California ISO

Draft Flexible Capacity Needs Assessment for 2025

April 11, 2024

Table of Contents

1. Introduction

Each year, the ISO conducts an annual flexible capacity technical study to determine the flexible capacity needs of the system for up to three years into the future. This helps to ensure the ISO maintains system reliability as specified in the ISO Tariff section 40.10.1. The ISO developed and evolved the study process in the ISO's Flexible Resource Adequacy Criteria and Must-Offer Obligation ("FRAC-MOO") stakeholder initiative and in conjunction with the CPUC annual Resource Adequacy proceeding (R.11-10-023). This report presents the ISO's flexible capacity needs assessment specifying the ISO's forecast monthly flexible capacity needs in year 2025.

The ISO calculates the overall flexible capacity need of the ISO system and the relative contributions to this need attributable to the load serving entities (LSEs) under each local regulatory authority (LRA). This report details the system-level flexible capacity needs and the aggregate flexible capacity need attributable to CPUC jurisdictional load serving entities (LSEs). This report does not break-out the flexible capacity need by LSE attributable to individual local regulatory authorities (LRAs) other than the CPUC.

The ISO will use the results from the study to allocate shares of the system flexible capacity needs to each LRA with LSEs responsible for load in the ISO Balancing Authority area consistent with the allocation methodology set forth in the ISO's Tariff section 40.10.2. Based on that allocation, the ISO will advise each LRA of its MW share of the ISO's flexible capacity needs.

Also as a part of the annual Flex RA process, the ISO calculates the annual Availability Assessment Hours (AAH). The AAH are used to determine the hours of greatest need to maximize the effectiveness of the RA Availability Incentive Mechanism (RAAIM), rewarding resources for being available during these hours. The AAH are updated annually and published in the Reliability Requirements BPM.

2. Summary of Overall Process

The ISO determines the quantity of flexible capacity needed each month to reliably address its flexibility and ramping needs for the upcoming resource adequacy year and publishes its findings in this flexible capacity needs assessment. The ISO calculates flexible capacity needs using the calculation method codified in the ISO Tariff. This methodology includes calculating the seasonal amounts of three flexible capacity categories and determining seasonal must-offer obligations for two of these flexible capacity categories. The key results of the ISO's flexible capacity needs assessment for 2025 are based on the CEC's 1-in-2 hourly IEPR forecast

Managed Total Energy for Load[1], which looks at the following components provided by the California Energy Commission for 2025:

a. Baseline Consumption Load
b. Behind the meter (BTM) photo voltaic (PV)
c. Behind the meter storage residential (RES) and non-residential (NONRES)
d. Electric vehicle (EV) charging
e. Additional achievable energy efficiency (AAEE)

In addition to the flexible capacity and ramping needs, the calculation of the annual availability assessment hours (AAH) are also completed as a part of the Flex RA study process using the IEPR data described above, as well as the most recent year of actuals.

2.1 Summary of Overall Results

1) The expected system-wide flexible capacity needs for 2025 are greatest in September with 27,010 MW, and lowest in March at 20,533 MW.

2) The calculated flexible capacity needed from the "base flexibility" category is 41 percent of the total amount of installed or available flexible capacity in the summer months (May – September) and 29 percent of the total amount of flexible capacity for the non-summer months (October – April). See Section 6 for detailed description of the method used.

3) The "peak flexibility" categories are the highest for both seasons in three years reflecting the trend toward the dominance of the primary net load ramp in the afternoon when the sun goes down.

4) The ISO established in this year's assessment for 2025 the time period of the must-offer obligation for resources counted in the "Peak" and "Super-Peak" flexible capacity categories as the five-hour periods of hour ending HE15 to HE19 for November through February and HE17 to HE21 for March/April through August, and the shoulder months September and October hours HE16-HE20. Section 8 discusses the monthly pattern of the must-offer obligation hours in 2025.

5) The ISO also published advisory requirements for two additional years (2026 and 2027) following the upcoming Resource Adequacy (RA) year at the ISO system total levels is shown in Figure 6.

6) The determined draft AAH for 2025 are HE17-21 for the summer months (June – October), HE17-21 for the winter months (January – February, and November – December), and lastly, HE18-H22 for spring months (March – May).

[1] https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-IEPR-03

3. Calculation of the ISO System-Wide Flexible Capacity Need

Based on the methodology described in the ISO's Tariff and the business practice manual[2], the ISO calculated the ISO system-wide flexible capacity needs as follows:

$$Flexibility\ Need_{MTH_y} = Max\left[\left(3RR_{HR_x}\right)_{MTH_y}\right] + Max\left(MSSC, 3.5\% * E\left(PL_{MTH_y}\right)\right) + \varepsilon$$

Where:

$Max[(3RR_{HRx})_{MTHy}]$ = Largest three hour contiguous ramp starting in hour x for month y
E(PL) = Expected peak load
MTHy = Month y
MSSC = Most Severe Single Contingency[3]
ε = Annually adjustable error term to account for load forecast errors and variability methodology

For the 2025 RA compliance year, the ISO will continue to set epsilon (ε) equal to zero.

In order to determine the flexible capacity needs, including the quantities needed in each of the defined flexible capacity categories, the ISO conducted a six-step assessment process:

1) Generated one minute net load forecast for years 2025 through 2027 using all expected[4] and existing grid connected wind and solar resources and the CEC (CED 2023 Hourly Forecast – CAISO – Planning Scenario) hourly IEPR load forecast. The ISO used the most recent year of one-minute actual load (2023) data to formulate a shaped and smoothed one-minute 2025-2027 load forecast. [5]

2) Calculated the forecast monthly system-level three-hour upward net load ramp plus either the greater of the most severe single contingency or approximately 50% of the contingency reserves requirement of the system. Further, classify the monthly three-hour upward net load ramp into three categories and then calculate the percentages of each category relative to the three-hour upward net load ramp in each month. For the

[2] Reliability Requirements business practice manual Section 10. Available at https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Reliability%20Requirements
[3] For the 2025 flex assessment, the ISO assumed its MSSC is the loss of one Diablo Unit, which is consistent with what was done in past assessments. Also, for this analysis the ISO continues to use 3.5% of its peak monthly load forecast to estimate the spinning reserve requirement of its contingency reserve obligation.
[4] Expected wind and solar resources also included monthly incremental renewable resources that are dynamically scheduled into the ISO.
[5] See the Draft 2025 Flexible Capacity Needs Assessment at https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2025 for more information on the shifting and smoothing methodology

definition of each of the three categories and the relevant percentage, please refer to Section 6 below.

3) Applied the calculated percentages in Step 2 to the contingency reserve requirements for each month, so that each category has the appropriate amount of contingency reserve as well the three-hour net load ramp component. For each category, the ISO uses the sum of these two quantities as the monthly flexible capacity need.

4) Analyzed the distributions of both the largest three-hour net load ramps for the primary and secondary net load ramps to determine the appropriate seasonal demarcations[6].

5) Calculated a simple average of the percent of base flexibility needs for all months within a season; and

6) Determined each LRA's contribution to the flexible capacity need.

4. Forecasting One-Minute Net load

The first step in developing the flexible capacity needs assessment was to forecast the net load. To produce this forecast, the ISO collected through surveys the requisite information regarding the existing build-out in 2023 and the expected build-out in 2025 through 2027 of the grid-connected wind and solar resources. After obtaining this data from all LSEs, the ISO constructed the forecast one-minute load, grid connected solar and wind resources before calculating the net load curves for 2025 through 2027.

4.1 Building the Forecasted Variable Energy Resource Portfolio

To collect the necessary data, the ISO sent a data request in December 2023 to the scheduling coordinators for all LSEs representing load within the ISO balancing area[7]. To assist with common questions regarding the survey, the ISO updated the FAQ document which is available on the stakeholder page.[8] The deadline for submitting the data request was January 15, 2024. At the time of the stakeholder call in February, the ISO had received data from all LSEs. The data request asked for information on each grid connected wind and solar resource that is connected within the ISO's footprint, in whole or in part, in addition to external wind/solar resources that are under contractual commitment to the LSE for all or a portion of its capacity that is expected to be dynamically imported into the ISO. Since the CEC's load forecast accounted for the expected -the-meter production, there was no need for the ISO to

[6] The three-hour primary ramp in each day is the largest three-hour ramp in that day, while the secondary three-hour ramp is the largest three-hour ramp outside the range of the primary three-hour ramp.
[7] A reminder notice was also sent out in early January 2024
[8] http://www.caiso.com/InitiativeDocuments/Flexible-Capacity-Requirement-Assessment-Survey-FAQ.pdf

include the behind-the-meter production in the net load calculation.

The ISO also requested LSEs to provide data on existing and expected Hybrid and Co-Located resources in order to quantify the contribution of the renewable component. The Co-Located resource type went live in December 2021 as part of Phase 1 of the hybrid resources initiative[9], and phase 2 went live February 1, 2023 and included the addition of the new Hybrid fuel type and the ability to identify Hybrid components by fuel type within the ISO's Master File. The submittals showed a total of about 6,314 MW of existing and expected Co-Located renewable resources (excluding storage) in the 2025 timeframe, which were factored into the flexible needs assessment. The survey submittals of Hybrid resources showed a total of 738 MW of expected renewable Hybrid components in 2025. For the 2023-2025 Flexible RA study, Co-Located renewables and renewable components of Hybrid resources were also included in calculating the flexible capacity needs.

The ISO expects there to be a large increase in Co-located and Hybrid resources with renewable components on the system throughout 2024-2027. Co-located resources have the ability to produce as capable and with their treatment in the market being nearly identical to those of a traditional VER, Co-Located resources were included in the 2023 and 2024 three-hour ramp forecast and flexible capacity study. In regards to Hybrid resources, although the Hybrid resources as a whole are expected to follow their dispatch operating targets (DOTs), the individual renewable components will contribute to the three-hour net load ramp. Renewable components of Hybrid resources must be considered in the flexible needs assessment because all variable resources contribute to the three-hour ramp. Variable resources, whether it be a standalone or the variable component of a Hybrid, contribute to the flexibility requirement of the system, thus the ISO incorporates forecasts to estimate the flexible needs associated with these resources. The ISO allows the storage component for Co-Located and Hybrid resources to count towards flexible capacity requirement. The ISO will continue to monitor the operations of Hybrid resources and their inclusion the Flex RA study in future years.

As part of the data request, the ISO also asked for behind-the-meter existing and expected capacity within each LSEs portfolio. For resources that are external to the ISO, the ISO requested additional information as to whether the resource would be either fixed or dynamically scheduled into the ISO. The ISO only included incremental external resources in the flexible capacity requirements assessment if they were identified to be dynamically scheduled to the ISO.

[9] https://stakeholdercenter.caiso.com/StakeholderInitiatives/Hybrid-resources

Using the LSE's submitted renewable resources data and the CEC's hourly load forecast, the ISO simulated the net load[10] output for 2025, 2026 and 2027 using actual one-minute load, wind and solar data for 2023. A breakdown of the LSEs submittal is shown in Table 1. The ISO is comparing the data submitted by the LSEs below to data in the interconnection que and current capacity to ensure alignment. The ISO may perform additional outreach to LSEs based on the data submitted to ensure all resources are being included.

Table 1: Total ISO System Variable Energy Resource Capacity for Year End Based on LSE Survey Data (Net Dependable Capacity-MW)[11]

Resource Type	Existing 2023	Expected 2024	Expected 2025
ISO Solar PV	11,757	11,800	11,966
ISO Solar Thermal	860	858	858
ISO Wind	4,626	4,663	4,870
Co-Located Resources (Wind)	0	0	0
Co-Located Resources (Solar)	4,524	5,676	6,314
Hybrid Resources (Wind)	30	30	30
Hybrid Resources (Solar)	337	672	738
Total Variable Energy Resource Capacity within the ISO	***22,133***	***23,698***	***24,775***
Cumulative Non ISO Wind/Solar Resources that's Dynamically Scheduled into the ISO	1,770	1,907	1,950
Total Internal and Dynamically Scheduled VERs in Flexible Capacity Needs Assessment	***23,903***	***25,606***	***26,725***
Incremental New VERs Additions Each Year (Included in Flexible Capacity Needs Assessment)		***1,703***	***1,119***
Maximum Expected BTM Solar PV Production in the CEC's Forecast		14,094	15,338
Cumulative behind-the-meter Solar PV Capacity reported by LSEs	15,370	16,857	18,268

Table 1 aggregates the system-wide variable energy resources output by year. Additionally, for existing solar and wind resources, the ISO used the most recent full year of actual solar output data available, which was 2023.

[10] Net load is defined as load minus wind production minus solar production.

[11] Data shown is for December of the corresponding year. The ISO aggregated variable energy resources across the ISO system to avoid concerns regarding the release of confidential information.[12]
https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-IEPR-03

Figure 1a and 1b below show the expected buildout by month and year for Hybrid and Co-Located resources with renewable components, broken down by fuel type. For this study, both Co-Located renewables and the renewable components of Hybrid resources were considered.

Figure 1a: Expected buildout of Hybrid Resources for 2023 through 2027

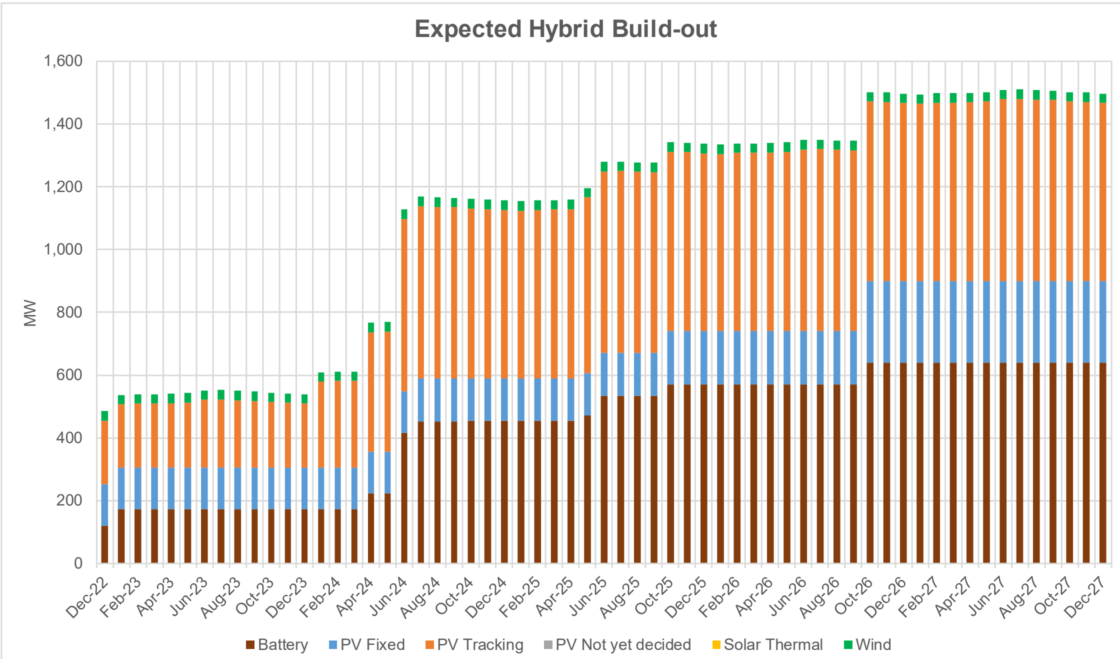
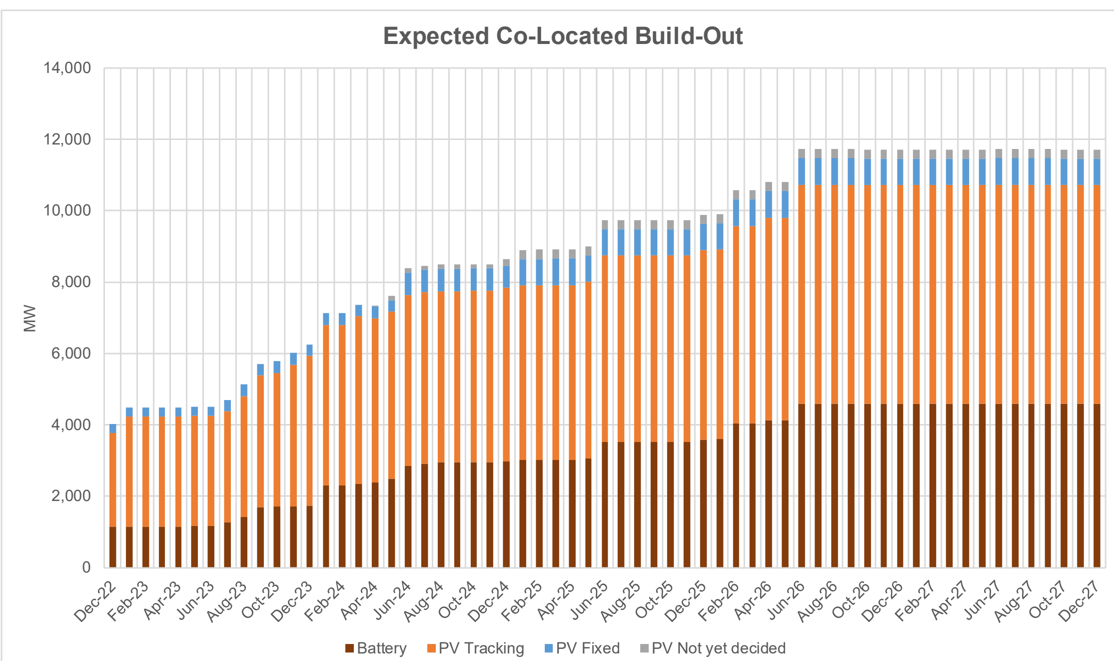


Figure 1b: Expected buildout of Co-Located Resources for 2023 through 2027



For future wind resources, the ISO scaled the overall one-minute wind production for each month of the most recent year by the expected future capacity divided by the installed wind capacity for the same month of the most recent year. Specifically, to develop the one-minute wind profiles for 2025, the ISO used the actual one-minute wind profile for 2023 using the following formula:

$$2025W_{Mth\_Sim\_1min} = 2023W_{Act\_1min} * \frac{2025W_{Mth\ Capacity}}{2023W_{Mth\ Capacity}}$$

Similarly, to develop one-minute transmission connected solar profiles for 2025, the ISO used the actual one-minute solar profiles for 2023 using the following formula:

$$2025S_{Mth\_Sim\_1min} = 2023S_{Act\_1min} * \frac{2025S_{Mth\ Capacity}}{2023S_{Mth\ Capacity}}$$

Given the amount of incremental wind and solar resources expected to come on line, this approach simply scales the one-minute production with respect to capacity.

4.1 Building One-Minute Net Load Profiles

The ISO used the CEC 2023 Integrated Energy Policy Report (IEPR) 1-in-2 hourly managed net load forecast (CED 2023 Hourly Forecast – CAISO – Planning Scenario) to develop one-minute load forecasts for each month[12]. The ISO first scaled the actual load for each minute of each hour of 2023 using an expected CEC's load growth factor for the corresponding hour.

$$2025L_{Mth,Day,Hour\_Sim\_1min} = 2023L_{Mth,Day,Hour\_Act\_1min} * \frac{2025L_{Mth,Day,Hour\_Forecast}}{2023L_{Mth,Day,Hour\_Actual}}$$

Using this load forecast and the expected wind and solar profiles developed in Section 4.1, the ISO then developed the one-minute net load profiles for subsequent years by aligning weekdays and weekends within each month.

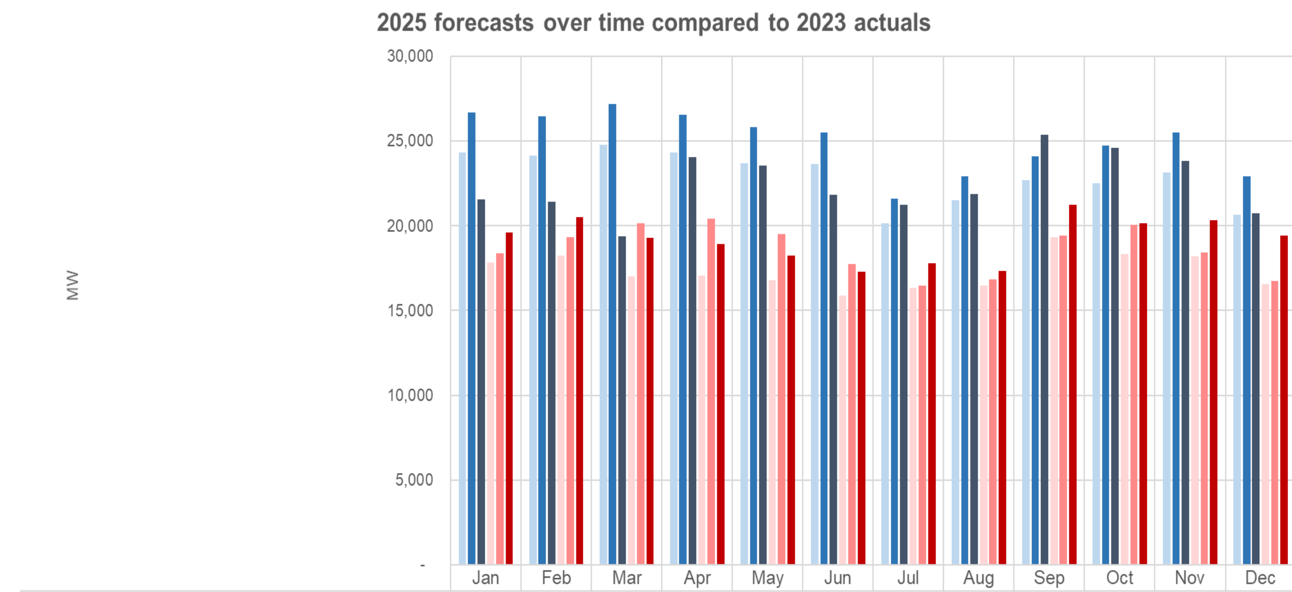
5. Calculating the Monthly Maximum Three-Hour Net load Ramps plus Reserve

In last year's study, the ISO has made adjustments to account for a high bias observed in the CEC IEPR forecast for the CAISO peak load and load ramp forecast. For the 2025 study, the ISO did not make any changes or apply any correction metrics to the three-hour ramp forecast after the above calculations were made. This is because the 2023 IEPR forecast used in calculating the 2025 three-hour ramp forecast for the 2024 study had improvements made to the incorporation of BTM solar based on historical data. Figure 2 below shows how the three-hour net load ramp forecast for 2025 has changed over time. There are multiple months where the

[12] https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-IEPR-03

latest forecast from this year, which incorporates the IEPR updates to behind-the-meter treatment, has led to a lower ramp forecast. The months with an increase in the ramp forecast or little changes with the 2024 update were the summer and fall months where air conditioning usage is highest. Due to these changes made by the CEC, the ISO elected to not implement any correction metrics to the forecast to allow an evaluation of the new IEPR methodology.

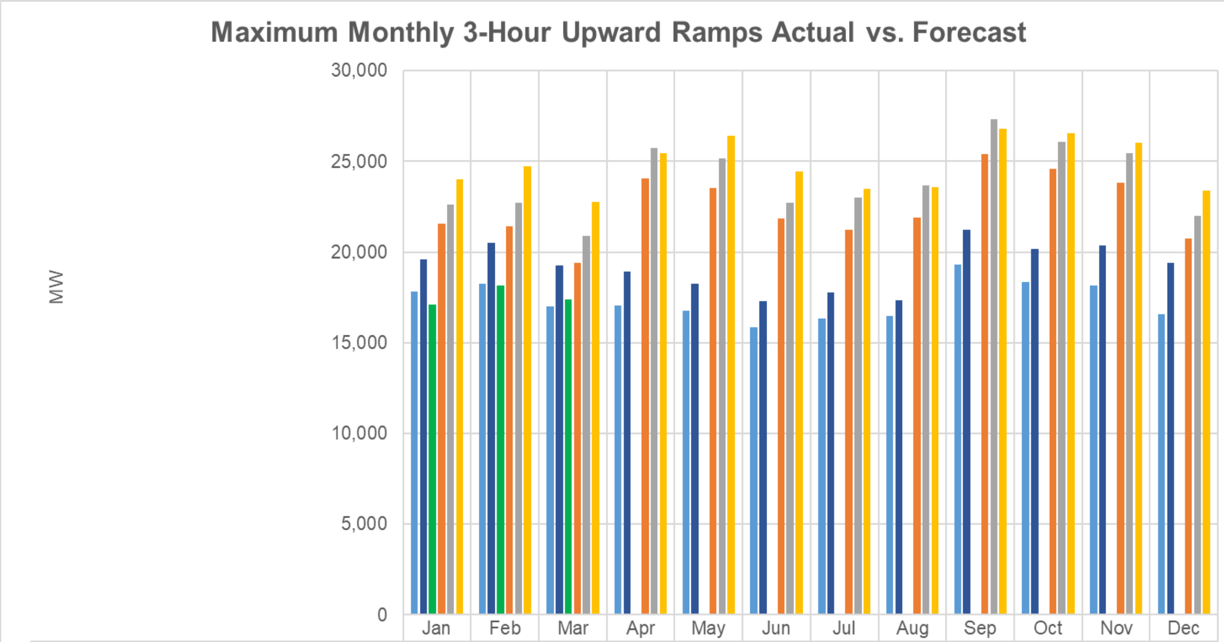
Figure 2: How the three-hour net load ramp forecast for 2025 has changed over time



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023 Forecast for 2025 Published w/ Error Correction	24,352	24,171	24,767	24,340	23,714	23,670	20,163	21,502	22,719	22,515	23,156	20,638
2023 Forecast for 2025 No Adjustments	26,715	26,484	27,213	26,540	25,844	25,509	21,620	22,945	24,083	24,736	25,501	22,943
2024 Forecast for 2025	21,554	21,418	19,383	24,041	23,541	21,838	21,252	21,894	25,396	24,604	23,837	20,730
2023 Actuals	17,821	18,261	17,003	17,052	16,778	15,864	16,340	16,488	19,325	18,336	18,182	16,559
2023 Actuals w/ curtailments added back in	18,361	19,324	20,173	20,416	19,527	17,757	16,488	16,843	19,433	20,049	18,424	16,752
2023 Actual w/out battery charging, pumps	19,596	20,496	19,277	18,920	18,261	17,283	17,786	17,346	21,242	20,157	20,346	19,428

Figure 3 shows the expected ISO system-wide largest three-hour net load ramp for each month of 2025 through 2027 compared with each month of the actual three-hour net load ramp for 2023 and through March 2024.

Figure 3: Expected ISO System Maximum Monthly Three-Hour Net Load Ramps

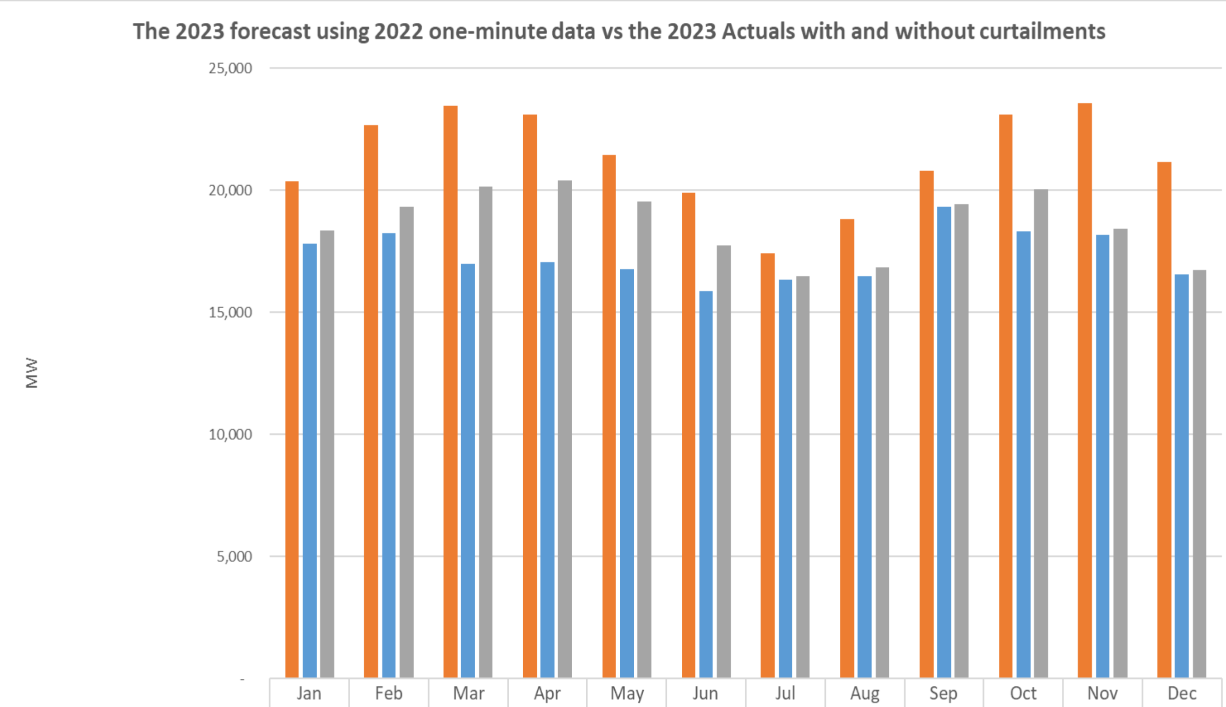


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023 Actual	17,821	18,261	17,003	17,052	16,778	15,864	16,340	16,488	19,325	18,336	18,182	16,559
2023 Actual w/out battery charging, pumps	19,596	20,496	19,277	18,920	18,261	17,283	17,786	17,346	21,242	20,157	20,346	19,428
2024 Actual	17,119	18,178	17,385									
2025 Ramp Fct	21,554	21,418	19,383	24,041	23,541	21,838	21,252	21,894	25,396	24,604	23,837	20,730
2026 Ramp Fct	22,608	22,695	20,885	25,761	25,184	22,710	23,013	23,668	27,341	26,088	25,452	21,999
2027 Ramp Fct	24,020	24,731	22,749	25,474	26,427	24,450	23,464	23,601	26,818	26,574	26,034	23,410

For 2025, the maximum three-hour upward ramp is expected to be approximately 25,396 MW in September and the minimum three-hour upward ramp of approximately 19,383 MW is expected to occur in March. This is a shift from historical forecasts where the largest three-hour ramp has been expected to occur in the spring months and the smallest ramps in the summer. However, as also shown in Figure 3, in 2023 the largest observed three-hour ramp occurred in September with a change of 19,325 MW over three hours, and the smallest ramp occurred in June with a ramp of 15,864 MW. Spring months often see the largest curtailments of resources, particularly solar resources. Curtailment of renewable resources leads to a higher mid-day net load and smaller three-hour ramps as observed in 2023. Incremental resources dynamically scheduled into the ISO for 2025, 2026 and 2027 are included in the calculation of the three-hour ramp forecast because the ISO must provide balancing services for these resources. Also, dynamically scheduled resources in the actual 2023 data were already factored into the ISO's load.

Depending on the time of day the curtailments occur, they can have an effect on reducing the three-hour ramp by raising the mid-day net load. The impact of curtailments on the three-hour ramp is shown in Figure 4. It is important to note that the actual three-hour net load ramps include real-time curtailments as the actual one-minute wind and solar data used to determine the forecast three-hour monthly ramps include curtailments[13]. As shown in Figure 4, curtailments can reduce the observed three-hour ramp compared to the actuals where curtailments are added back into the actuals, so they are not included in the impacts on the three-hour ramp.

Figure 4: The ISO 2023 Expected Maximum Monthly three-Hour Ramp vs 2023 Actuals With and Without Curtailments

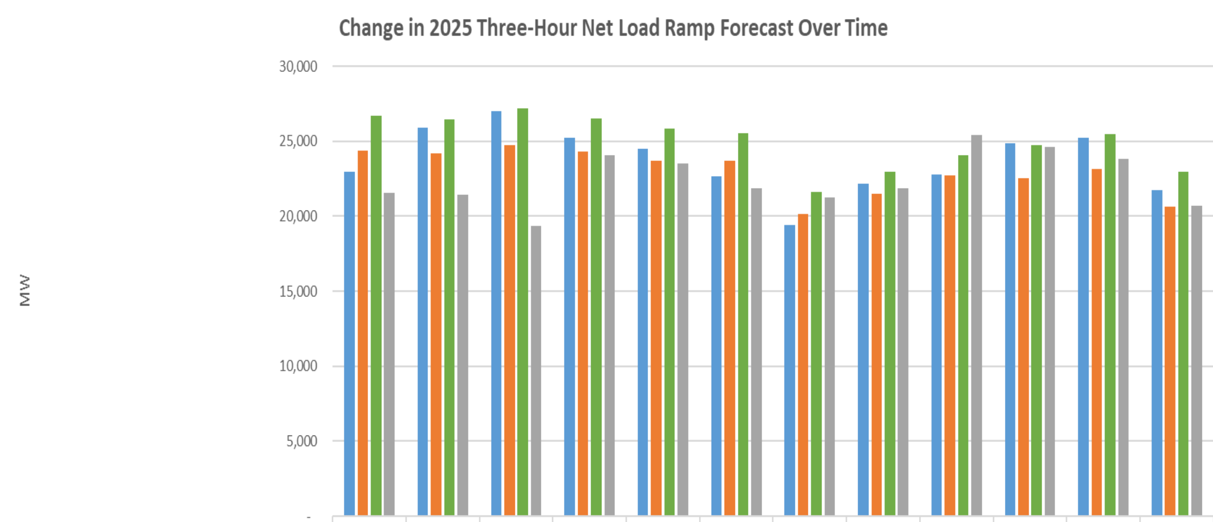


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023 Forecast	20,357	22,665	23,475	23,092	21,458	19,913	17,430	18,832	20,790	23,087	23,582	21,148
2023 Actuals	17,821	18,261	17,003	17,052	16,776	15,864	16,340	16,488	19,325	18,336	18,182	16,559
2023 Actuals + Curtailments	18,361	19,324	20,173	20,416	19,527	17,757	16,488	16,843	19,433	20,049	18,424	16,752

Other factors that can impact the three-hour ramp include tempertaues and cloud cover. January-March 2023 featured well above normal precipitation and cloud cover across much of the state. Due to the reduction in behind-the-meter solar generation, this resulted in lower observed three-hour ramps, and is likely the reason why the actuals are significantly lower than the forecast. The summer months were relatively mild with periods of below and above normal temperatures, so summer loads were not as high as other recent years, which could have led to larger three-hour ramps due to periods of lower mid-day loads. March through June and October featured a large number of curtailments for the month, which act to raise mid-day loads and lead to smaller ramps.

[13] Curtailments would be reflected in the actual three-hour ramps if the ISO curtailed renewables in real time.

Figure 5: Comparing the Change in the 2025 three-hour Ramp Forecast From 2022-2024



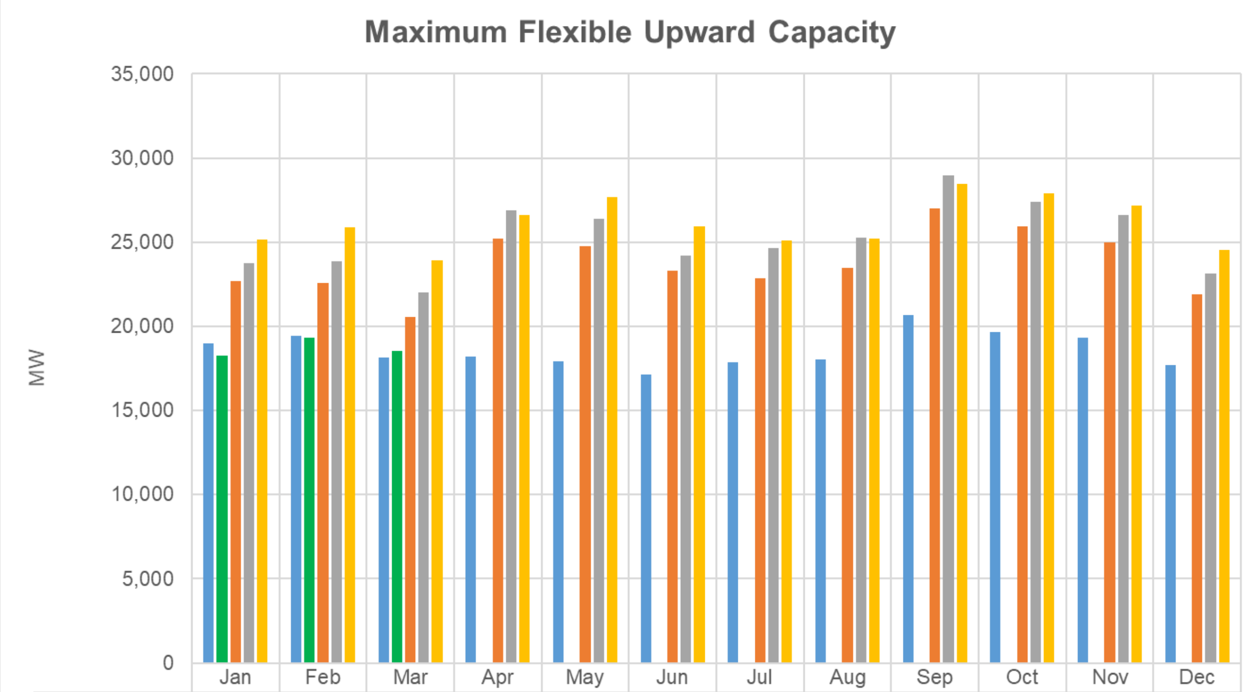
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022 Forecast for 2025	22,995	25,889	27,002	25,259	24,489	22,666	19,400	22,183	22,767	24,892	25,239	21,766
2023 Forecast for 2025 w/ error correction	24,352	24,171	24,767	24,340	23,714	23,670	20,163	21,502	22,719	22,515	23,156	20,638
2023 Forecast for 2025 no adjustments	26,715	26,484	27,213	26,540	25,844	25,509	21,620	22,945	24,083	24,736	25,501	22,943
2024 Forecast for 2025	21,554	21,418	19,383	24,041	23,541	21,838	21,252	21,894	25,396	24,604	23,837	20,730

Figure 5 above shows the change in the published 2025 three-hour ramp forecast over time. For most months, the 2023 IEPR forecast adopted in 2024 for 2025 increased or stayed similar in magnitude compared to the 2023 forecast for 2025. The first three months of the year featured a large reduction in the three-hour net load ramp forecast with the 2024 IEPR update. This is likely due to the changes that the CEC made to incorporating behind-the-meter into the load forecast as mid-day loads during these months tend to be the most heavily impacted by behind-the-meter generation.

To determine the monthly flexible capacity needs for 2025, the ISO summed the monthly largest three-hour contiguous ramps with the maximum of either the most severe single contingency or 3.5 percent of the forecast peak-load for each month. This sum yields the ISO system-wide monthly flexible capacity needs for 2025 and advisory needs for 2026 and 2027.

As shown in Figure 6, the forecast flexible capacity for all months for years 2025-2027 are higher than the actual flexible capacity needs in 2023 and January through March of 2024.

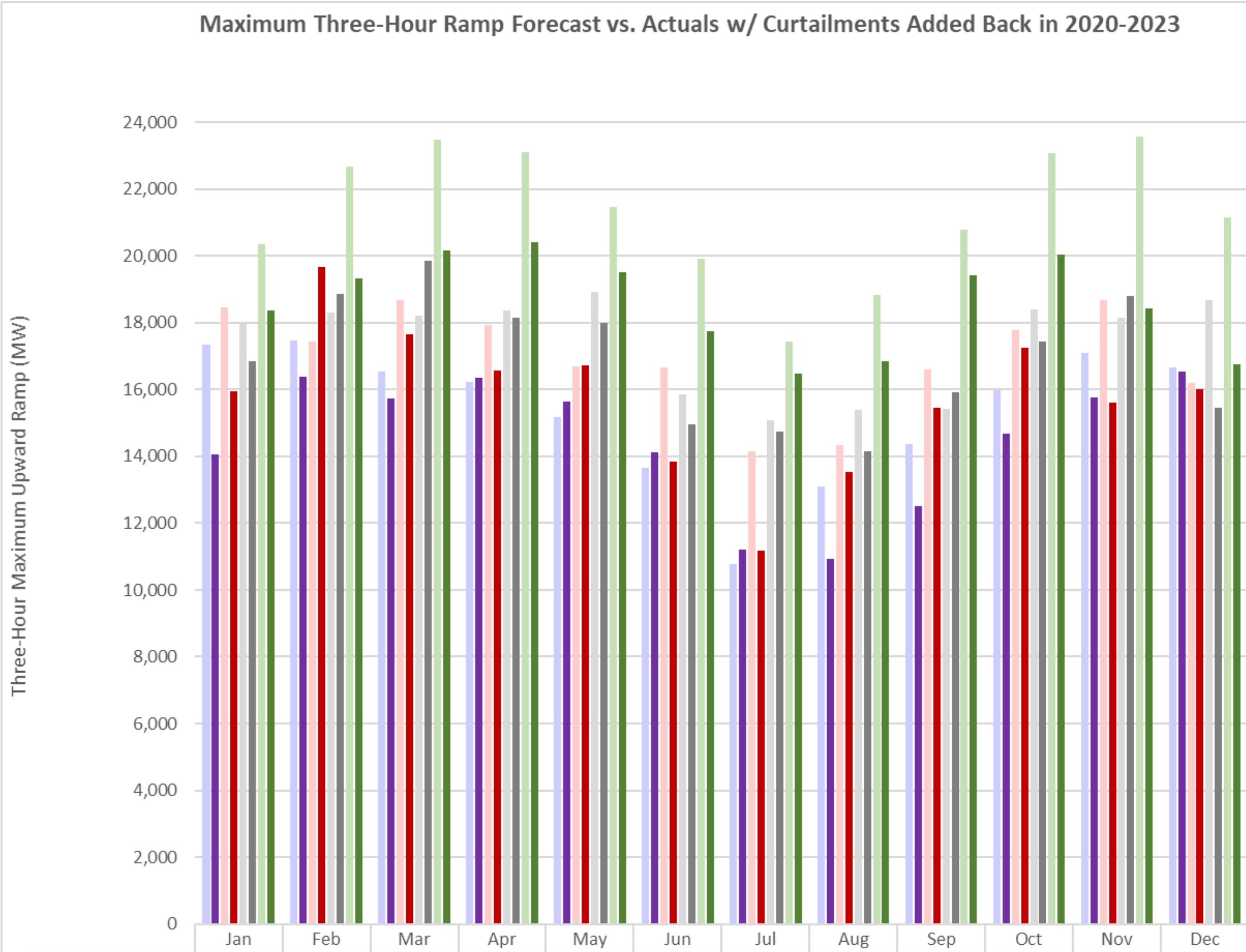
Figure 6: The ISO Monthly Maximum Three-Hour Flexible Capacity Requirements



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023 Act Flex	18,971	19,411	18,153	18,202	17,928	17,126	17,864	18,046	20,684	19,633	19,332	17,709
2024 Act Flex	18,269	19,328	18,535									
2025 Fct Flex	22,704	22,568	20,533	25,191	24,740	23,317	22,869	23,469	27,010	25,920	24,987	21,880
2026 Fct Flex	23,758	23,845	22,035	26,911	26,383	24,198	24,635	25,247	28,964	27,402	26,602	23,149
2027 Fct Flex	25,170	25,881	23,899	26,624	27,670	25,944	25,091	25,225	28,462	27,920	27,184	24,560

In Figure 4 above, a comparison between the three-hour ramp actual with and without curtailments is shown for 2023, and for most months there is an impact of up to 10 percent on the three-hour ramp actuals when curtailments are included. A detailed accuracy analysis of the three-hour ramp forecast for years 2020-2023 is shown in Figure 7. The ramp forecast for each year was created from the previous year's one-minute actual load, wind, and solar data. For example, the 2023 monthly forecast bars were created in 2022 using actual 2021's one-minute load, wind and solar data and the CEC IEPR forecast from 2021. As shown, the monthly three-hour ramp appears to be higher than forecast when compared to the actuals for most months. It is important to note that the actual data in Figure 7 has curtailments added back in. While the 2023 actual data used to form the three-hour ramp forecast does include wind and solar curtailments, the forecast provided does not account for real-time wind or solar curtailments on a given day that would impact the three-hour ramp. The below actuals values show what the maximum three-hour ramp would have been had there not been any curtailments to wind or solar resources.

Figure 7: A comparison of the forecast three-hour ramp to the actual three-hour ramp (including curtailments) for years 2020-2023



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020 Forecast	17,350	17,476	16,550	16,230	15,171	13,666	10,768	13,087	14,373	15,965	17,110	16,660
2020 Act + Curtail	14,051	16,393	15,716	16,347	15,645	14,132	11,213	10,924	12,522	14,666	15,749	16,522
2021 Forecast	18,446	17,424	18,682	17,936	16,695	16,652	14,156	14,335	16,589	17,779	18,666	16,207
2021 Act + Curtail	15,949	19,669	17,665	16,558	16,722	13,856	11,187	13,531	15,440	17,254	15,611	16,001
2022 Forecast	17,990	18,294	18,212	18,377	18,911	15,863	15,085	15,382	15,429	18,400	18,150	18,669
2022 Act + Curtail	16,840	18,871	19,850	18,136	17,990	14,942	14,737	14,149	15,908	17,438	18,794	15,452
2023 Forecast	20,357	22,665	23,475	23,092	21,458	19,913	17,430	18,832	20,790	23,087	23,582	21,148
2023 Act + Curtail	18,361	19,324	20,173	20,416	19,527	17,757	16,488	16,843	19,433	20,049	18,424	16,752

6. Calculating the Seasonal Percentages Needed in Each Category

As described in the ISO Tariff sections 40.10.3.2 and 40.10.3.3, the ISO divided its flexible capacity needs into various categories based on the system's operational needs. These categories are based on the characteristics of the system's net load ramps and the mix of resources that can be used to meet the system's flexible capacity needs. Certain use-limited resources may not qualify to be counted towards the flexible capacity needs under the base flexibility category and may only be counted under the peak flexibility or super-peak flexibility categories, depending on their characteristics. Although there is no limit to the amount of flexible capacity that can come from resources meeting the base flexibility criteria, there is a maximum amount of flexible capacity that can come from resources that only meet the criteria to be counted under the peak flexibility or super-peak flexibility categories.

The ISO structured the flexible capacity categories to meet the following needs:

Base Flexibility: Operational needs determined by the magnitude of the largest three-hour secondary net load[14] ramp

Peak Flexibility: Operational need determined by the difference between 95 percent of the maximum three-hour net load ramp and the largest three-hour secondary net load ramp

Super-Peak Flexibility: Operational need determined by five percent of the maximum three-hour net load ramp of the month

These categories include different minimum flexible capacity operating characteristics and different limits on the total quantity of flexible capacity within each category. In order to calculate the quantities needed in each flexible capacity category, the ISO conducted a three-step assessment process as follows:

1) Calculated the forecast percentages needed in each category in each month;
2) Analyzed the distributions of both the largest three-hour net load ramps for the primary and secondary net load ramps to determine appropriate seasonal demarcations; and
3) Calculated a simple average of the percent of base flexibility needs from all months within a season.

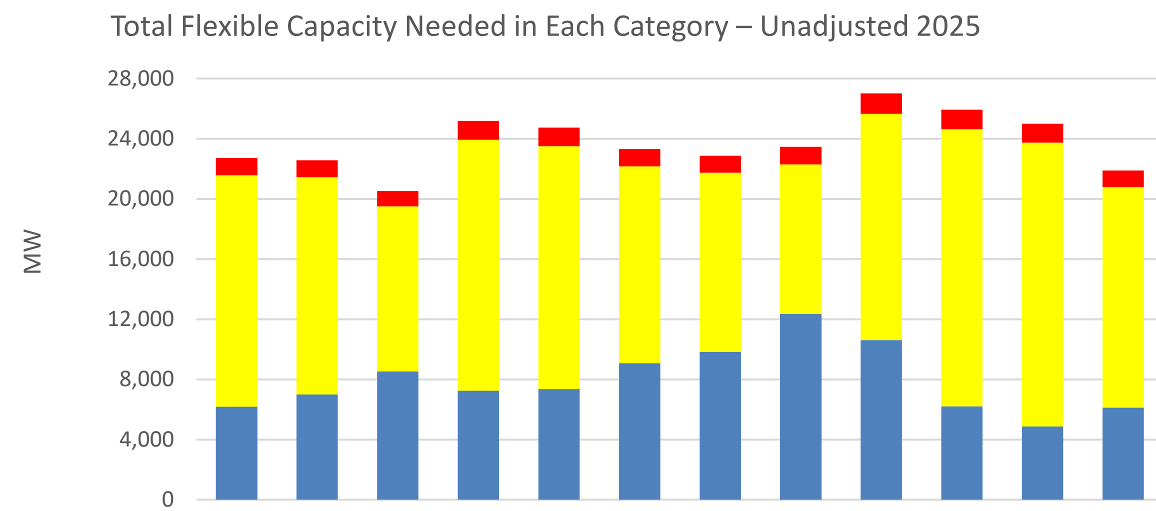
6.1 Calculating the Forecast Percentages Needed in Each Category in Each Month

Based on the categories defined above, the system level needs for 2025 were calculated based only on the maximum monthly three-hour net load calculation. Then the quantity needed in each category in each month was calculated based on the above descriptions. The secondary net load ramps were then calculated to eliminate the possibility of over-lapping time intervals between the primary and secondary net load ramps. Finally, the contingency reserve requirements were added to the different categories proportional to the percentages

[14] The largest daily secondary three-hour net load ramp is calculated as the largest net load ramp that does not correspond with the daily maximum net load ramp. For example, if the daily maximum three-hour net load ramp occurs between 5:00 p.m. and 8:00 p.m., then the largest secondary ramp would not overlap with the 5:00 p.m. - 8:00 p.m. period

established by the maximum three-hour net load ramp. The calculation of flexible capacity needs for each category for 2025 is shown in Figure 8.

Figure 8: ISO System-Wide Flexible Capacity Monthly Calculation by Category for 2025



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,135	1,128	1,027	1,260	1,237	1,166	1,143	1,173	1,350	1,296	1,249	1,094
Peak Flexibility	15,380	14,446	10,973	16,672	16,154	13,070	11,912	9,931	15,043	18,422	18,862	14,667
Base Flexibility	6,189	6,994	8,533	7,259	7,349	9,081	9,814	12,364	10,616	6,202	4,875	6,119

6.2 Analyzing Ramp Distributions to Determine Appropriate Seasonal Demarcations

To determine the seasonal percentages for each flexible capacity category, the ISO analyzed the distributions of the largest three-hour net load ramps for the primary and secondary net load ramps to determine appropriate seasonal demarcations for the base flexibility category. The secondary net load ramps provide the ISO with the frequency and magnitude of secondary net load ramps. Assessing these distributions helps the ISO identify seasonal differences that are needed for the final determination of percent of each category of flexible capacity. The primary and secondary net load ramp distributions are shown for each month in Figure 9 and Figure 10, respectively.

Figure 9: Percentile Distribution of Daily Primary Three-hour Net Load Ramps for 2025

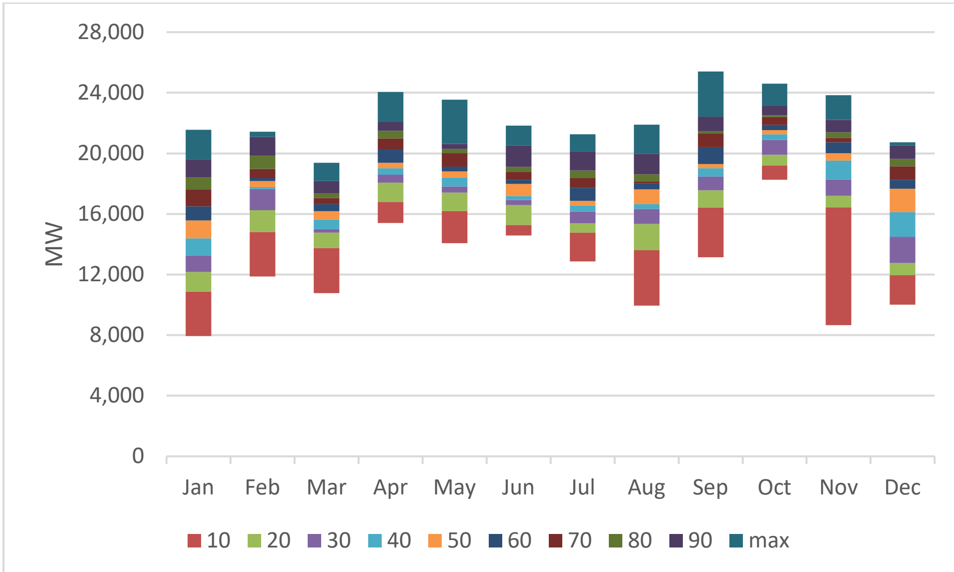
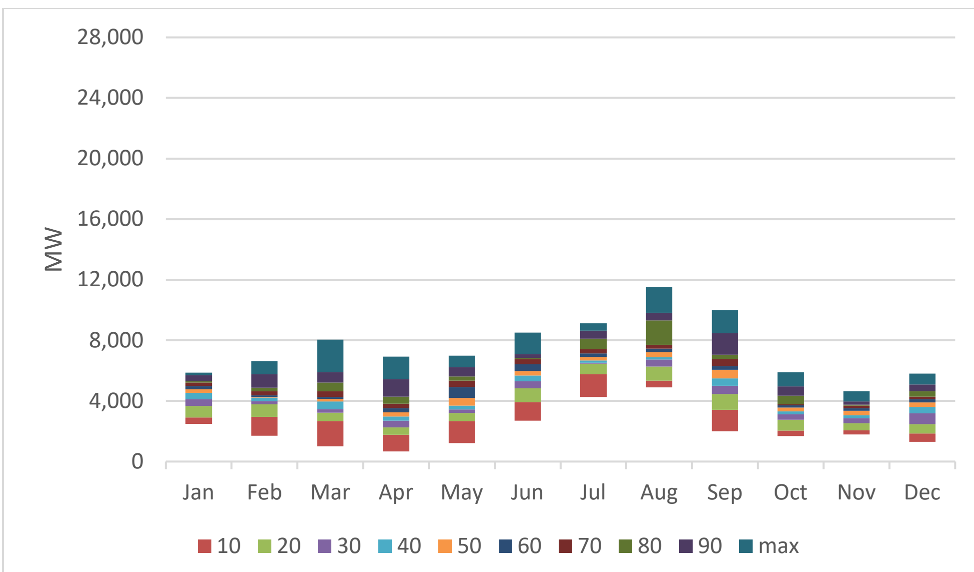


Figure 10: Percentile Distribution of Secondary Three-hour Net load Ramps for 2025



As shown in Figure 9 and Figure 10, there are certain variations for the primary and the secondary ramps over the months. These variations may have some impact on the ratios of maximum secondary ramp over maximum of primary ramp in each month. To reduce the potential impact of these ratios, which defines the values of base category in the flexible requirement, the ISO substitutes the seasonal averages of the ratios into the ratio in each months. Here, summer is May through September, and winter is October to February. Table 2 shows the unadjusted and adjusted percentages used in calculating the base category over the months.

Table 2: Unadjusted Monthly Ratio and Adjusted Seasonal Ratio

	Actual Contributions			Seasonal Contribution		
	Unadjusted			Adjusted		
Month	Base Flexibility	Peak Flexibility	Super-Peak Flexibility	Base Flexibility	Peak Flexibility	Super-Peak Flexibility
January	27%	68%	5%	29%	66%	5%
February	31%	64%	5%	29%	66%	5%
March	42%	53%	5%	29%	66%	5%
April	29%	66%	5%	29%	66%	5%
May	30%	65%	5%	41%	54%	5%
June	39%	56%	5%	41%	54%	5%
July	43%	52%	5%	41%	54%	5%
August	53%	42%	5%	41%	54%	5%
September	39%	56%	5%	41%	54%	5%
October	24%	71%	5%	29%	66%	5%
November	20%	75%	5%	29%	66%	5%
December	28%	67%	5%	29%	66%	5%

As shown in Figure 9, the distribution (i.e. the height of the distribution for each month) of the daily maximum three-hour net load ramps are smaller during the summer months. The base flexibility resources were designed to address days with two separate net load ramps. The distributions of these secondary net load ramps indicates that the ISO does not need to set seasonal percentages in the base flexibility category at the percentage of the higher month within that season. Accordingly, the ISO must ensure there is sufficient base ramping for all days of the month. Furthermore, particularly for summer months, the ISO did not identify two distinct ramps each day. Instead, the secondary net load ramp may be a part of single long net load ramp.

The distributions of the primary and secondary ramps provide additional support for the summer/non-summer split. Accordingly, the ISO proposes to maintain two flexible capacity needs seasons that mirror the existing summer season (May through September) and non-summer season (January through April and October through December) used for resource adequacy. This approach has two benefits.

First, it mitigates the impact that variations in the net load ramp in any given month can have on determining the amounts for the various flexible capacity categories for a given season. For example, a month may have either very high or low secondary ramps that are simply the result of the weather in the year. However, because differences in the characteristics of net load ramps are largely due to variations in the output of variable energy resources, and these variations are predominantly due to weather and seasonal conditions, it is reasonable to break out the flexibility categories by season. Because the main differences in weather in the ISO system are between summer and non-summer months, the ISO proposes to use this as the basis for the seasonal breakout of the needs for the flexible capacity categories.

Second, adding flexible capacity procurement to the RA program will increase the process and information requirements. Maintaining a seasonal demarcation that is consistent with the current RA program will reduce the potential for errors in resource adequacy showings.

With more penetration of renewable energy in the ISO market, the daily net load shape shows gradual dominance of primary ramp over years, see Table 1. The ISO continues to show an increase in the need of peak category resources, due to the increasing growth of the primary ramp during sunset. In 2025, the percentages of peak category are decreased from their counterparts in 2024, in winter lowering from 66.43% to 68.11%, and from 54.29% down to 57.75% in summer.

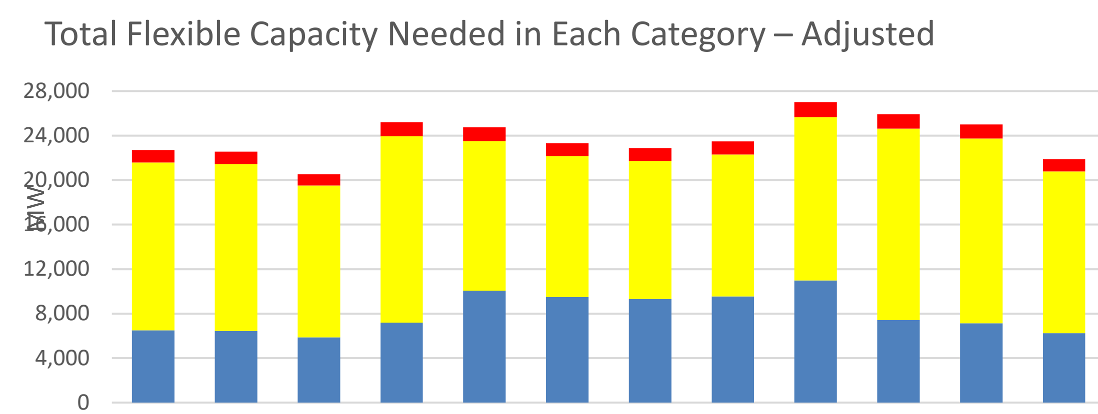
Table 3: Change in peak category weighting over the past four years

Month	2021	2022	2023	2024	2025
January	57.30%	55.06%	62.74%	68.11%	66.43%
February	57.30%	55.06%	62.74%	68.11%	66.43%
March	57.30%	55.06%	62.74%	68.11%	66.43%
April	57.30%	55.06%	62.74%	68.11%	66.43%
May	45.62%	45.39%	49.28%	57.75%	54.29%
June	45.62%	45.39%	49.28%	57.75%	54.29%
July	45.62%	45.39%	49.28%	57.75%	54.29%
August	45.62%	45.39%	49.28%	57.75%	54.29%
September	45.62%	45.39%	49.28%	57.75%	54.29%
October	57.30%	55.06%	62.74%	68.11%	66.43%
November	57.30%	55.06%	62.74%	68.11%	66.43%
December	57.30%	55.06%	62.74%	68.11%	66.43%

6.3 Calculate a Simple Average of the Percent of Base Flexibility Needs

The ISO calculated the percentage of base flexibility needed using a simple average of the percent of base flexibility needs from all months within a season. Based on that calculation, the ISO proposes that flexible capacity meeting the base-flexibility category criteria comprise 29 percent of the ISO system flexible capacity need for the non-summer months and 41 percent for the summer months. Peak flexible capacity resources could be used to fulfill 66 percent of non-summer flexibility needs and 54 percent of summer flexible capacity needs. The super-peak flexibility category is fixed at a maximum five percent across the year. We have observed over the years that the base flexibility category percentages continue to lower where the peak flexible capacity percentages continue to rise. As with the increase in the flexible capacity need, the change is largely attributable to the continued growth of both grid connected and behind-the-meter solar. As the gird connected solar and the incremental behind-the-meter solar continue to grow we are seeing an increase in the down-ramp associated with sunrise, especially during the shoulder months where there is minimal heating or cooling load. The ISO's proposed system-wide flexible capacity categories are provided in Figure 11.

Figure 11: System-wide Flexible Capacity Need in Each Category for 2025 -Adjusted



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,135	1,128	1,027	1,260	1,237	1,166	1,143	1,173	1,350	1,296	1,249	1,094
Peak Flexibility	15,081	14,991	13,639	16,733	13,431	12,658	12,415	12,741	14,663	17,217	16,597	14,534
Base Flexibility	6,488	6,449	5,867	7,198	10,072	9,492	9,310	9,555	10,996	7,407	7,140	6,252

7. Allocating the Flexible Capacity Needs to Local Regulatory Authorities

The ISO's allocation methodology is based on the contribution of a local regulatory authority's LSEs to the maximum three-hour net load ramp.

Specifically, the ISO calculated the LSEs under each local regulatory authority's contribution to the flexible capacity needs using the following inputs:

1) The maximum of the most severe single contingency or 3.5 percent of forecasted peak load for each LRA based on its jurisdictional LSEs' peak load ratio share

2) Δ Load – LRA's average contribution to load change during the top five daily maximum three-hour net load ramps within a given month from the previous year times total change in ISO load

3) Δ Wind Output – LRA's average percent contribution to changes in wind output during the five greatest forecasted three-hour net load changes times ISO total change in wind output during the largest three-hour net load change

4) Δ Solar PV – LRA's average percent contribution to changes in solar PV output during the five greatest forecasted three-hour net load changes times total change in solar PV output during the largest three-hour net load change

These amounts are combined using the equation below to determine the contribution of each LRA, including the CPUC and its jurisdictional load serving entities, to the flexible capacity need.

Flexible Capacity Need = Δ Load – Δ Wind Output – Δ Solar PV +

*Max(MSSC, 3.5% * Expected Peak * Peak Load Ratio Share)*

The above equation can be simply expressed as

$$\textit{Flex Requirement} = \Delta NL_{2025} + R_{2025}$$

$$= \Delta L_{2025} - \Delta W_{2025} - \Delta S_{2025} + R_{2025}$$

The ISO uses the following symbols to illustrate the evolution of allocation formula:

*L (load), W (wind), S (solar), and NL (net load), R (reserve) = max(MSCC, 3.5*peak load),*

NL = L – W – S,

ΔNL = ΔL – ΔW – ΔS,

Where

Δ is denoted as ramp,

ΔNL_{2025} Net load ramp requirement in 2025,

$\Delta NL_{sc,2025}$ Net load ramp allocation for LSC in 2025,

pl_r_{lsc} CEC peak load ratio, and finally,

Σ the summation of all LSC. In 2023, the ISO has forecasts from CEC L_{2025}, where survey results from $W_{2025} = \Sigma W_{lsc,\,2025}$, $S_{2025} = \Sigma S_{lsc,\,2025}$, and all the estimated ramps are ΔL_{2025}, ΔW_{2025}, ΔS_{2025}, plus R_{2025}. Moreover, the ISO has the peak load ratio list from CEC which totals to 100 percent, $\Sigma pl\_r_{lsc} = 1$.

Based the above information, the allocation for wind, solar, and reserve portion of flexible need is straight forward as follows

$$\text{\textit{Flex Need}} = \Delta NL_{2025} + \Sigma pl\_r_{lsc} * R_{2025}$$

$$= \Delta L_{2025} - \frac{\Sigma W_{lsc,\,2025}}{W_{2025}} * \Delta W_{2025} - \frac{\Sigma S_{lsc,2025}}{S_{2025}} * \Delta S_{2025} + \Sigma pl\_r_{lsc} * R_{2025}$$

Since the ISO has no pre-knowledge of, $\Delta L_{lsc,y+2}$, the load ramp at LSE level in future year $y + 2$ at the current year $y = 2023$, the allocation of ΔL_{2025} to SC has been more challenging. Over the years, the ISO has used different approaches to meet the challenge.

In year 2014-2016, the ISO used an intuitive formula as

$$\frac{\Delta L_{lsc,\,y}}{\Delta L_{y}} \Delta L_{y+2},$$

where $\Delta L_{y} = \Sigma \Delta L_{lsc,\,y}$ is the summation of metered load ramp available at LSC level in year y. Later, the ISO realized this approach had a risk to unstable allocation, since the divider ΔL_{y}, the system load ramp can be zero or negative.

In year 2017-2018, the ISO employed the following formula

$$\Delta L_{lsc,y+2} = L^{E}_{lsc,y}\left(\frac{L^{E}_{y+2}}{L^{E}_{y}}\right) - L^{S}_{lsc,y}\left(\frac{L^{S}_{y+2}}{L^{S}_{y}}\right),$$

where $S =$ ramping start time, $E =$ramping end time.

The above seemingly a bit more complicated formula carefully avoided the potential zero divider ΔL_{y}, but later the ISO found out that it had a material drawback. Unlike the original formula used in 2014-2016, the revised formula carried little scalability for each SC, that is, the historical load ramp $\Delta L_{lsc,\,y}$ has no explicit impact on future $y + 2$ allocation $\Delta L_{lsc,\,y+2}$.

Starting from year 2019, the ISO proposed a new formula which best utilizes $\Delta L_{sc,\,y}$ while the system ΔL_{y} is not in the denominator,

$$\Delta L_{2025} = \Delta L_{2023} + (\Delta L_{2025} - \Delta L_{2023})$$

$$= \Sigma \Delta L_{lsc,\,2023} + \frac{\Sigma L^{M}_{lsc,\,2023}}{L^{M}_{2023}} * \left(\Delta L_{2025} - \Delta L_{2023}\right),$$

where ΔL_{2023} is the average load portion of top 5 maximum 2023 three-hour ramps and L^{M}_{2023} is the average load at beginning and the end of points during those top 5 ramps. In 2025, each LSC will receive:

$$\Delta L_{lsc,\,2023} + \frac{L^{M}_{lsc,\,2023}}{L^{M}_{2023}} * (\Delta L_{2025} - \Delta L_{2023})$$

Therefore each LSC's contribution $\Delta L_{lsc,\,2023}$ will be explicitly projected into future year 2025, and any additional increase of differences of average load portions $(\Delta L_{2025} - \Delta L_{2025})$ will be allocated by a load ratio share. The new calculation provides stable allocation for the load proportion.

Any LRA with a negative contribution to the flexible capacity need is limited to a zero megawatt allocation, not a negative contribution. As such, the total allocable share of all LRAs may sum to a number that is slightly larger than the flexible capacity need. The ISO does not currently have a process by which a negative contribution could be reallocated or used as a credit for another LRA or LSE.

The ISO will make all non-confidential working papers available and data that the ISO relied on for the Final Flexible Capacity Needs Assessment for 2025. Specifically, the ISO will post materials and data used to determine the monthly flexible capacity needs, the contribution of CPUC jurisdictional load serving entities to the change in load, and seasonal needs for each flexible capacity category. This data is available for download as a large Excel file named "2025 Flexible Capacity Needs Assessment –Net Load Data" here. The file above is the one-minute forecast from the CEC IEPR. Table 4 shows the final calculations of the individual contributions, of each of the inputs to the calculation of the maximum three-hour continuous net load ramp at a system level.

Table 4: Individual Contributions of each Input into the Net Load

Month	Load contribution 2025	Wind contribution 2025	Solar contribution 2025	Total percent 2025
January	33.21%	-2.71%	-64.08%	100%
February	38.03%	0.76%	-62.73%	100%
March	44.09%	0.95%	-56.86%	100%
April	37.56%	-0.58%	-61.86%	100%
May	33.27%	-2.70%	-64.02%	100%
June	34.36%	2.67%	-68.31%	100%
July	28.41%	3.27%	-74.86%	100%
August	28.95%	0.38%	-71.43%	100%
September	34.23%	0.06%	-65.83%	100%
October	35.74%	-0.21%	-64.05%	100%
November	34.69%	-0.04%	-65.27%	100%
December	28.29%	-0.30%	-71.41%	100%

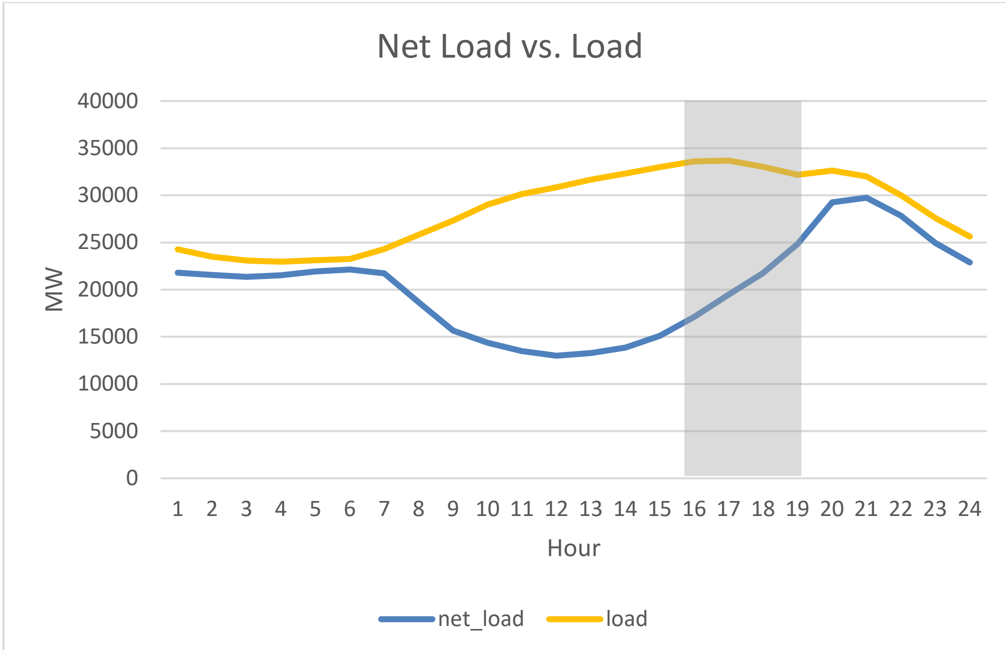
When looking at the contribution to the maximum three-hour continuous net load ramp shown in Table 4, the above total percentage is calculated as Load – Wind – Solar. For example, when looking at August 100 percent contribution is determined by:

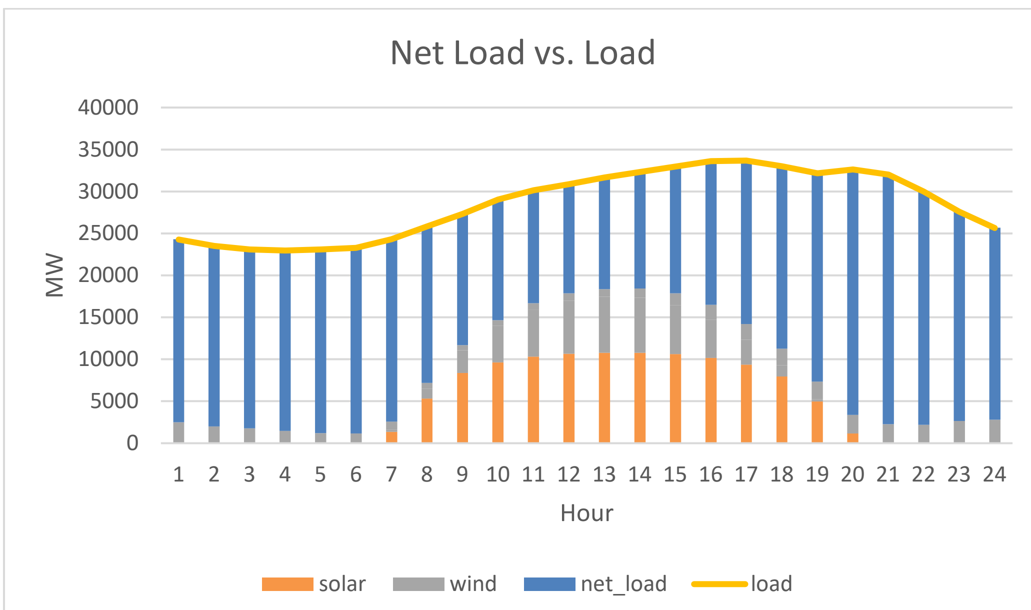
Total Contribution = 28.95% -0.38 – (-71.43%) = 100%

As Table 4 shows, Δ Load is not the largest contributor to the net load ramp because the incremental solar PV mitigates morning net load ramps. The solar resources are leading to maximum three-hour net load ramps during summer months that occur in the afternoon. This is particularly evident during July, August, and December. This implies that the maximum three-hour net load ramp typically occurs during sunset. The contribution of solar PV resources has increased relative to last year’s study and remains a significant driver of the three-hour net load ramps. Since the CEC has behind meter solar embedded in its 2025 hourly load forecast, the interplay between load and solar contributions will depend on the scales of future expansion of utility base solar PV and future installation of behind meter solar panels. The ISO anticipates more solar dominance in the ISO flexible needs in the coming years.

Figure 12 illustrates the behavior of load, wind, and solar when the net load reaches its maximum. In this example, the load ramp has a negative contribution to the net load ramp.

Figure 12: Examples of Load Contribution to Net Load Ramp





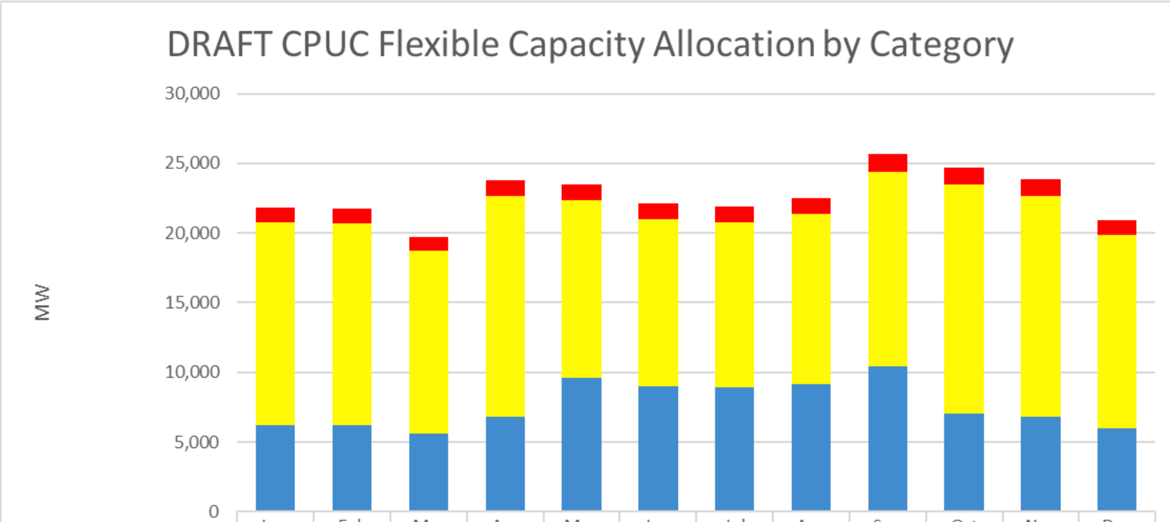
The CPUC allocations are shown in Table 5 and Figure 13. The contributions calculated for other LRAs will only be provided to show the contribution of its jurisdictional LRA as per section 40.10.2.1 of the ISO tariff.

Table 5: CPUC Jurisdictional LSEs' Contribution to Flexible Capacity Needs

Month	Load	Wind	Solar	reserve	Total Allocation
January	6,988	-548	-13,248	1,046	21,830
February	8,002	152	-12,887	1,046	21,783
March	8,272	173	-10,563	1,046	19,708
April	8,398	-130	-14,244	1,046	23,818
May	7,378	-596	-14,437	1,090	23,501
June	7,033	545	-14,295	1,344	22,128
July	5,792	652	-15,254	1,470	21,863
August	6,140	78	-14,998	1,432	22,492
September	8,226	15	-16,031	1,467	25,709
October	8,390	-49	-15,073	1,196	24,708
November	7,878	-9	-14,898	1,046	23,831
December	5,712	-55	-14,133	1,046	20,945

Finally, the ISO applied the seasonal percentage established in Section 6 to the contribution of CPUC jurisdictional load serving entities to determine the expected flexible capacity needed in each flexible capacity category. These results are detailed in Figure 13.

Figure 13: CPUC Flexible Capacity Need in Each Category for 2025



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,091	1,089	985	1,191	1,175	1,106	1,093	1,125	1,285	1,235	1,192	1,047
Peak Flexibility	14,500	14,469	13,091	15,821	12,759	12,013	11,869	12,211	13,957	16,412	15,830	13,913
Base Flexiblity	6,238	6,224	5,631	6,806	9,568	9,009	8,901	9,157	10,466	7,060	6,810	5,985

8. Determining the Seasonal Must-Offer Obligation Period

Under ISO Tariff Sections 40.10.3.3 and 40.10.3.4, the ISO establishes the specific five-hour period during which flexible capacity counted in the peak and super-peak categories will be required to submit economic energy bids into the ISO's market (*i.e.*, have an economic bid must-offer obligation). The average net load curves for each month provide the most reliable assessment of whether a flexible capacity resource would provide the greatest benefit. The ISO analyzes the starting time of the calculated daily net load ramp to ensure the must-offer obligation hours line up with daily maximum three hour net load ramp and support the continuous net load need thereafter, which is typically correlated to the solar ramp down during sunset. Table 6 shows the frequency of forecasted starting hour for the three-hour net load ramp, the starting hours are following a stable trend over the years, this is due to solar being the largest contributor to three hour net load ramp.

Table 6: Frequency of forecasted Starting Hour of the Maximum Three-Hour Net Load Ramp for 2025

	Three Hour Net Load Ramp Start Hour (Hour Ending)				
Month	14:00	15:00	16:00	17:00	18:00
January	2	27	2		
February		17	11		
March		3	11	17	
April			1	29	
May				31	
June			3	27	
July			1	30	
August		2	9	18	2
September		1	29		
October		10	21		
November	7	22	1		
December	4	27			

Table 7 below shows an early (HE15), start of the three-hour ramp pattern for November through February. For the months of March through August, the majority of days likely have a HE17 starting time of the three hour net load ramp. The fall shoulder months, September and October, have the starting time concentrated on HE16.

Table 7: Summary of MOO Hours Proposed by the ISO for 2025

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HE15-HE19	x	x									x	x
HE16-HE20									x	x		
HE17-HE21			x	x	x	x	x	x				

In summary, based on the data for all daily maximum three hour net load ramps, the ISO believes that the appropriate flexible capacity must-offer obligation for peak and super-peak flexible capacity categories is HE 15 through HE 19 for January and February, and November through December; HE 16 to HE 20 for September and October, HE 17 through HE 21 for March through August.

The ISO reviewed the timing of the top five net load ramps to confirm that the intervals captured the largest net load ramps. As shown above, the proposed intervals do, in fact, capture the intervals of the largest ramps. Both of these changes are consistent with continued solar growth and reflect the fact that the initial solar drop-off is a primary driver of the three-hour net load ramp. This is further supported by the contributing factors shown in Table 2, above.

9. Availability Assessment Hours

The availability assessment hours (AAH) were originally developed as part of the ISO standard capacity product and are maintained as part of the Reliability Service Initiative. This includes the RA Availability Incentive Mechanism (RAAIM). The goal of calculating the AAH is to determine the hours of greatest need to maximize the effectiveness of RAAIM by rewarding resources for being available during hours of greatest need.

To calculate the AAH, the ISO does the following:

1. Uses the CEC hourly IEPR forecast
2. Calculate the hourly average load by hour for each month for years 2023-2027
3. Calculate the top 5 percent of load hours within each month using the hourly load distribution in step 2

For this annual study, the draft recommendation for 2025 will be published and the estimated for years 2026 and 2027.

In the 2023 Flexible Capacity Study published in 2022, the ISO included the addition of a spring season for the months of March and April which had shown a shift to a later AAH to hour-ending 18-22 (5 p.m. – 10 p.m.). In the 2024 Flexible Capacity study published in 2023, May was added into the spring season. The addition of a spring season with later AAH was based on both the recent historical trends and the IEPR forecast for future years. In this year's study, the ISO recommends the same seasonal definition as last year, and proposes HE17-21 for summer (June – October), HE17-21 for winter (November – December and January – February), and HE18-22 for spring (March – May).

Historical actuals and trends in the IEPR forecast are the data to support this proposal which can be found in Table 8 below. Table 8a below shows the number of times each hour is within the top 5 percent of load hours using the 2023 actual ISO load while Table 8b shows the CEC IEPR forecast for 2025.

Table 8a: Count of the number of times each hour is in the top 5% of load hours for each month of the 2023 ISO actual load

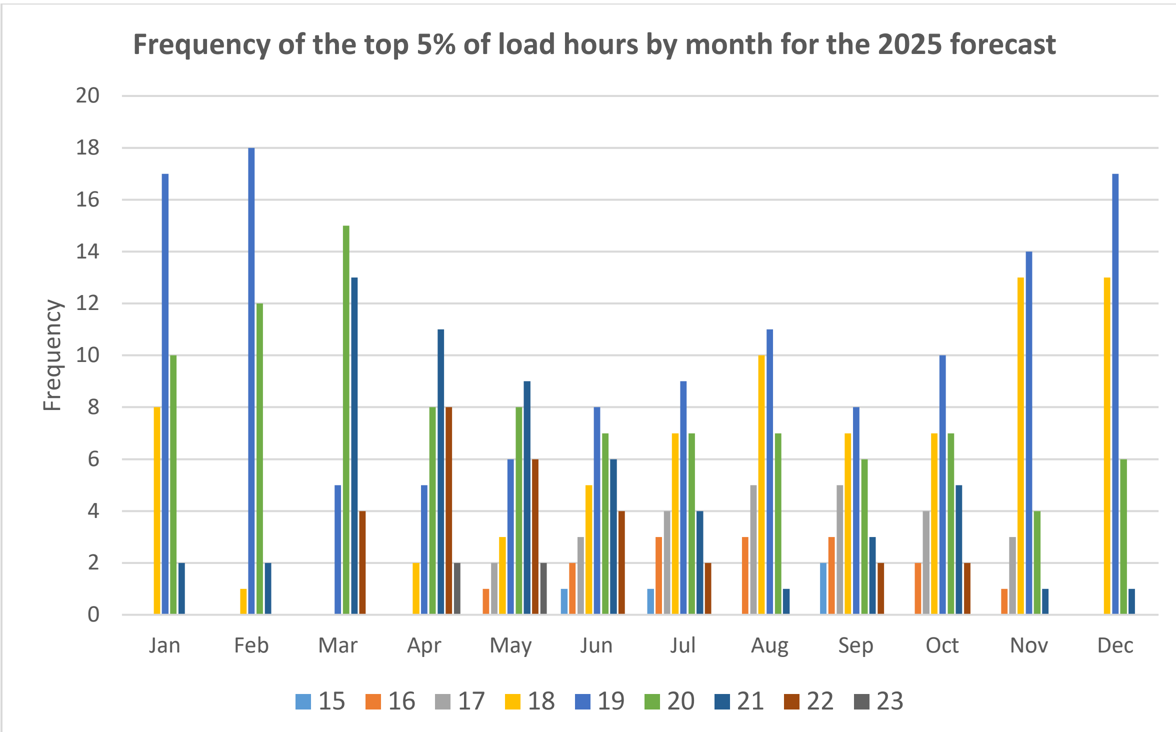
	Hour	15	16	17	18	19	20	21	22	23	Season
	Jan			2	12	13	6	2			Winter
	Feb				7	8	8	5			Winter
	Mar				2	7	10	8	2		Spring
	Apr				3	3	10	9	5	2	Spring
	May			2	4	5	7	10	6	3	Spring
MONTH	Jun	1	1	2	2	4	8	8	8	2	Summer
	Jul		3	5	9	9	8	3			Summer
	Aug	1	3	7	8	8	7	3			Summer
	Sep		3	4	9	8	6	5	1		Summer
	Oct	1	4	7	8	8	6	2	1		Summer
	Nov			5	16	9	6				Winter
	Dec			6	11	10	6	3			Winter
Total		**3**	**14**	**40**	**91**	**92**	**88**	**58**	**23**	**7**	

Table 8b: Count of the number of times each hour is in the top 5% of load hours for each month of CEC 2025 forecasted load

	Hour	15	16	17	18	19	20	21	22	23	Season	Recommendation
	Jan				8	17	10	2			Winter	HE17-HE21
	Feb				1	18	12	2			Winter	HE17-HE21
	Mar					5	15	13	4		Spring	HE18-HE22
	Apr				2	5	8	11	8	2	Spring	HE18-HE22
	May		1	2	3	6	8	9	6	2	Spring	HE18-HE22
MONTH	Jun	1	2	3	5	8	7	6	4		Summer	HE17-HE21
	Jul	1	3	4	7	9	7	4	2		Summer	HE17-HE21
	Aug		3	5	10	11	7	1			Summer	HE17-HE21
	Sep	2	3	5	7	8	6	3	2		Summer	HE17-HE21
	Oct		2	4	7	10	7	5	2		Summer	HE18-HE22
	Nov		1	3	13	14	4	1			Winter	HE17-HE21
	Dec				13	17	6	1			Winter	HE17-HE21
Total		**4**	**15**	**26**	**76**	**128**	**97**	**58**	**28**	**4**		

Table 8b, and Figure 14 look at the distribution of the top 5 percent of load hours by month for the 2025 forecast which is used to form the draft AAH. Figure 14 is a graphic display of the Table 8b and illustrates the highest frequency of the top 5 percent of forecasted load hours for all months in 2025.

Figure 14: The frequency of the top 5% of load hours for the 2025 forecast



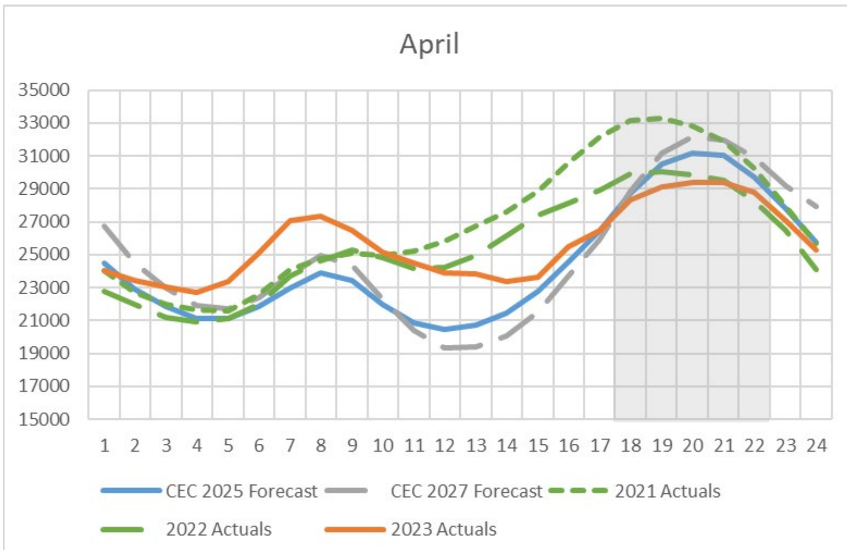
When analyzing the AAH, it is also beneficial to view the maximum observed and forecasted load for each month to visualize the forecasted load shape compared to recent actuals. The timing and shape of the load peak, as well as the magnitude and timing of the ramps into and out of load peak can all be impacted by weather events such as extreme heat for the given month or heavy rainfall. The most recent three years of actuals along with the CEC forecast for 2025 and 2027 are shown in Figure 15 and show how much the load actuals can vary by year for selected months. In April for example, 2021 was warmer than 2022, leading to higher peak and mid-day loads compared to 2023 which was much more mild. The rest of the months are included in the draft allocation presentation on the 2025 Flex RA stakeholder page.[15]

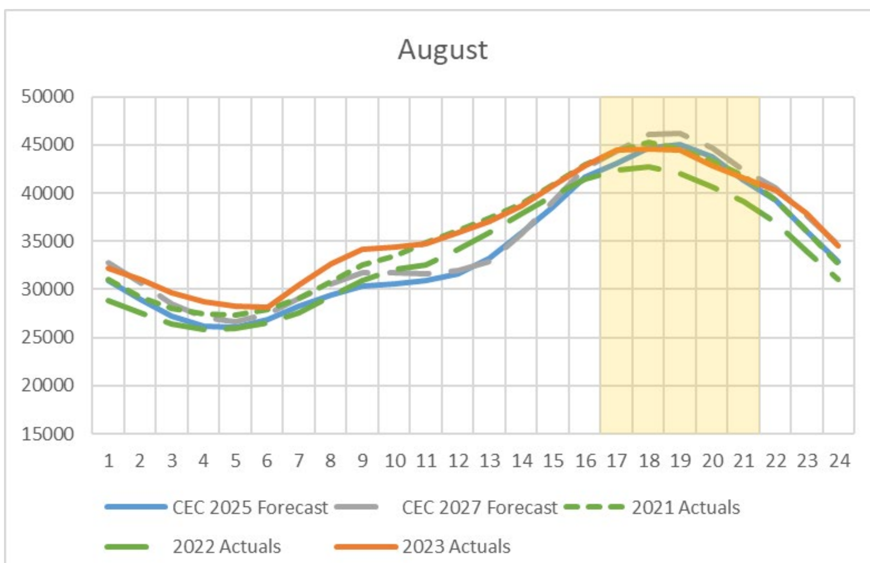
One item to note is that the ISO is monitoring 2026 and 2027 for a shift in the winter months (January – February, November – December) to later AAH of HE18-22. This can be observed in Figure 15 below for the month of November, where the 2025 and 2027 forecasts

[15] https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2025

from the CEC show an increase in the evening load hours. This has not been observed in the 2021-2023 actuals; however, the forecast for 2025 does support this later shift for winter. In Table 8b above, HE18 and HE19 do have a higher frequency of the top 5 percent of load hours compared to the actuals in Table 8a. For this reason, the ISO is monitoring the winter season and does note potential for a shift in the AAH for some or all of the winter months to be HE18-22 in future Flex RA studies.

Figure 15: The April (top), August (middle) and November (bottom) maximum load actuals from 2021-2023 and maximum CEC forecast for 2025 and 2027





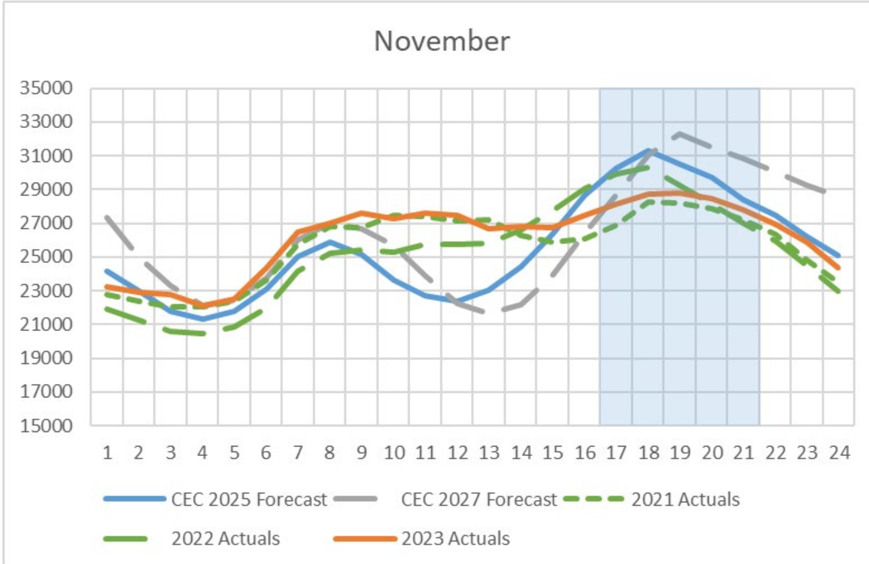


Table 9 below shows the draft recommendation for the winter and summer seasons. The final recommendation for 2024 and the draft recommendation for 2025 do not change. Again, it is noted that the ISO is monitoring the winter months of January – February and November – December for the advisory years of 2026 and 2027 to a potential shift to the later AAH hours of HE18-22, which is noted in the figure.

Table 9: The AAH draft recommendation

Summer and Winter Season Draft Recommendation

January – February, June - December

Year	Start	End
2024 (Final)	HE 17	HE 21
2025 (Draft)	HE 17	HE 21
2026 (Estimate)	HE 17	HE 21
2027 (Estimate)	HE 17	HE 21

Spring Season Draft Recommendation

March – May

Monitoring January – February, November, December for 2026, 2027

Year	Start	End
2024 (Final)	HE 18	HE 22
2025 (Draft)	HE 18	HE 22
2026 (Estimate)	HE 18	HE 22
2027 (Estimate)	HE 18	HE 22

10. Next Steps

Comments on the 2025 Draft Flexible Capacity Needs Assessment and AAH are due on Monday, April 29, 2024. The ISO plans to publish the final Flexible Capacity Needs Assessment paper and final AAH for 2025 by May 17, 2024. The 2025 Flexible Capacity Needs Assessment to establish the ISO system flexible capacity needs for 2026 will begin in early 2025.

The ISO has also established an internal RA working group which is evaluating potential changes to the Flex RA process. As a part of the CAISO's Resource Adequacy Working group process, the CAISO and stakeholders have identified the need to reexamine Flex RA. Particularly, as the resource fleet has evolved, we will evaluate the overall need for a Flex RA product, including whether the currently designed Flexible RA provides reliability benefits commensurate to the administrative burden on stakeholders and the CAISO. Additionally, we will look at potential enhancements to the Flex RA design, where the processes may need to be altered to better obtain our reliability objectives.