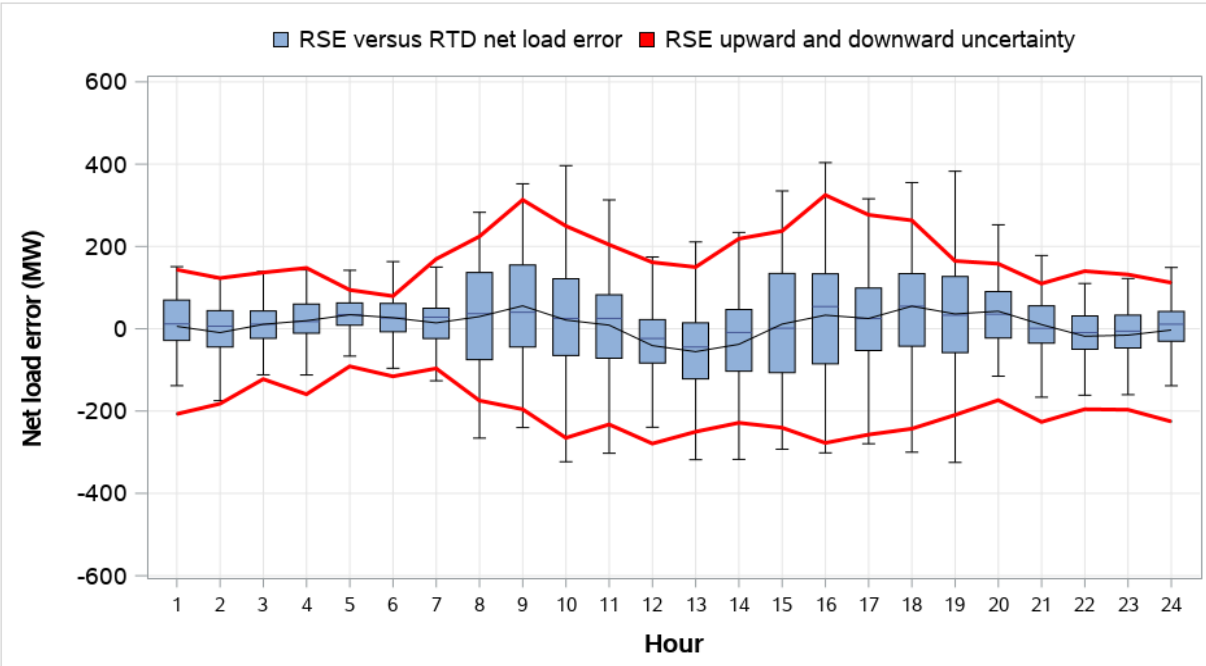


Figure 9.22 LADWP distribution of RSE and RTD load and VER error (weekdays, August 2022)

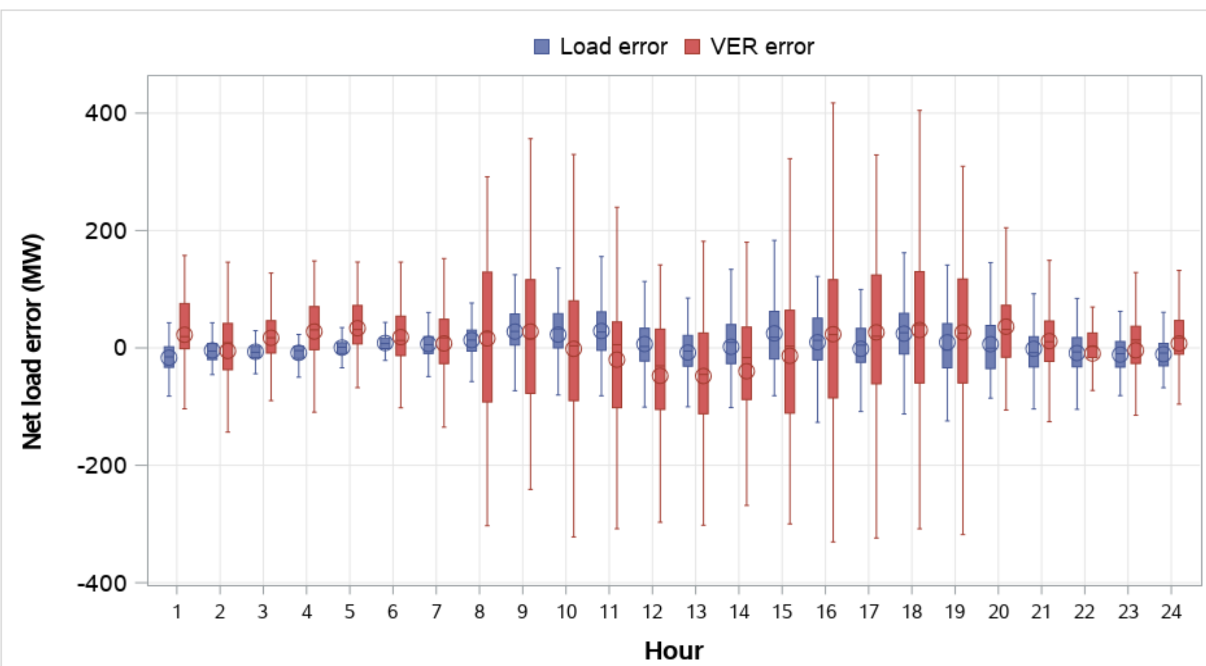


Figure 9.23 NorthWestern Energy average uncertainty by component (weekdays, August 2022)

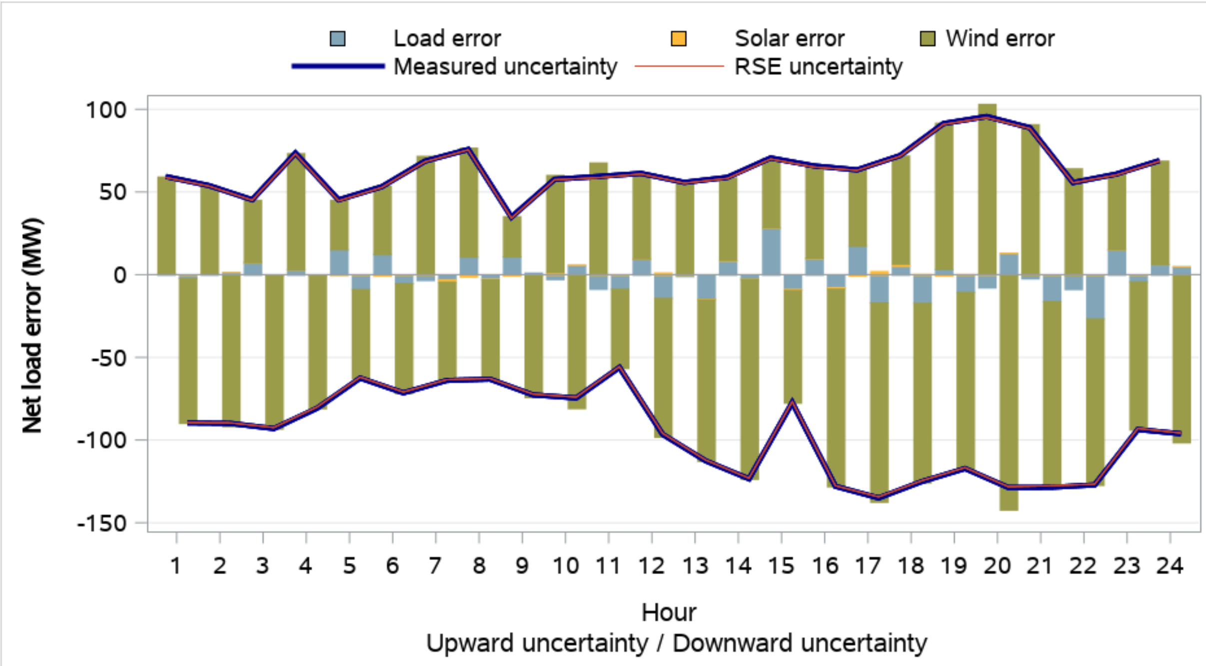


Figure 9.24 NorthWestern Energy distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

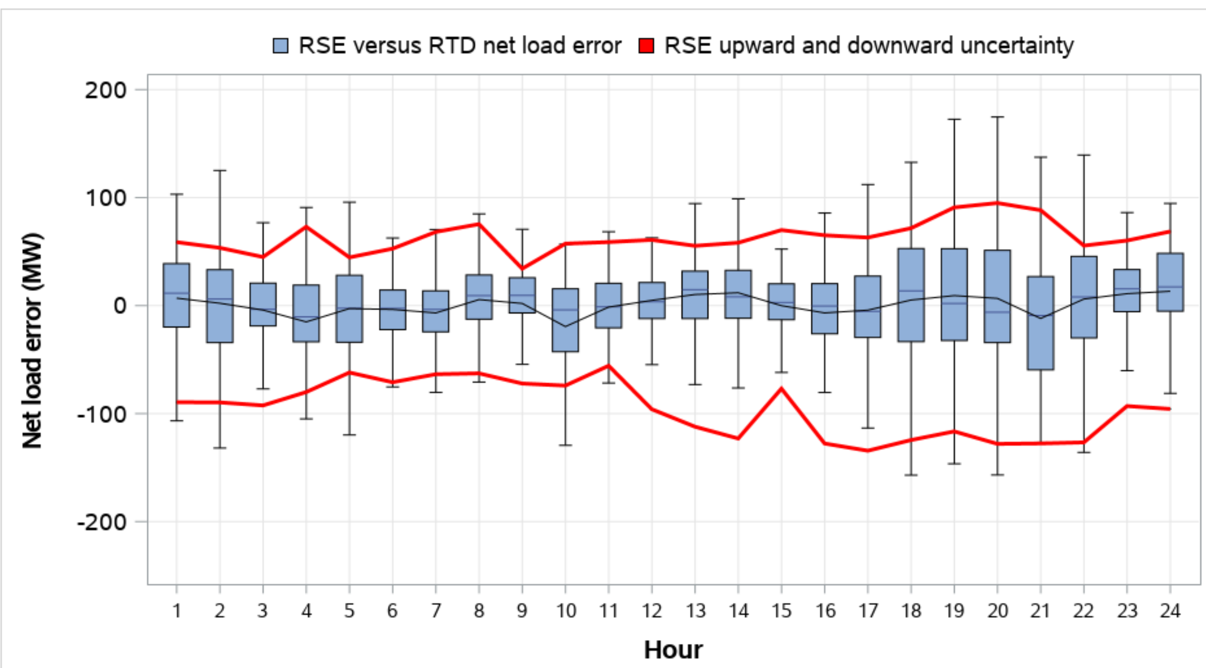


Figure 9.25 NorthWestern Energy distribution of RSE and RTD load and VER error (weekdays, August 2022)

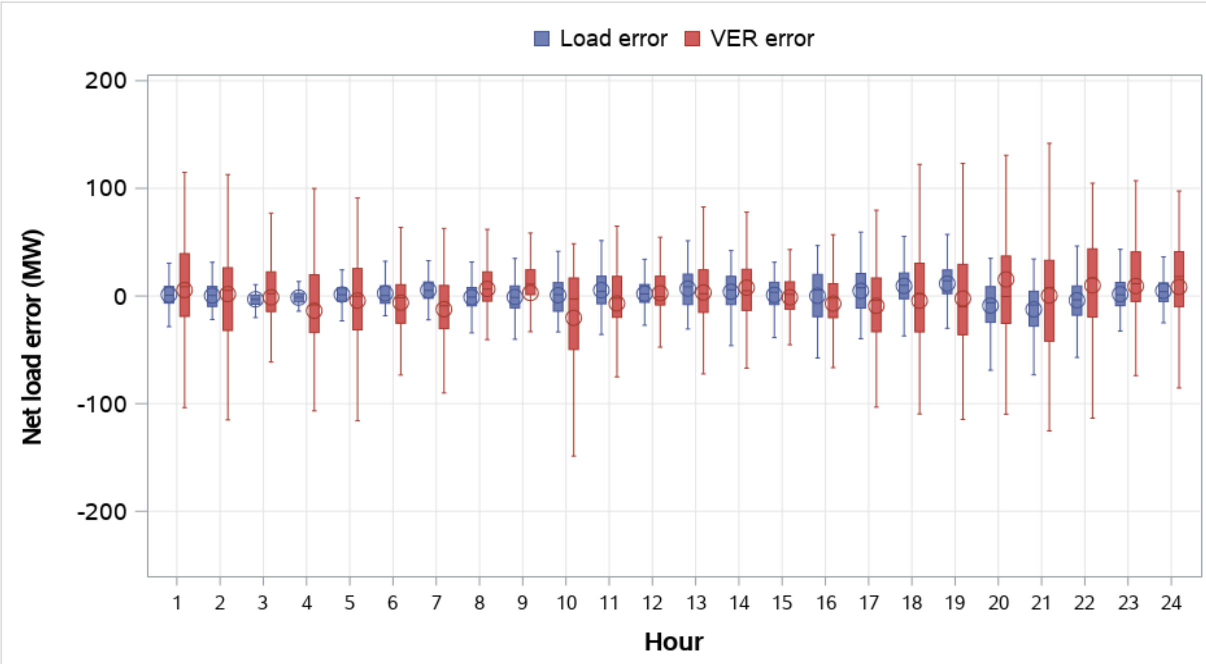


Figure 9.26 NV Energy average uncertainty by component (weekdays, August 2022)

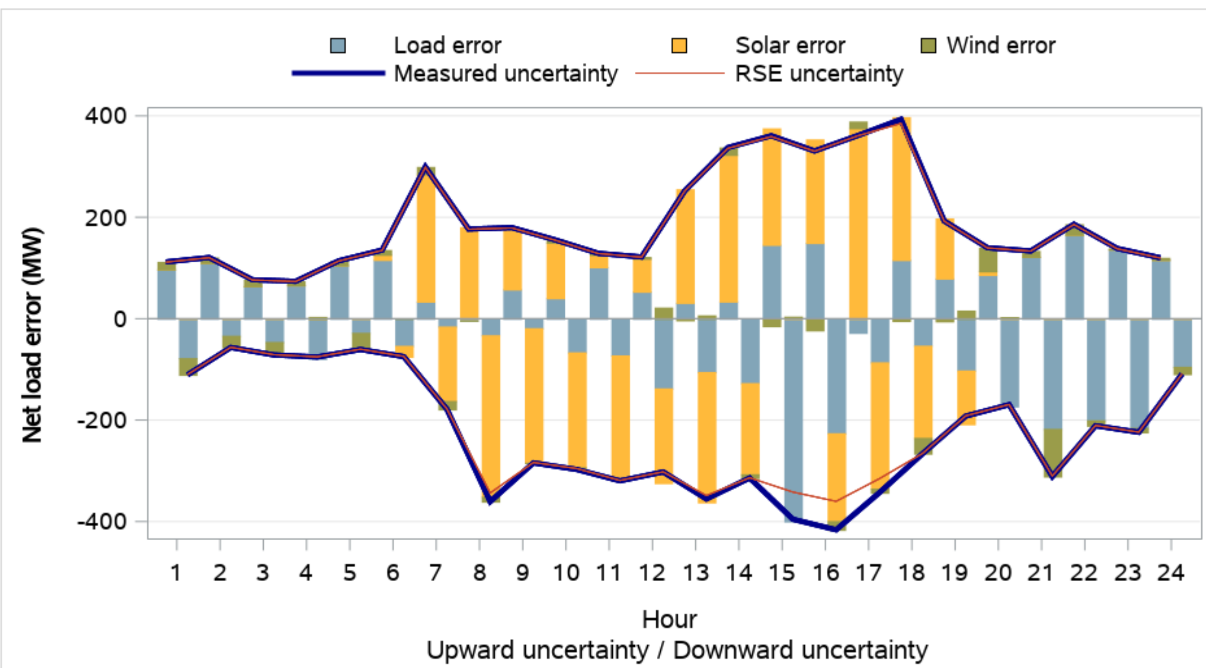


Figure 9.27 NV Energy distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

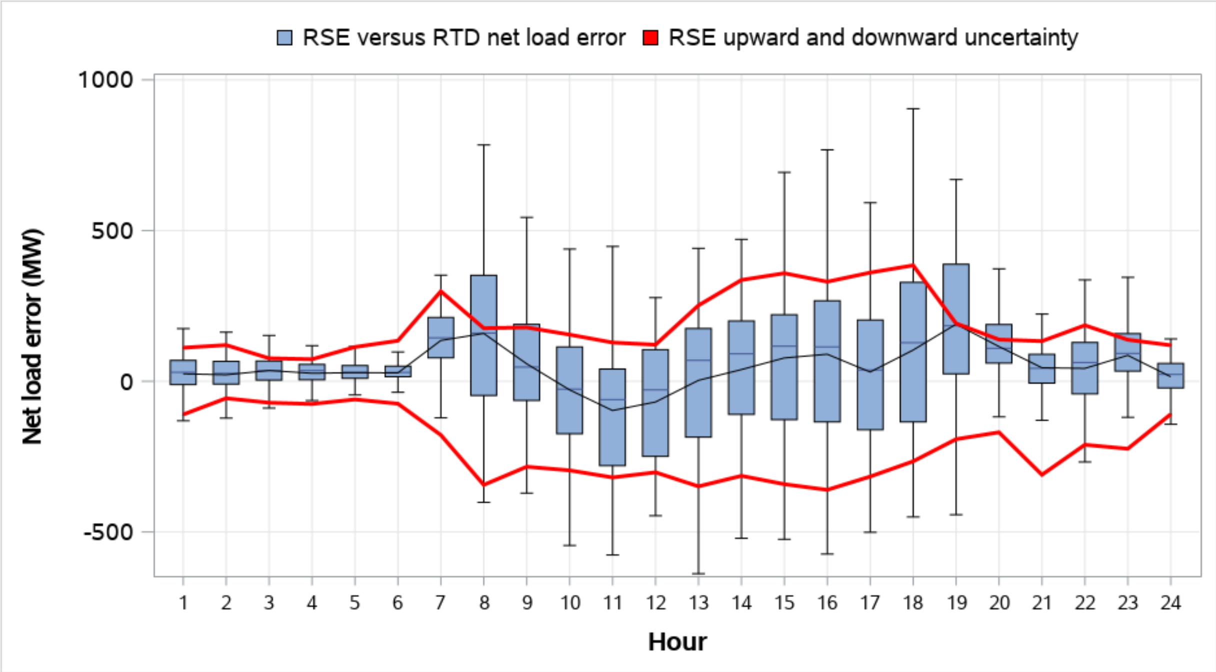


Figure 9.28 NV Energy distribution of RSE and RTD load and VER error (weekdays, August 2022)

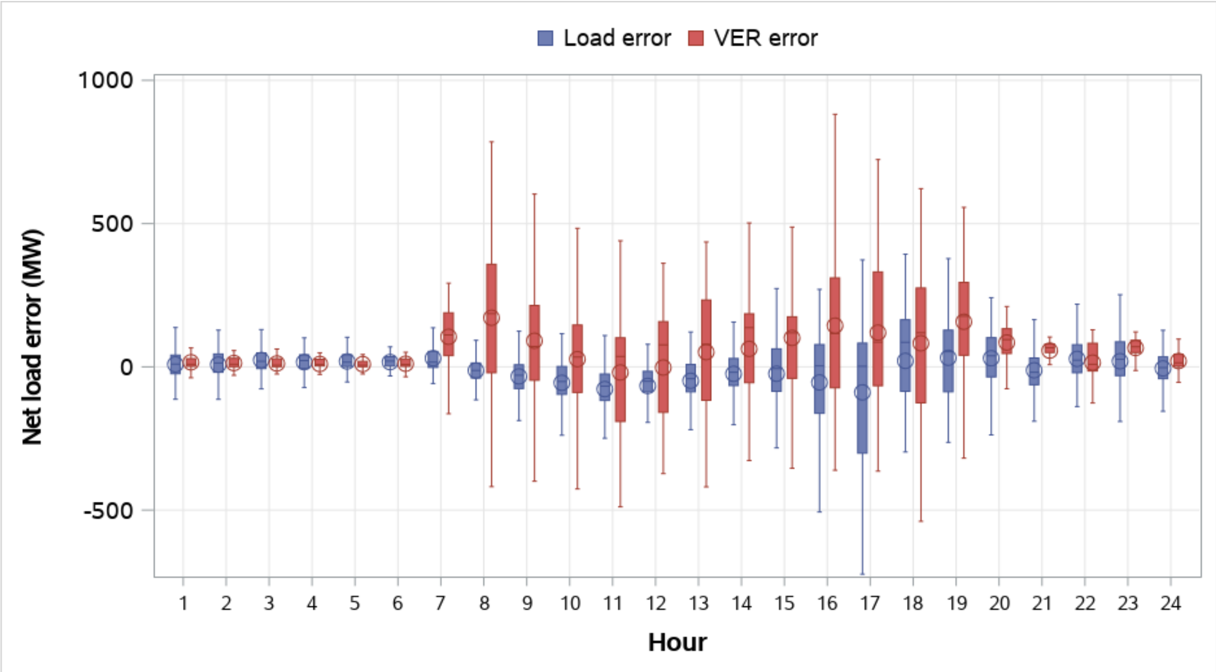


Figure 9.29 PacifiCorp East average uncertainty by component (weekdays, August 2022)

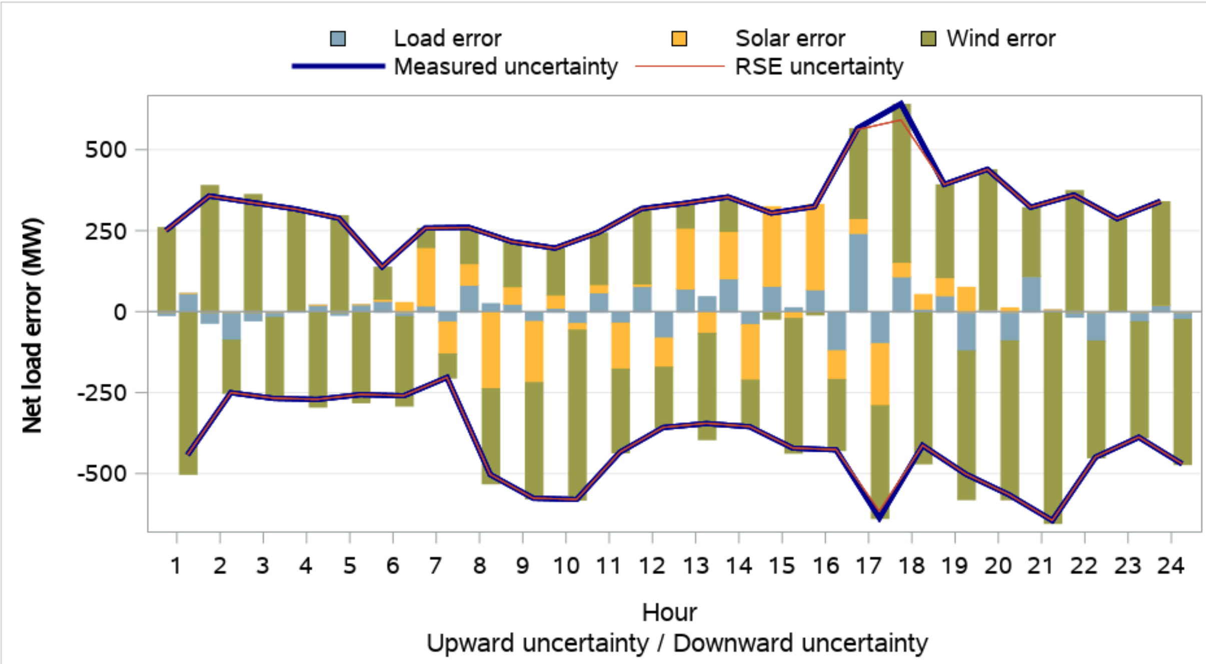


Figure 9.30 PacifiCorp East distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

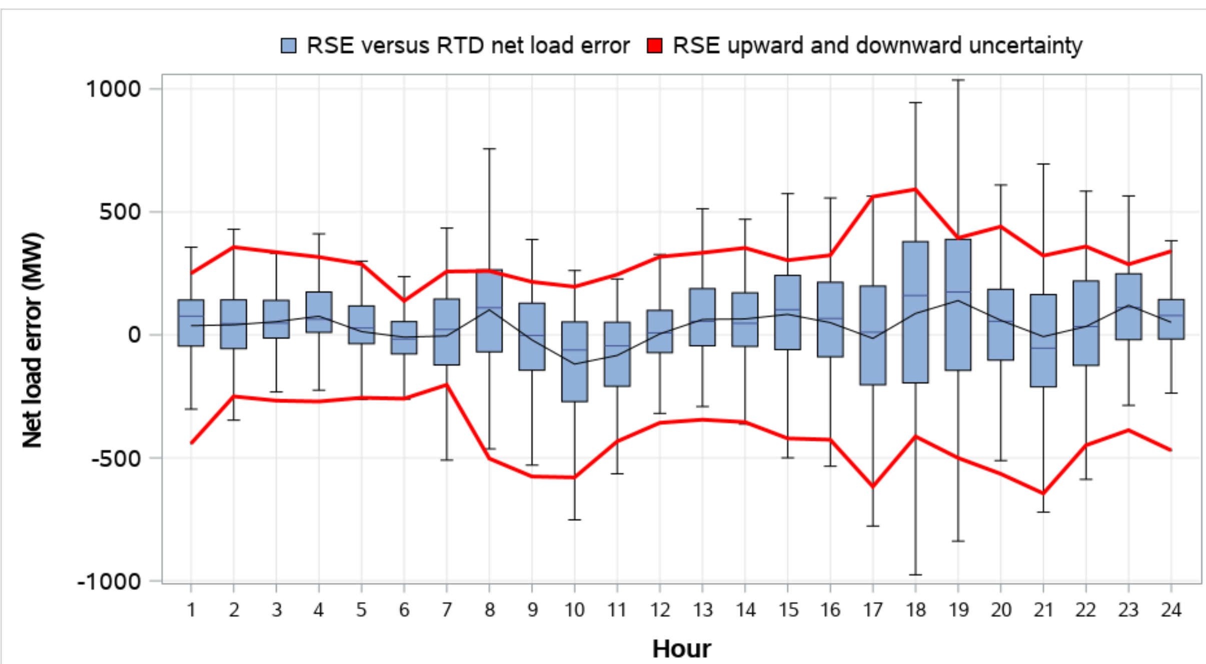


Figure 9.31 PacifiCorp East distribution of RSE and RTD load and VER error (weekdays, August 2022)

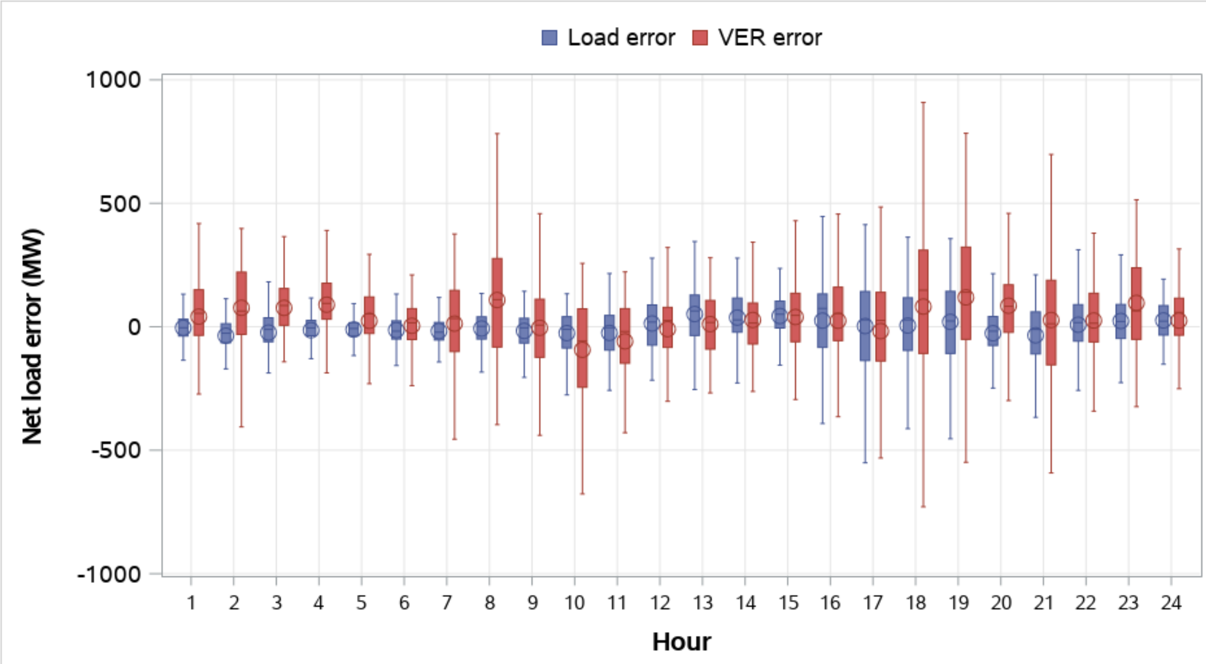


Figure 9.32 PacifiCorp West average uncertainty by component (weekdays, August 2022)

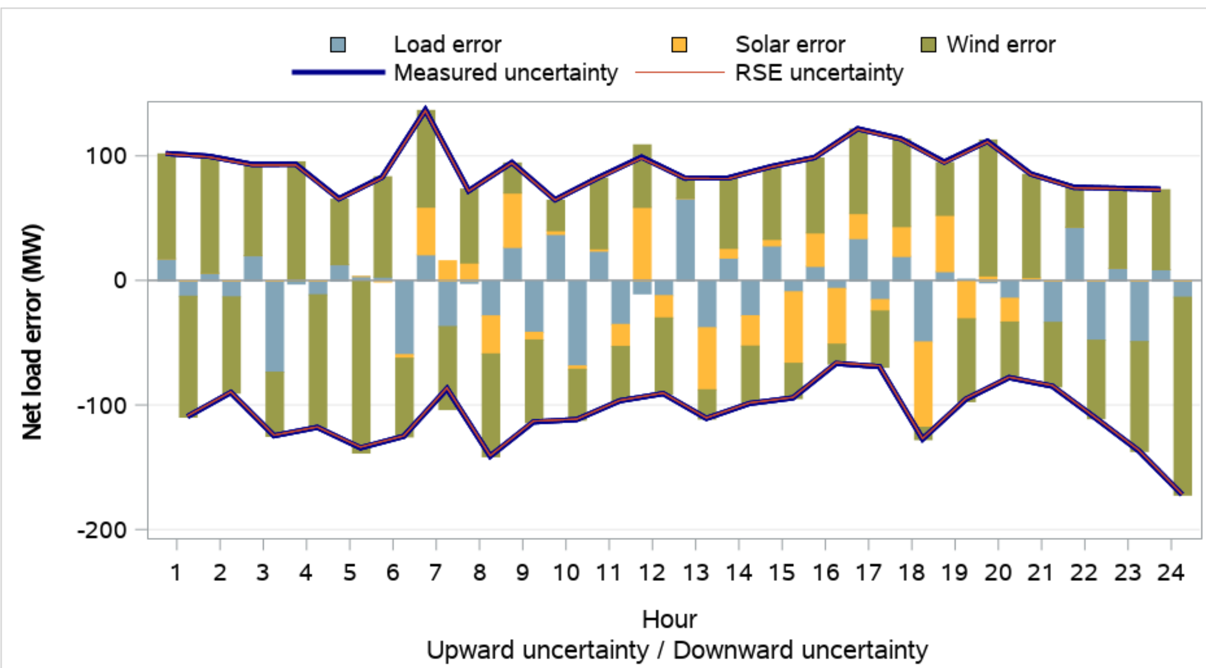


Figure 9.33 PacifiCorp West distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

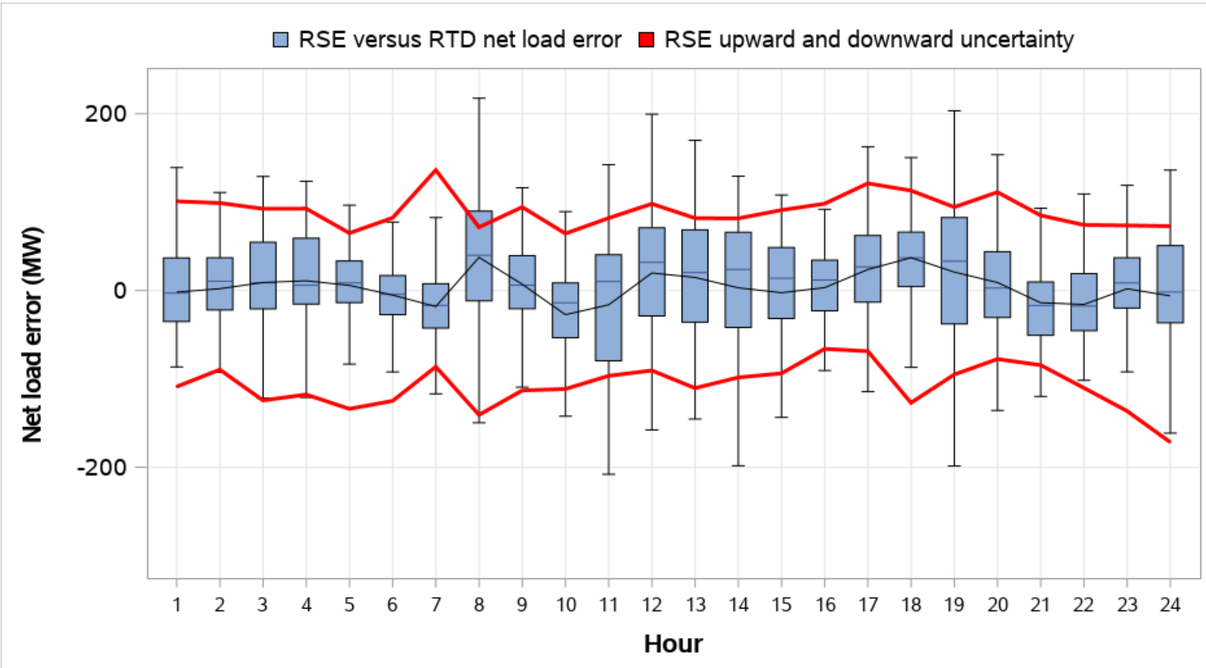


Figure 9.34 PacifiCorp West distribution of RSE and RTD load and VER error (weekdays, August 2022)

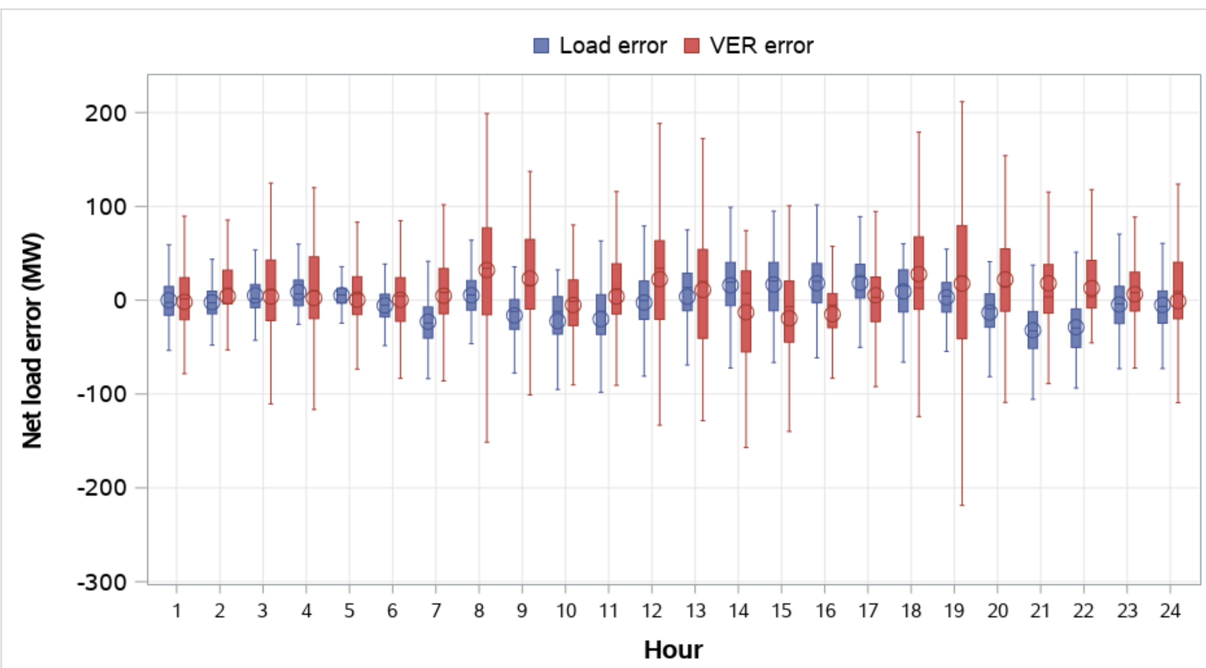


Figure 9.35 Portland General Electric average uncertainty by component (weekdays, August 2022)

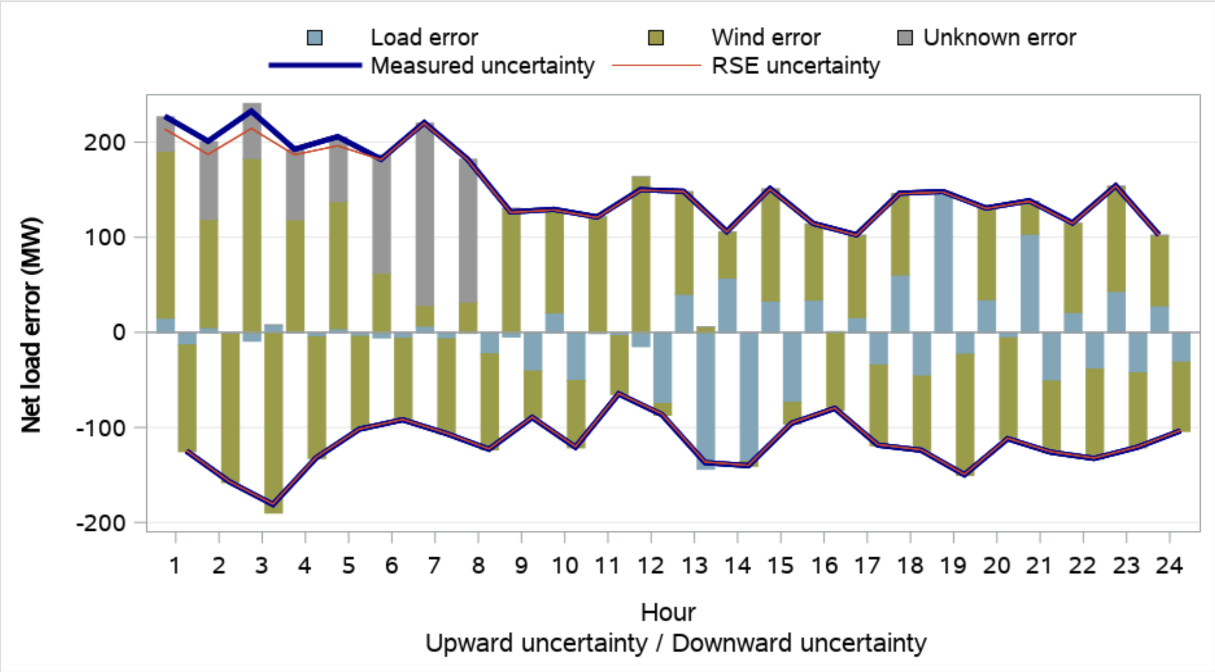


Figure 9.36 Portland General Electric distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

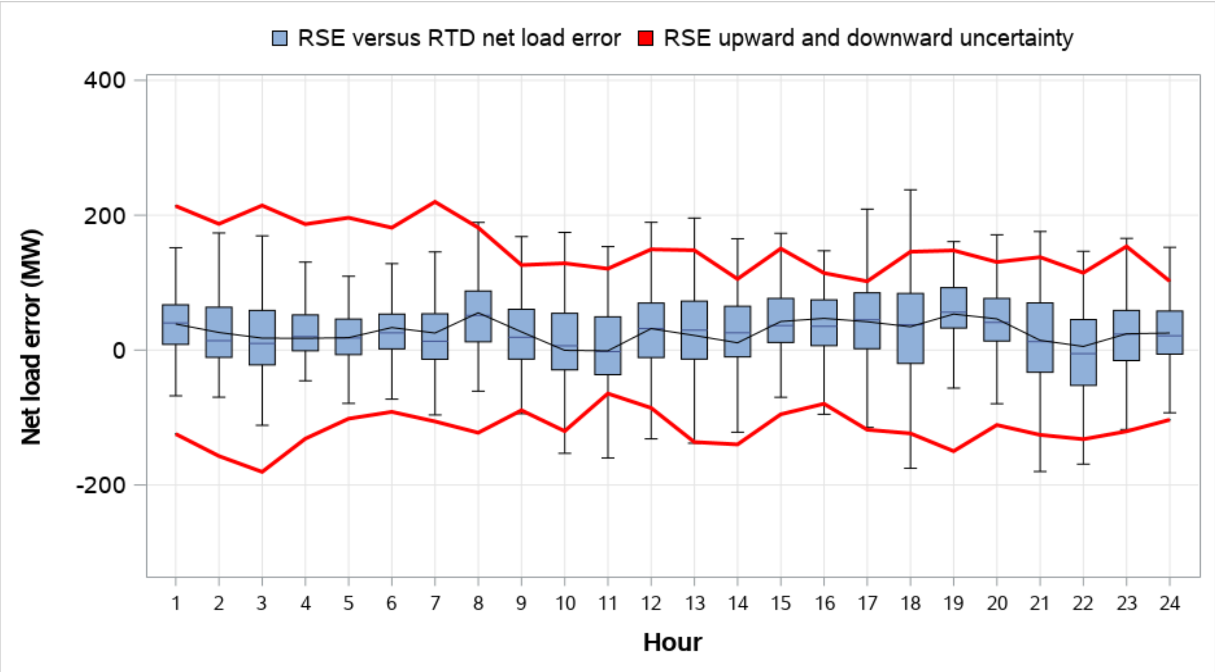


Figure 9.37 Portland General Electric distribution of RSE and RTD load and VER error (weekdays, August 2022)

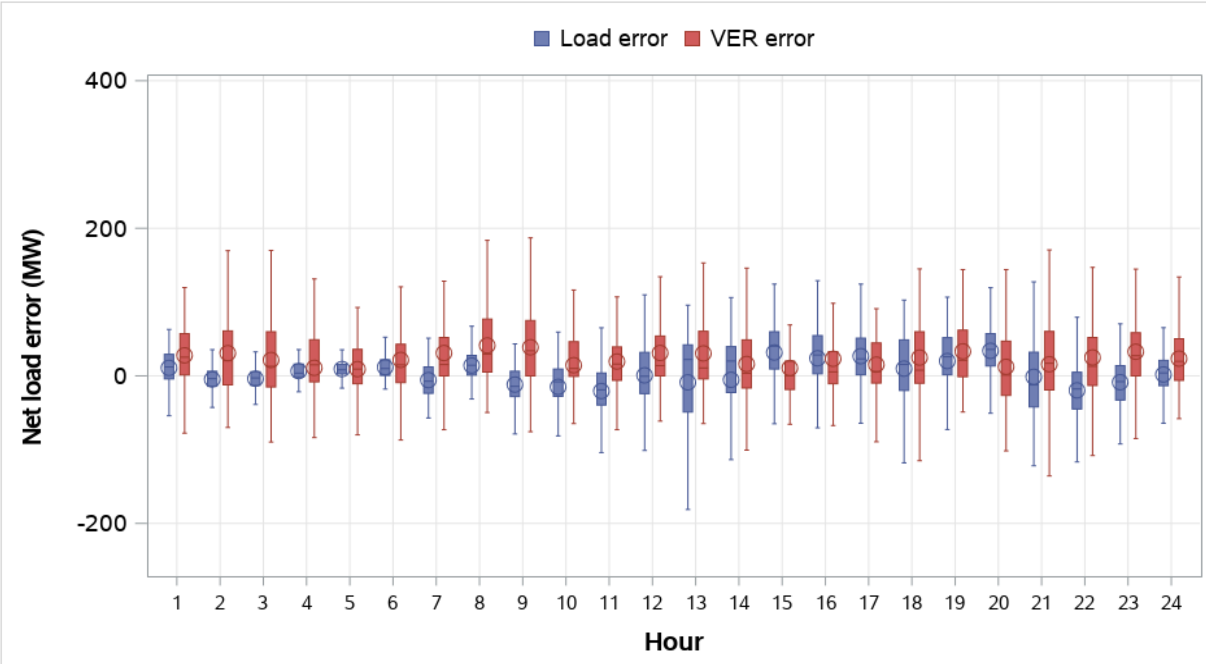


Figure 9.38 Powerex average uncertainty by component (weekdays, August 2022)

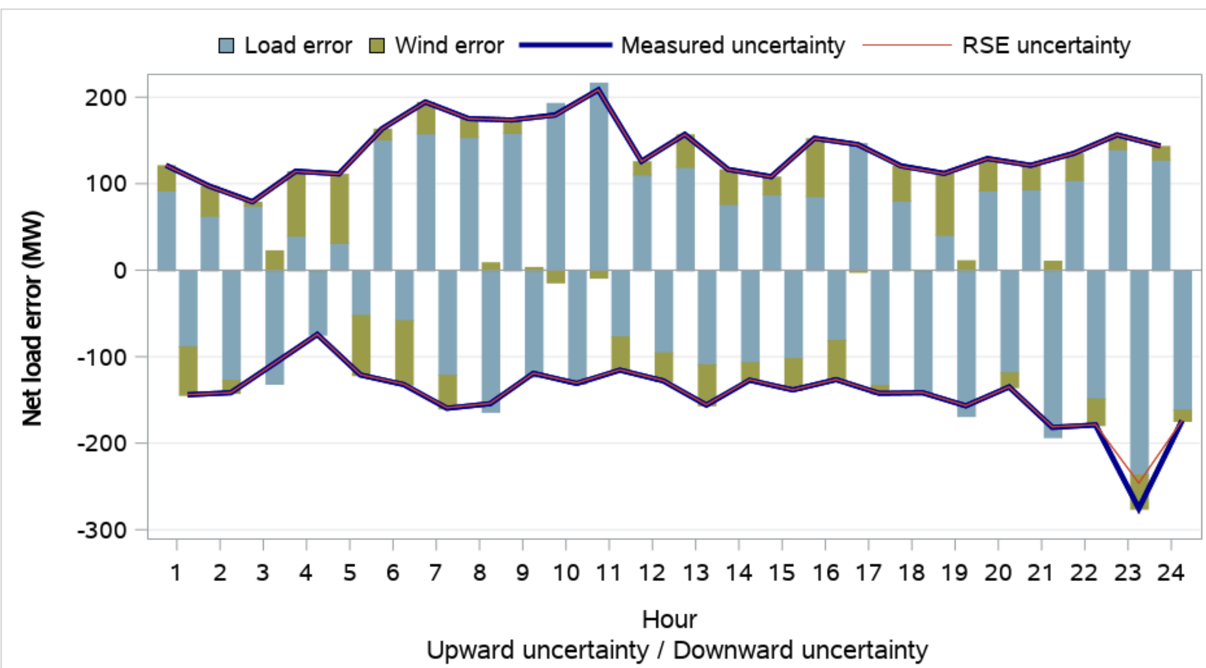


Figure 9.39 Powerex distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

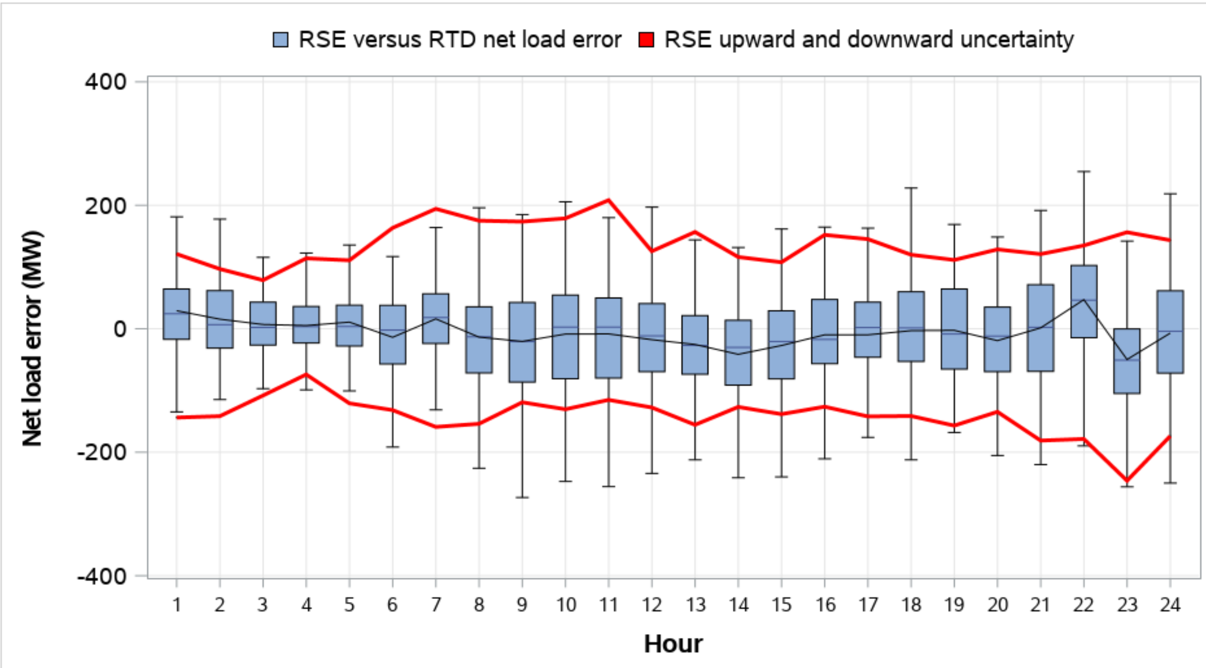


Figure 9.40 Powerex distribution of RSE and RTD load and VER error (weekdays, August 2022)

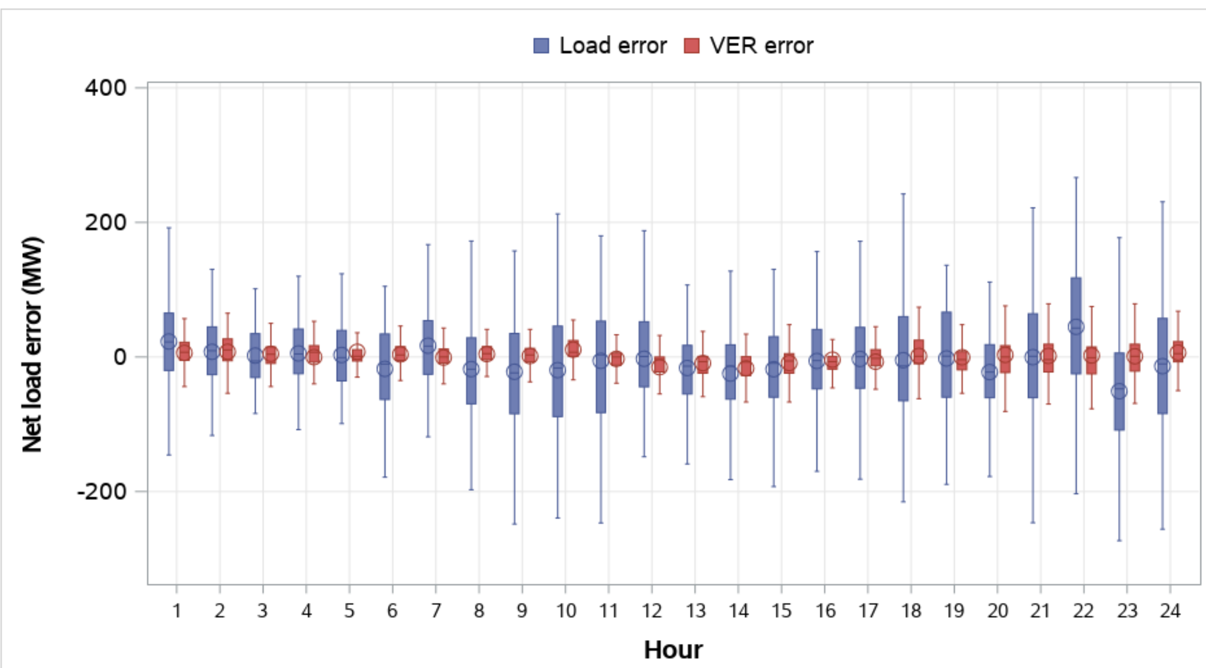


Figure 9.41 PNM average uncertainty by component (weekdays, August 2022)

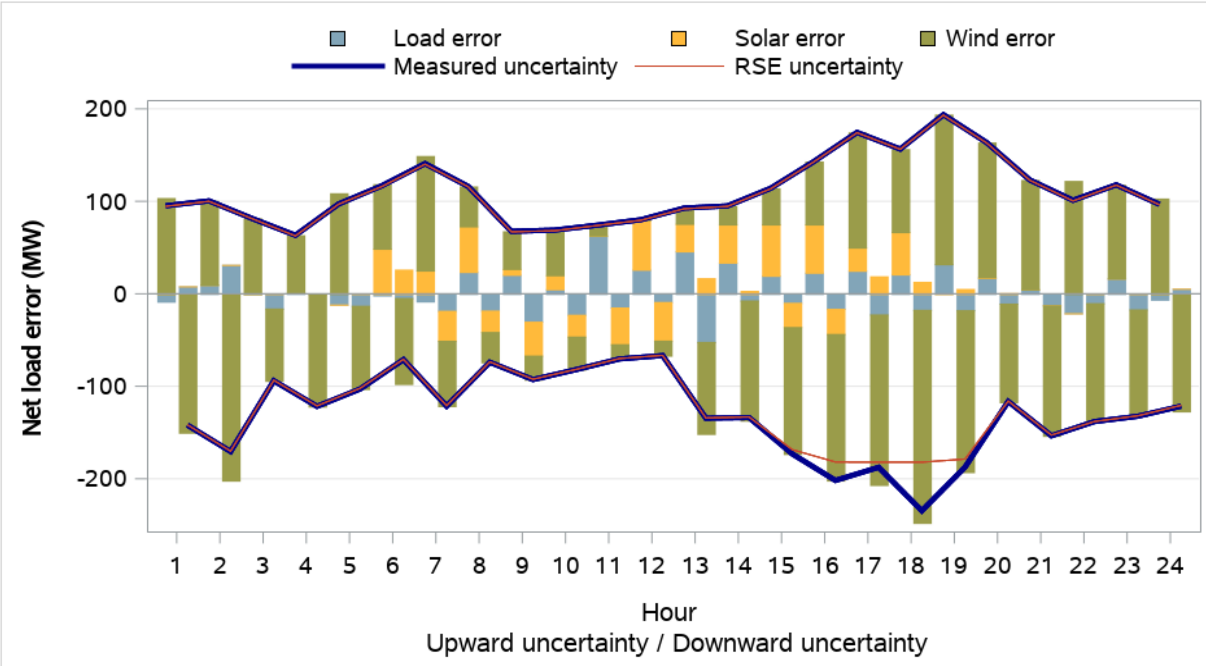


Figure 9.42 PNM distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

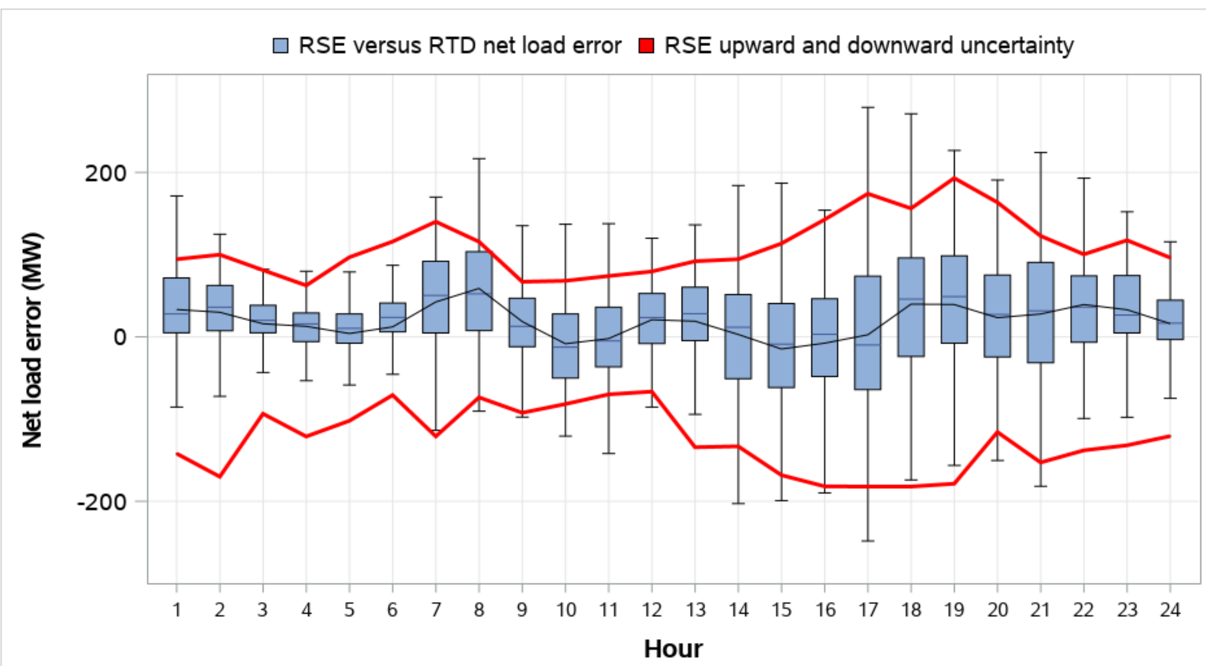


Figure 9.43 PNM distribution of RSE and RTD load and VER error (weekdays, August 2022)

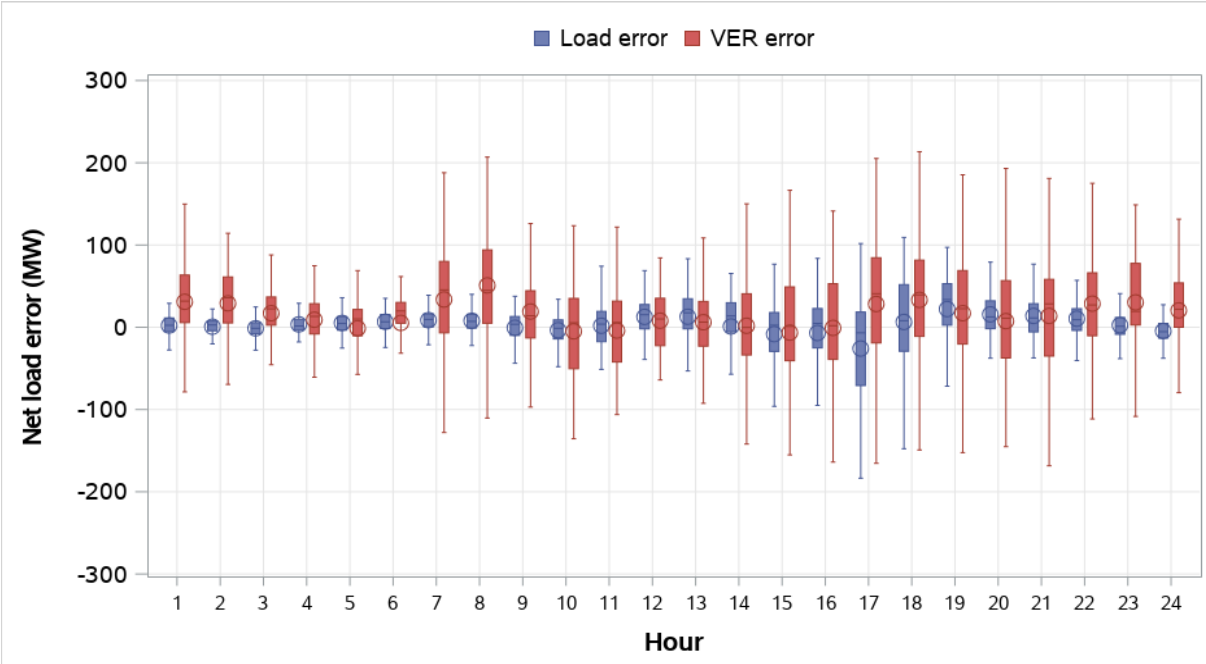


Figure 9.44 Puget Sound Energy average uncertainty by component (weekdays, August 2022)

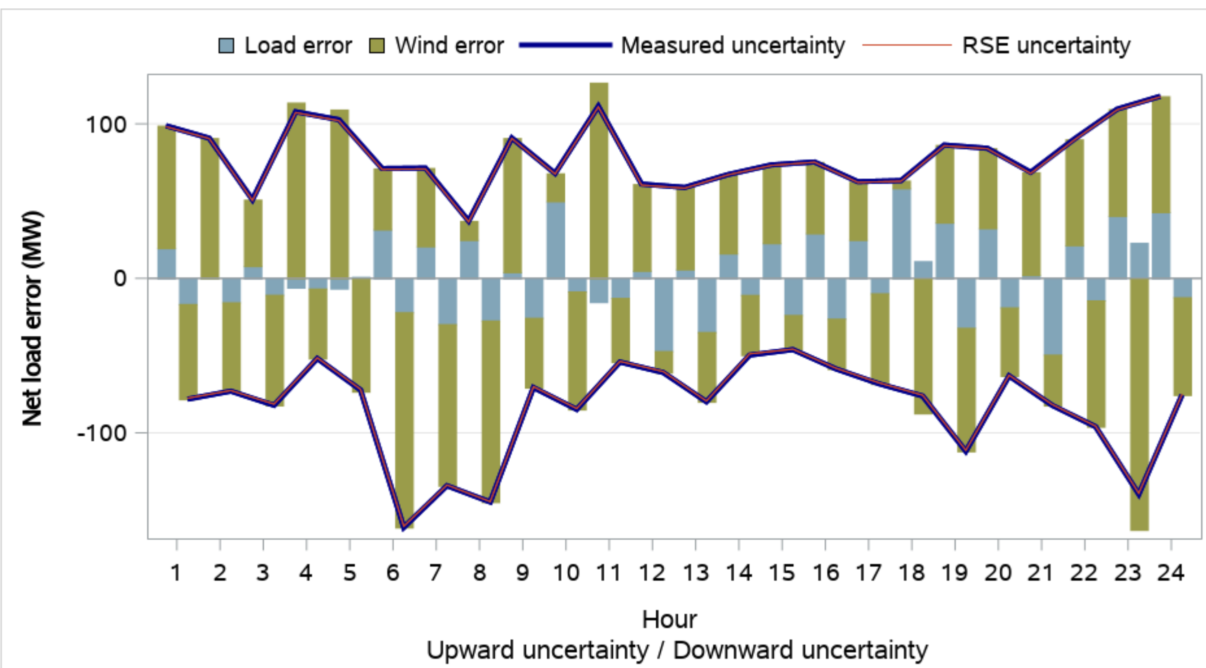


Figure 9.45 Puget Sound Energy distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

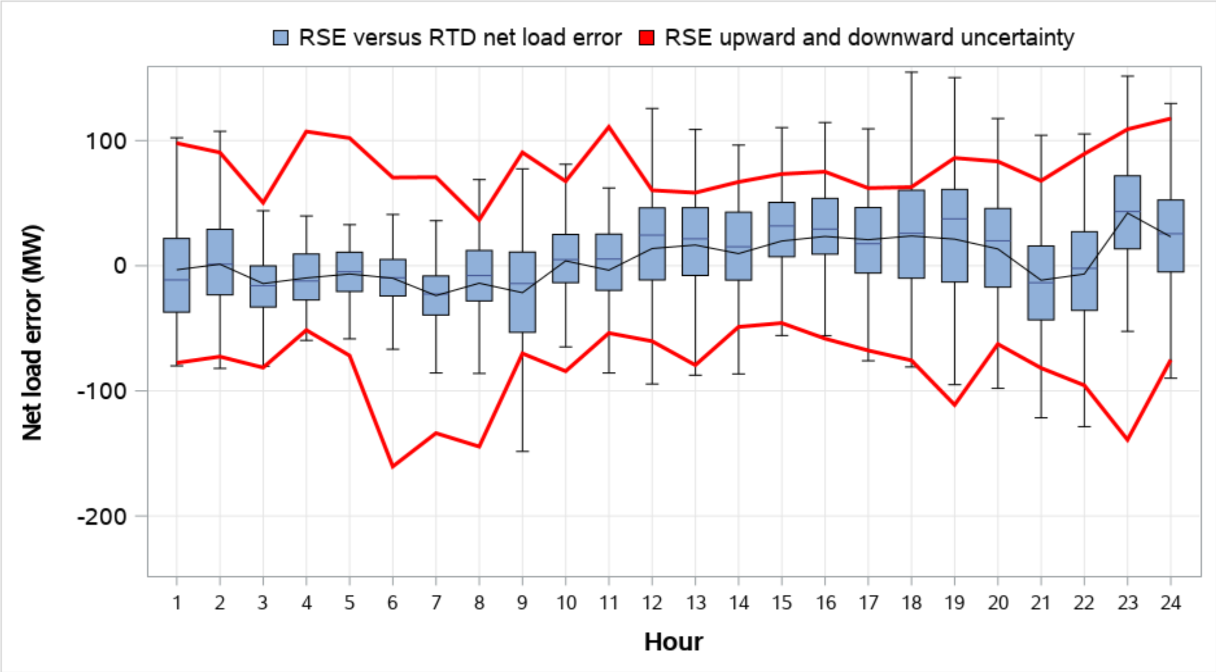


Figure 9.46 Puget Sound Energy distribution of RSE and RTD load and VER error (weekdays, August 2022)

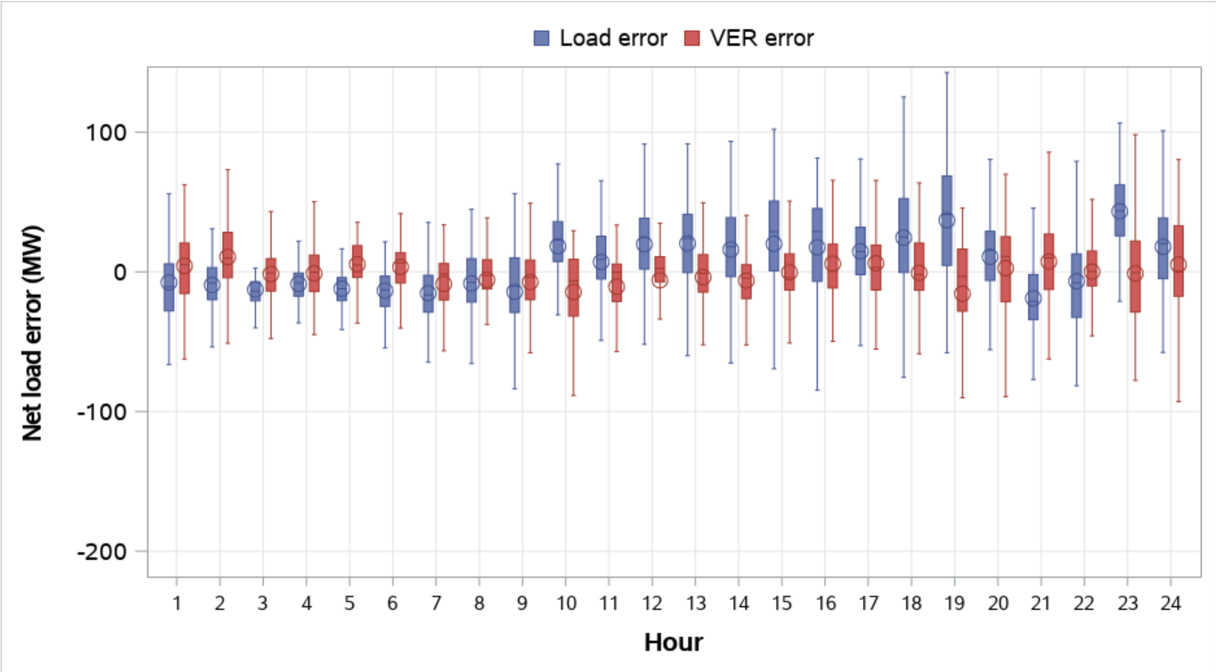


Figure 9.47 Salt River Project average uncertainty by component (weekdays, August 2022)

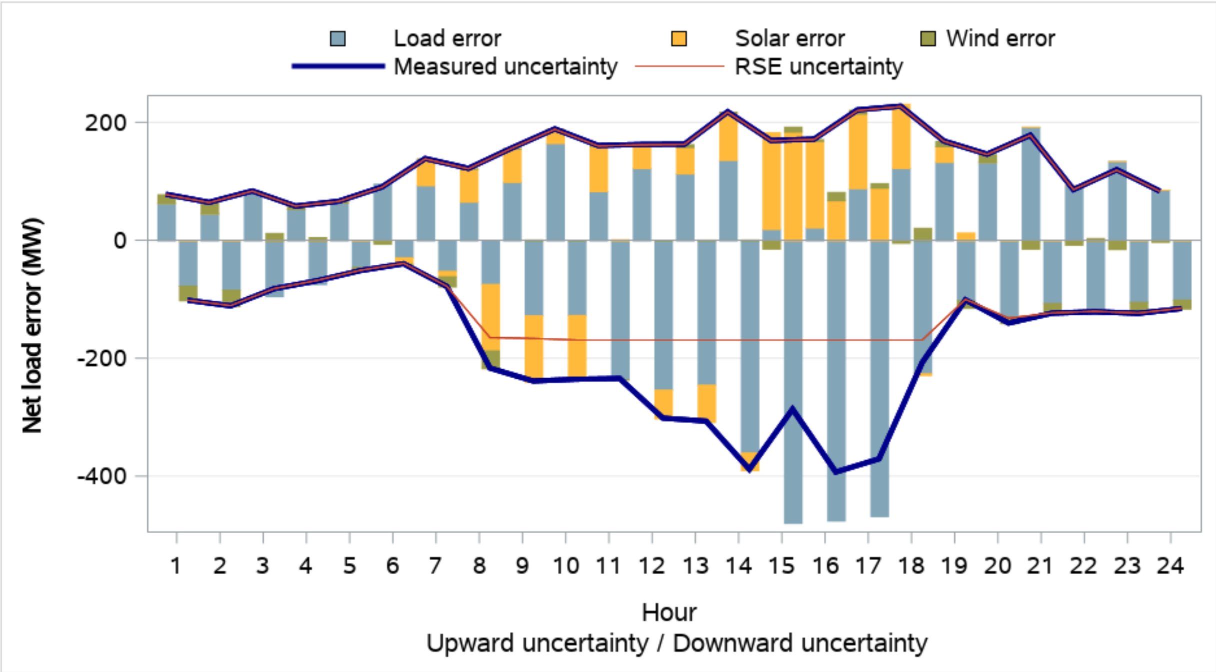


Figure 9.48 Salt River Project distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

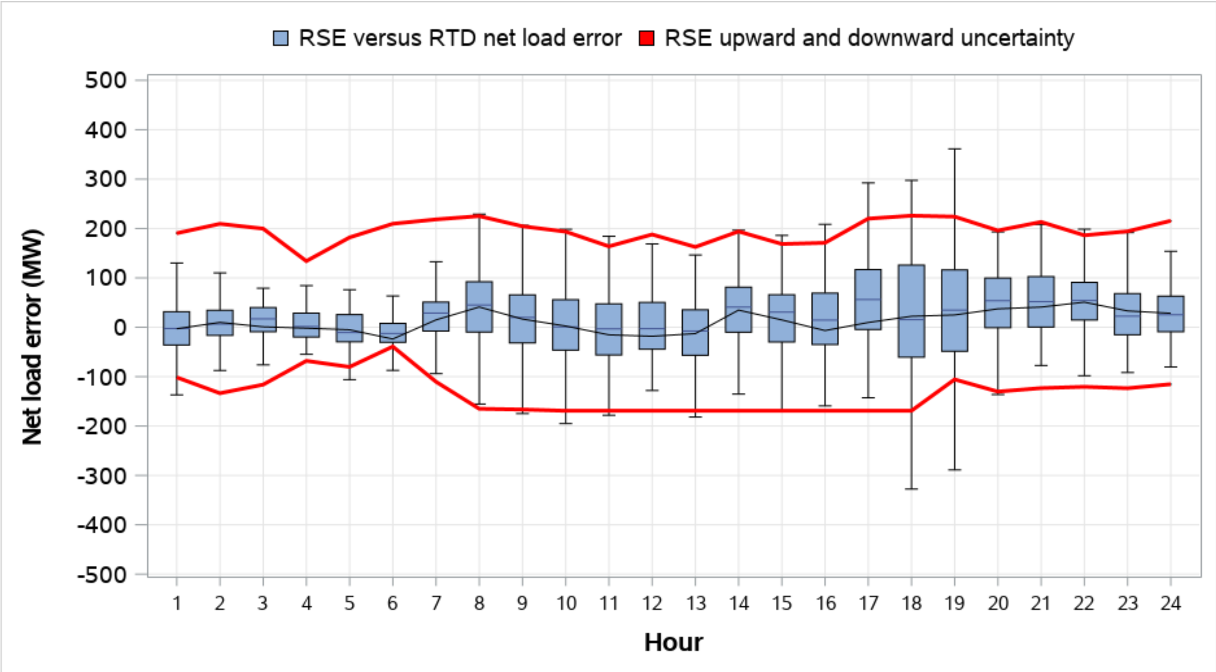


Figure 9.49 Salt River Project distribution of RSE and RTD load and VER error (weekdays, August 2022)

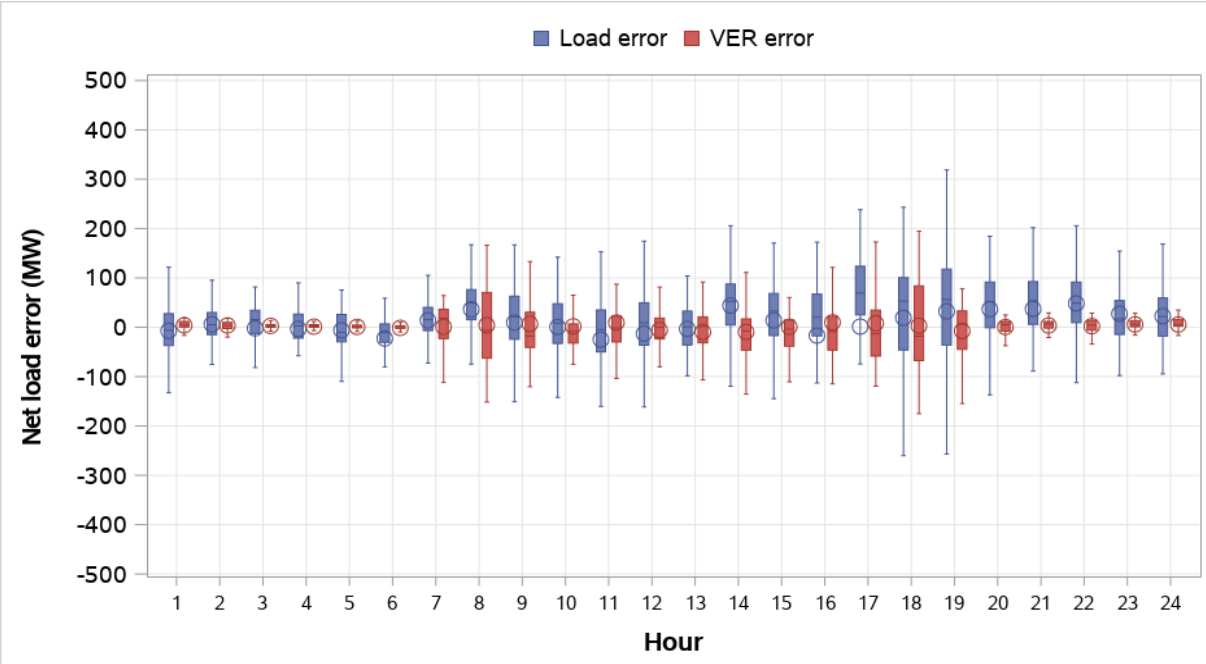


Figure 9.50 Seattle City Light average uncertainty by component (weekdays, August 2022)

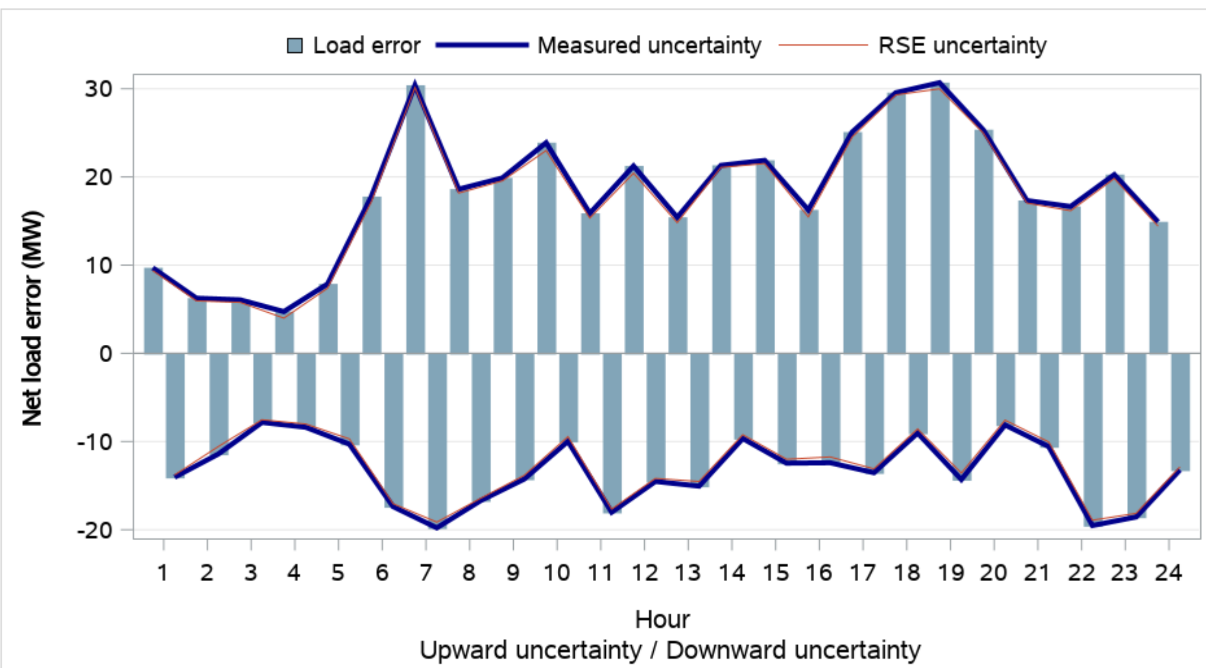


Figure 9.51 Seattle City Light distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

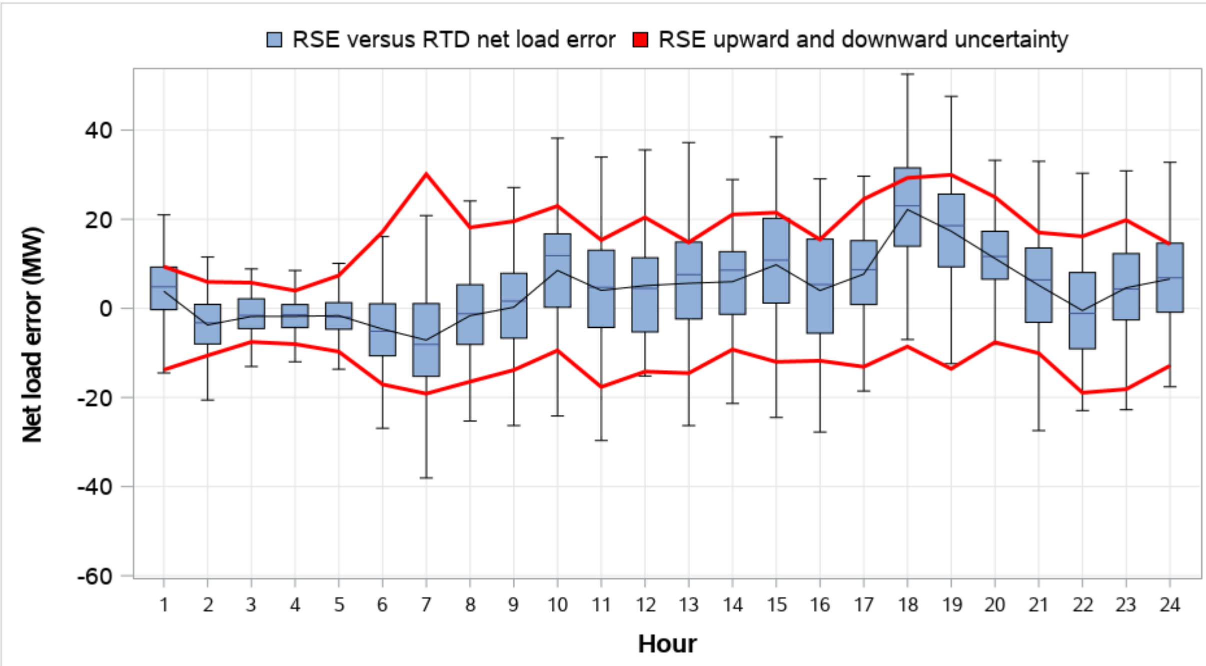


Figure 9.52 Seattle City Light distribution of RSE and RTD load and VER error (weekdays, August 2022)

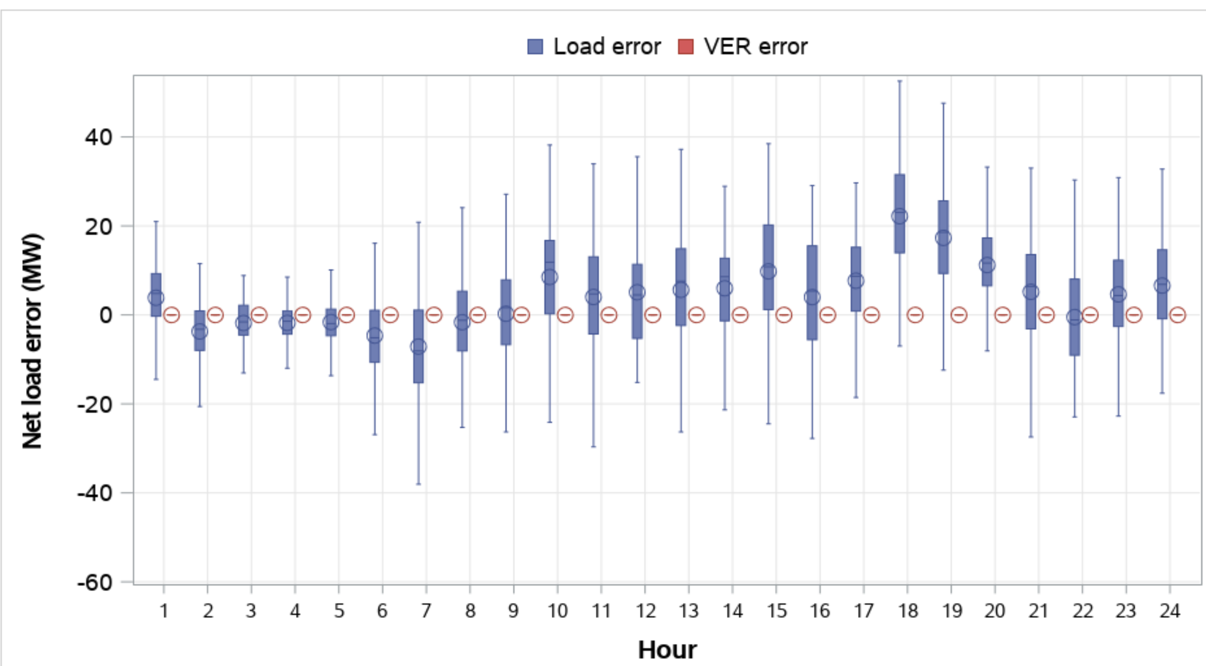


Figure 9.53 Tacoma Power average uncertainty by component (weekdays, August 2022)

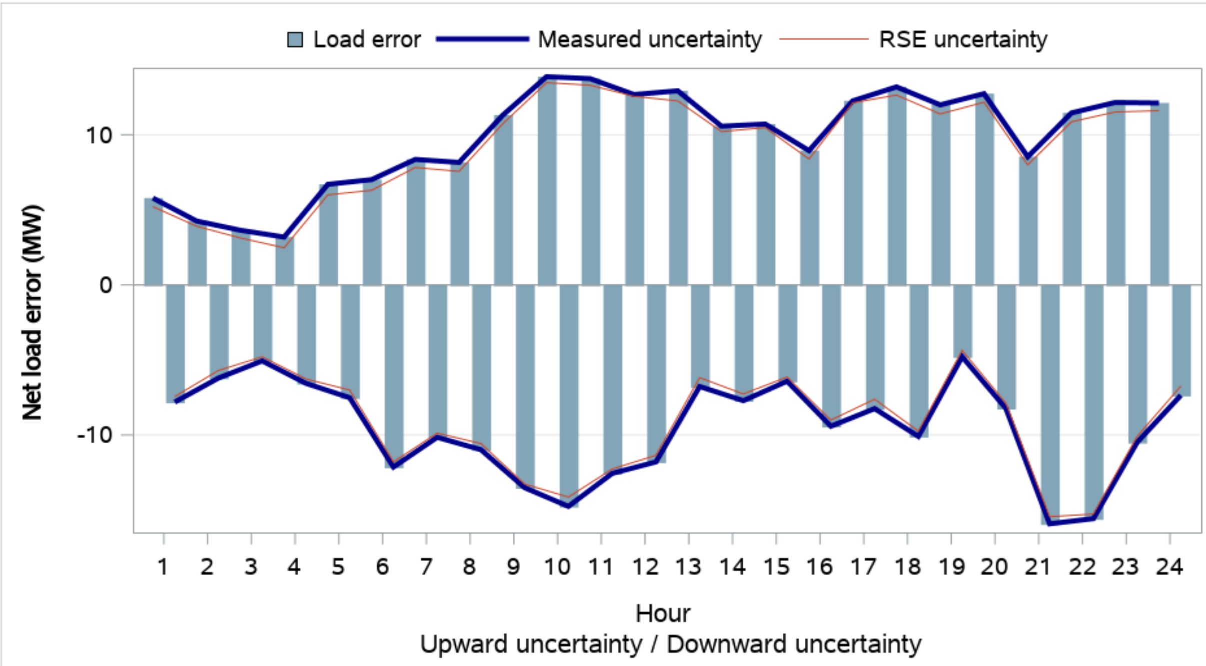


Figure 9.54 Tacoma Power distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

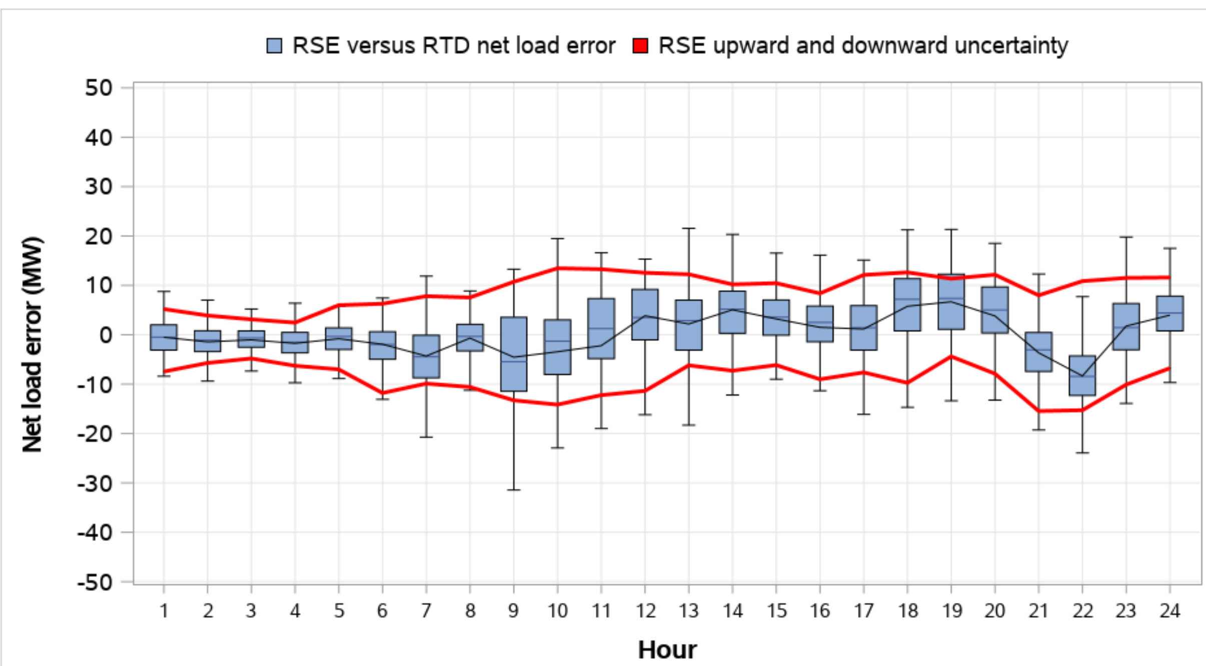


Figure 9.55 Tacoma Power distribution of RSE and RTD load and VER error (weekdays, August 2022)

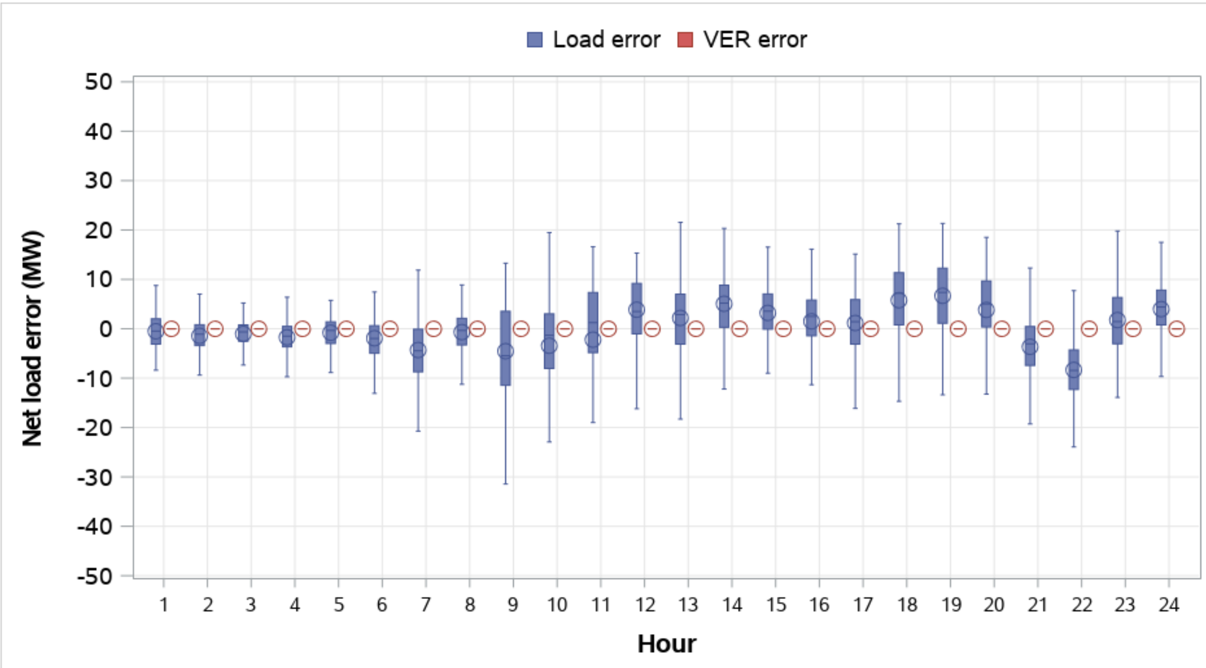


Figure 9.56 Tucson Electric Power average uncertainty by component (weekdays, August 2022)

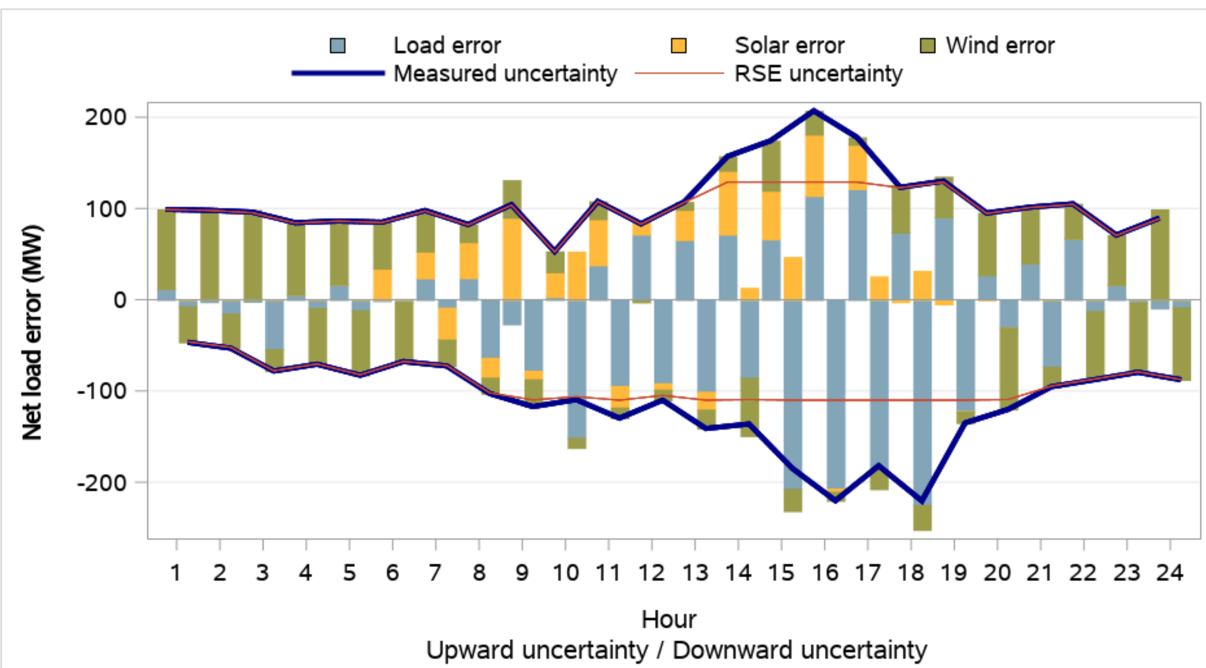


Figure 9.57 Tucson Electric Power distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

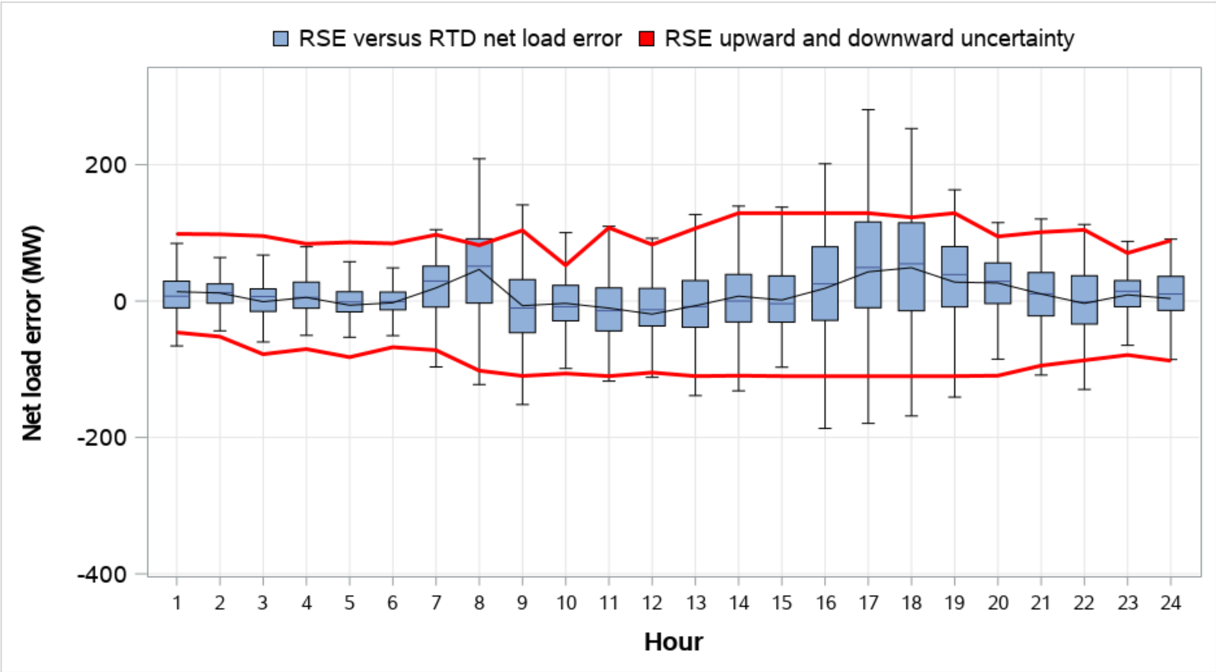


Figure 9.58 Tucson Electric Power distribution of RSE and RTD load and VER error (weekdays, August 2022)

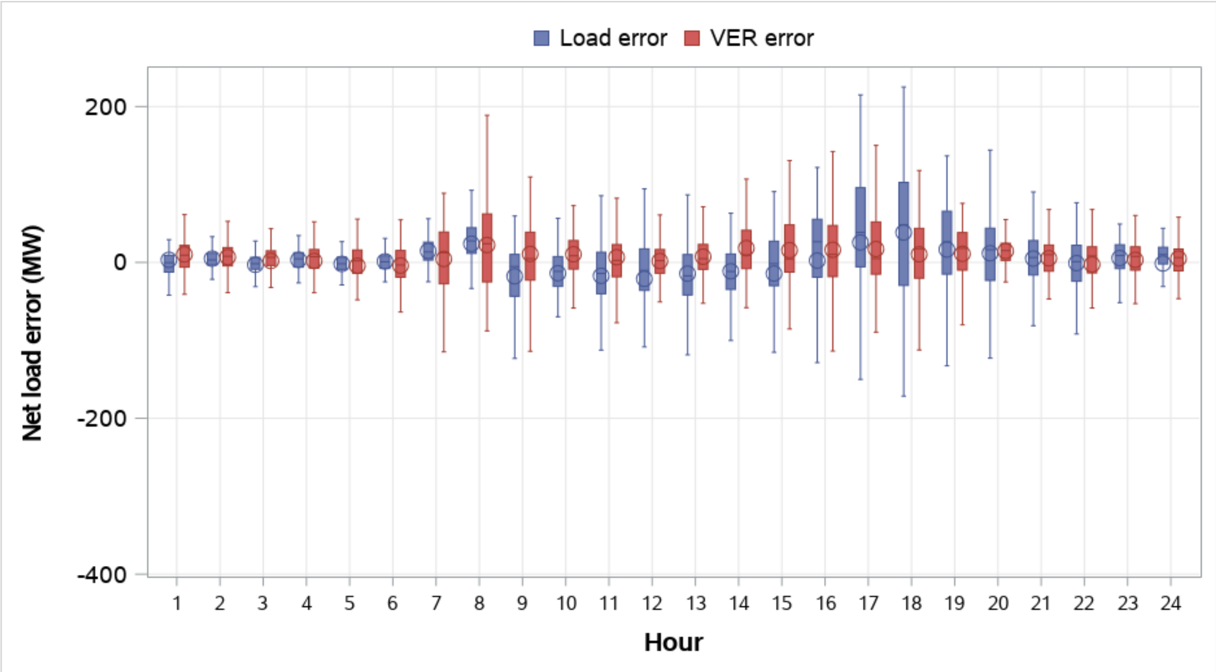


Figure 9.59 Turlock Irrigation District average uncertainty by component (weekdays, August 2022)

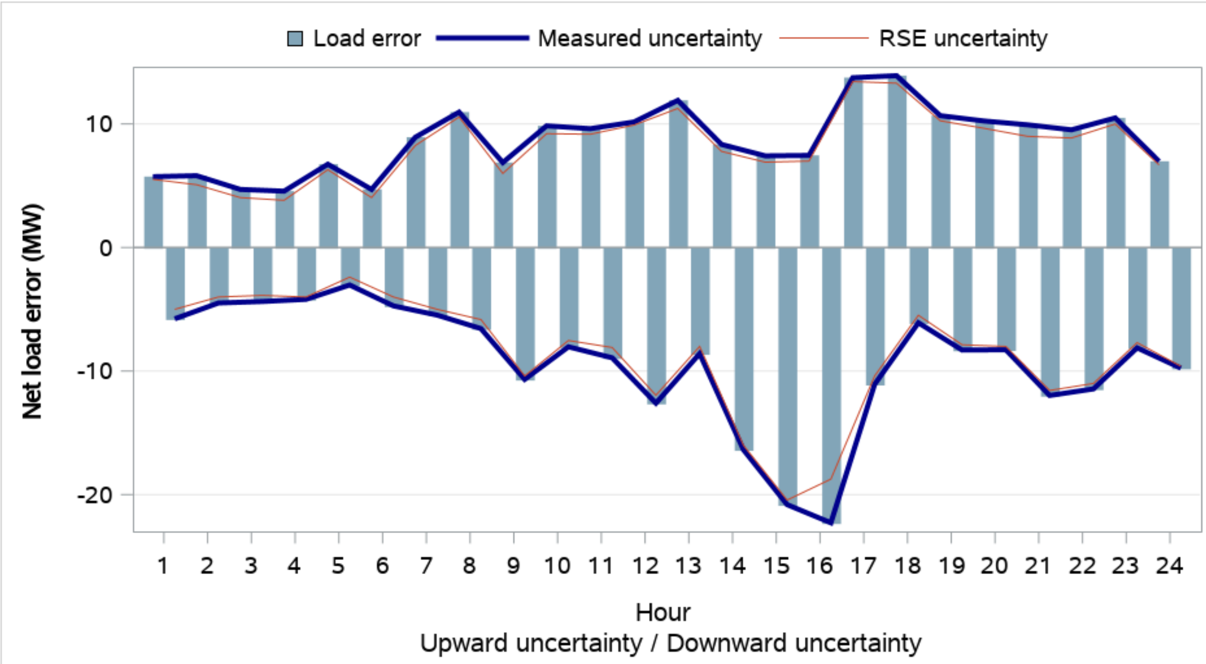


Figure 9.60 Turlock Irrigation District distribution of RSE and RTD net load error and comparison to RSE uncertainty (weekdays, August 2022)

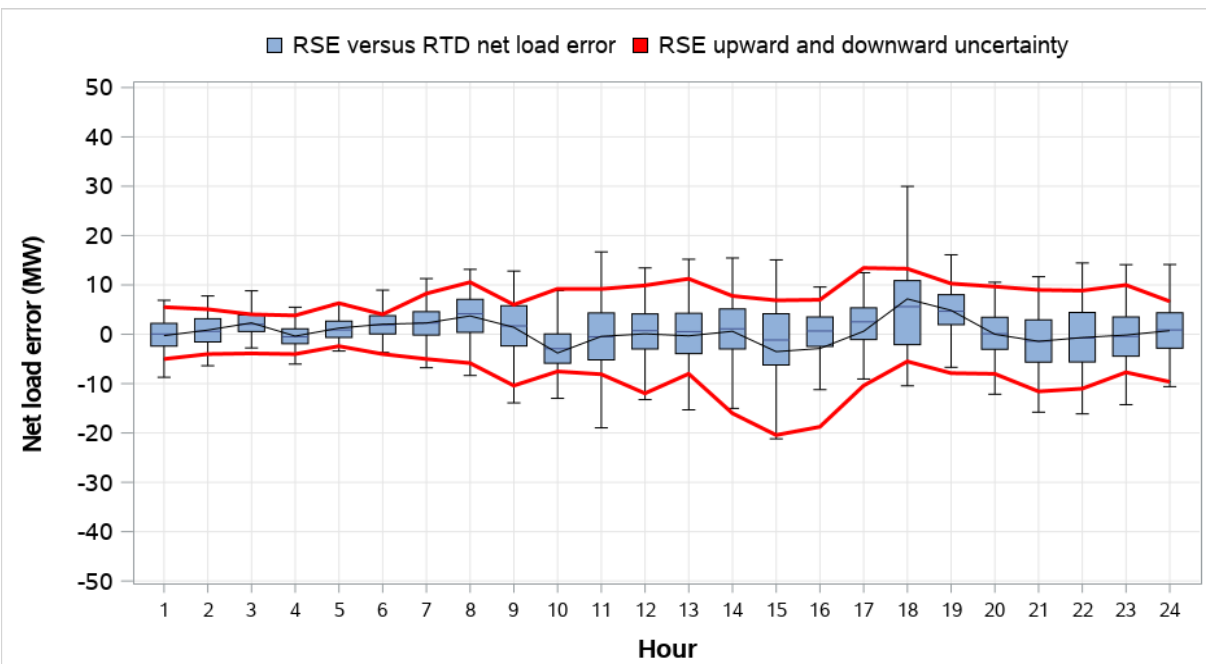
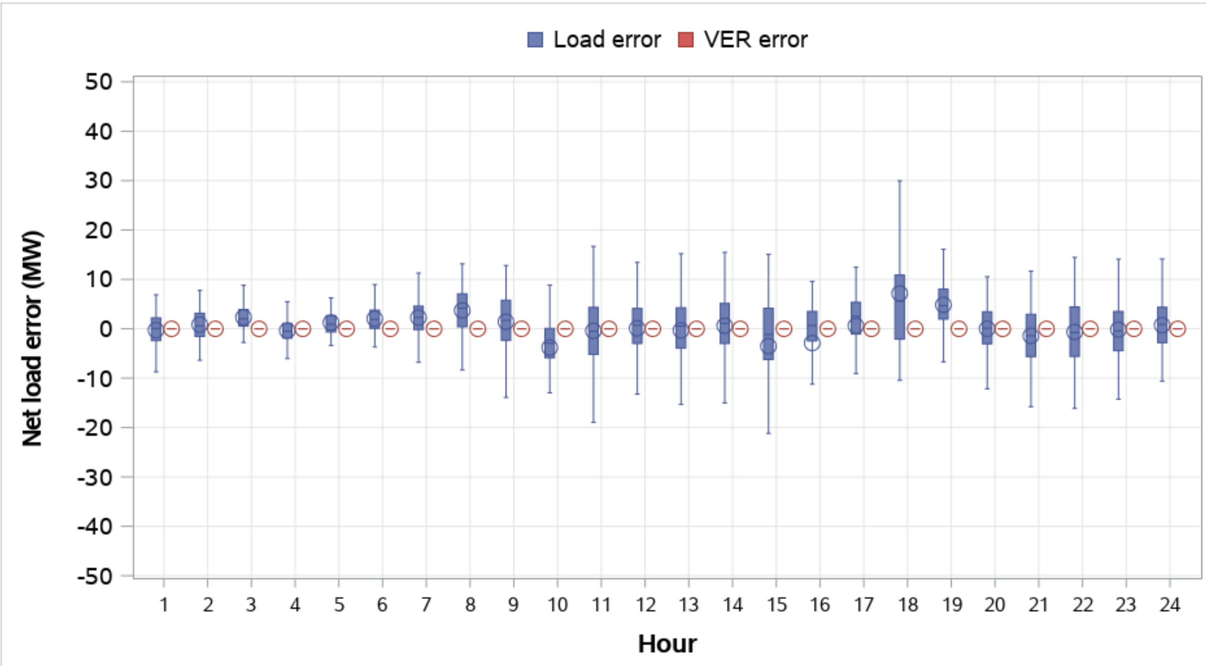


Figure 9.61 Turlock Irrigation District distribution of RSE and RTD load and VER error (weekdays, August 2022)



10 Resource sufficiency evaluation implementation issues

This section summarizes current resource sufficiency evaluation implementation issues that were identified.

1. In some cases, each side of an auto-mirror resource was counted differently for both CAISO and non-CAISO balancing areas in the bid-range capacity test. An update as part of summer 2021 enhancements allowed auto-mirroring for intertie transactions between CAISO and non-CAISO balancing areas. Here, the more granular 15-minute auto-mirror schedule, which accounts for intertie ramping between hours, was included in the capacity test for the non-CAISO balancing area; however, for the CAISO capacity test, the hourly block schedule is used.

2. In some cases, CAISO import and export schedules were not correctly capped by the transmission profile e-tag at 40 minutes prior to the test hour. As part of phase 1 enhancements, effective June 1, 2022, CAISO interchange awards which have not been tagged by 40 minutes prior to the test hour are expected to be removed from the tests. This helps align the interchange schedules used in the resource sufficiency evaluation with what is reasonably expected to be delivered. DMM has identified cases in which the contribution of an interchange schedule in the capacity test was not consistent with the transmission profile e-tag at the time of the test.

3. In some cases, battery storage capacity counted in the bid-range capacity test exceeded actual availability. As part of phase 1 enhancements, effective June 1, 2022, the California ISO implemented new logic to consider the initial state-of-charge for a battery unit in the tests. DMM has identified cases following implementation when counted battery storage capacity (above the energy base schedule) exceeded what could be provided relative to the maximum operating level and ancillary service obligation. This issue overestimates counted test capacity for the CAISO balancing authority area.

4. In some cases, the tests did not consider an outage or de-rate when they were not active for the entire hour being evaluated. Outage and de-rated capacity are currently considered at an hourly level.

5. DMM has identified a case in which both the bid-range capacity test and flexible ramping sufficiency test did not account for an exceptional dispatch for the upcoming hour being evaluated. The tests are expected to account for any active exceptional dispatch.