BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

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Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations	Rulemaking 21-10-002 (Filed October 7, 2021)

CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION FINAL 2023 FLEXIBLE CAPACITY NEEDS ASSESSMENT AND FINAL 2023 AVAILABILITY ASSESSMENT HOURS

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Dated: May 17, 2022

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BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations	Rulemaking 21-10-002 (Filed October 7, 2021)

CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION
FINAL 2023 FLEXIBLE CAPACITY NEEDS ASSESSMENT AND
FINAL 2023 AVAILABILITY ASSESSMENT HOURS

Pursuant to the December 2, 2021 Assigned Commissioner's Scoping Memo and Ruling and the April 28, 2022 Administrative Law Judge E-mail Ruling Modifying Schedule for Flexible Capacity Requirement Issues, the California Independent System Operator Corporation (CAISO) submits its 2023 Final Flexible Capacity Needs Assessment and Final 2023 Availability Assessment Hours (Attachment A). The CAISO also includes a spreadsheet that provides specific calculations for the overall flexible capacity needs arising from the Commission's jurisdictional load serving entities (Attachment B). The CAISO recommends the Commission allocate individual load serving entity flexible capacity obligations based on the overall values reflected in Attachment B. The report is publicly available on the CAISO's website. Per Rule 1.9 (d)(2) of the Commission's Rules of Practice and Procedure, the CAISO is providing a Notice of Availability (Attachment C) to the service list for Rulemaking 21-10-002, a link to the report is provided in the notice.

The 2023 Flexible Capacity Needs Assessment and 2023 Availability Assessment Hours have been vetted through the CAISO's annual flexible capacity needs assessment stakeholder process.[1] The CAISO posted a draft Final Flexible Capacity Needs Assessment and draft 2023

[1] See CAISO Flexible capacity needs assessment – 2023 stakeholder page here: https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2023

Availability Assessment Hours on April 14, 2022. The draft Availability Assessment Hours proposed the creation of an additional "spring" season for March and April 2023. The CAISO received three stakeholder comments[2] on the draft report and draft assessment hours on April 28, 2022, with no objections to the addition of a new spring season. There were no changes to the 2023 flexible capacity requirements or allocations between the draft and final reports. In addition, the recommendation for the 2023 Availability Assessment Hours remains the same in the final report as in the draft presentation.

The CAISO recommends the Commission allocate the total 2023 flexible capacity requirements reflected in Attachment B amongst its jurisdictional load serving entities and looks forward to consulting with the Commission as the CAISO establishes the 2023 availability assessment hours.

Respectfully submitted,

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[2] See stakeholder comments on draft Final Flexible Capacity Needs Assessment and draft 2023 Availability Assessment Hours here: https://stakeholdercenter.caiso.com/Comments/AllComments/9b5da24e-252f-46c4-b15e-be4478491c8c

ATTACHMENT A

Final 2023 Flexible Capacity Needs Assessment
And
Final 2023 Availability Assessment Hours

Final Flexible Capacity Needs Assessment for 2023

May 17, 2022

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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 2023.

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.

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 2023 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 2023:

a. Baseline Consumption Load
b. Behind the meter photo voltaic (PV)
c. Behind the meter storage residential (RES) and non-residential (NONRES)

[1] https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report/2021-1

d. Electric vehicle (EV) charging
e. Additional achievable energy efficiency (AAEE)

2.1 Summary of Overall Results

1) Expected system-wide flexible capacity needs for 2023 are greatest in the non-summer months and range from 19,034 MW in July to 24,732 in November 2023.

2) The calculated flexible capacity needed from the "base flexibility" category is 46 percent of the total amount of installed or available flexible capacity in the summer months (May – September) and 32 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 2023 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 through August, the shoulder months September and October will use HE16-HE20. Section 8 is devoted for the discussion of the monthly pattern of the must-offer obligation hours in 2023.

5) The ISO also published advisory requirements for two additional years (2024 and 2025) following the upcoming Resource Adequacy (RA) year at the ISO system total levels is shown in Figure 5.

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

[2] Reliability Requirements business practice manual Section 10. Available at http://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Reliability%20Requirements

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 2023 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 1-minute net load forecast for years 2023 through 2025 using all expected[4] and existing grid connected wind and solar resources and the CEC (CAISO - Mid Baseline- AAEE Scenario 3 – AAFS Scenario 3) Hourly IEPR load forecast. The ISO used the most recent year of minute-by-minute actual load (2021) data to formulate a shaped and smoothed minute-by-minute 2023-2025 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 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

[3] For the 2022 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 2023 Flexible Capacity Needs Assessment at https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2023 for more information on the shifting and smoothing methodology
[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.

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

4. Forecasting Minute-by-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 the requisite information regarding the existing build-out in 2021 and the expected build-out in 2023 through 2025 of the grid-connected wind and solar resources. After obtaining this data from all LSEs, the ISO constructed the forecast minute-by-minute load, wind, and grid connected solar before calculating the net load curves for 2023 through 2025.

4.1 Building the Forecasted Variable Energy Resource Portfolio

To collect the necessary data, the ISO sent a data request in December, 2021 to the scheduling coordinators for all LSEs representing load in the ISO balancing area[7]. The deadline for submitting the data was January 15, 2022. At the time of the stakeholder call in January, the ISO had received data from all LSEs but is performing outreach to ensure all expected resources and fuel types are included. 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. Since the CEC's load forecast accounted for the expected behind-the-meter production, there was no need for the ISO to 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. The new co-located resource type went live in December 2021 as part of Phase 1 of the hybrid resources initiative[8], and phase 2 goes live in fall 2022, including the addition of the new hybrid fuel type. The submittals showed an average of about 2,959 MW of expected co-located renewable resources (excluding storage) in the 2023 timeframe, which were factored into the flexible needs assessment. The survey submittals of hybrid resources showed an average of 551 MW of renewable hybrid components in 2023. For the 2023 Flexible RA study, these were also included in calculating the flexible capacity needs.

The ISO expects there to be a large increase in these new types of resource on the system throughout 2022 and 2023. 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 three-hour ramp forecast and flexible capacity study. In regards to hybrid resources, although the hybrid resource as a whole will need to follow their dispatch optimization targets, the

[7] A reminder notice was also sent out in early January, 2022

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

individual renewable components will contribute to the 3-hour net load ramp. Renewable components of hybrid resources must be considered in the flexible needs assessment because all renewable resources contribute to the three-hour ramp. Renewable resources, whether it be a standalone renewable or renewable component of a hybrid, contribute to the flexibility requirement and the ISO incorporates forecasts to estimate these needs. The ISO allows the storage component for co-located and hybrid resources to count for flexible capacity. 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.

Using the LSEs' submitted renewable resources data and the CEC's hourly load forecast, the ISO simulated the variable energy resources' net load[9] output for 2023, 2024 and 2025 using actual minute-by-minute load, wind and solar data for 2021. A breakdown of the LSEs submittal is shown in Table 1.

Table 1: Total ISO System Variable Energy Resource Capacity for Year End Based on LSE Survey Data (Net Dependable Capacity-MW)[10]

Resource Type	Existing 2021	Expected 2022	Expected 2023
ISO Solar PV	11,261	11,556	12,322
ISO Solar Thermal	860	858	858
ISO Wind	4,523	4,801	4,912
Co-Located Resources (Wind/Solar)	880	1,744	3,769
Hybrid Resources (Wind/Solar)	2	419	608
Total Variable Energy Resource Capacity within the ISO	***17,526***	***19,377***	***22,468***
Incremental Non ISO Wind/Solar Resources that's Dynamically Scheduled into the ISO		204	204
Total Internal and Dynamically Scheduled VERs in Flexible Capacity Needs Assessment	***17,526***	***19,581***	***22,672***
Incremental New VERs Additions Each Year (Included in Flexible Capacity Needs Assessment)		***2,055***	***3,091***
Maximum behind-the-meter Solar PV Production in the CEC's Forecast	9,866	11,019	12,028
Cumulative behind-the-meter Solar PV Capacity reported by LSEs	11,385	12,603	13,805

Note: The incremental behind-the-meter Solar PV production was imbedded in the CEC's hourly load forecast and therefore the LSE survey data was not explicitly factored into the flexible needs assessment.

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

[10] 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.

Table 1 aggregates the variable energy resources system wide 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 2021.

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 2021 through 2025

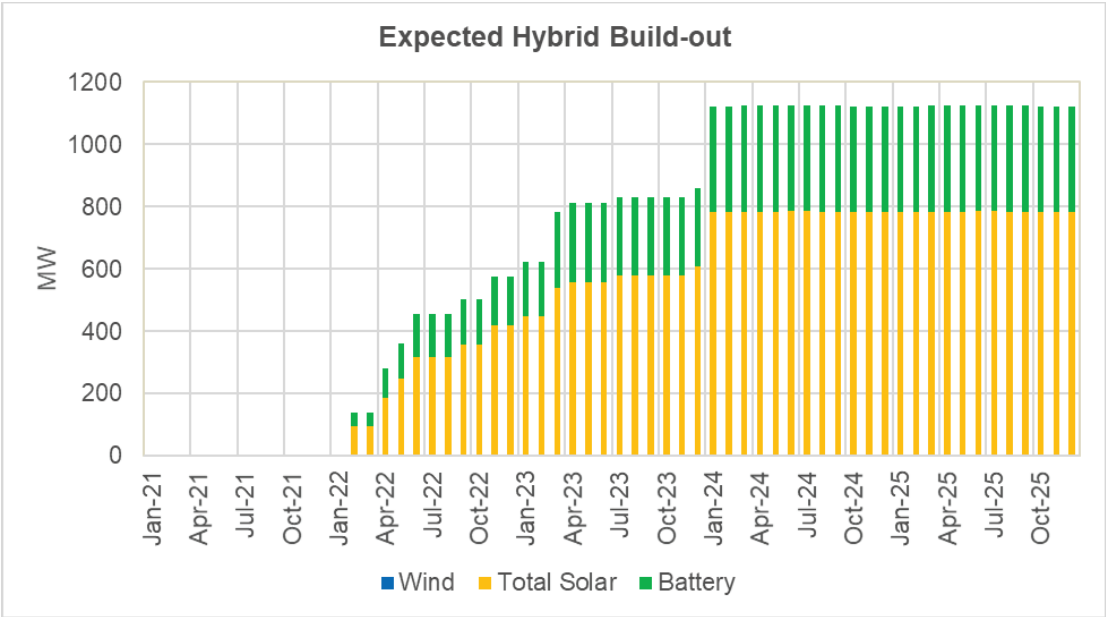
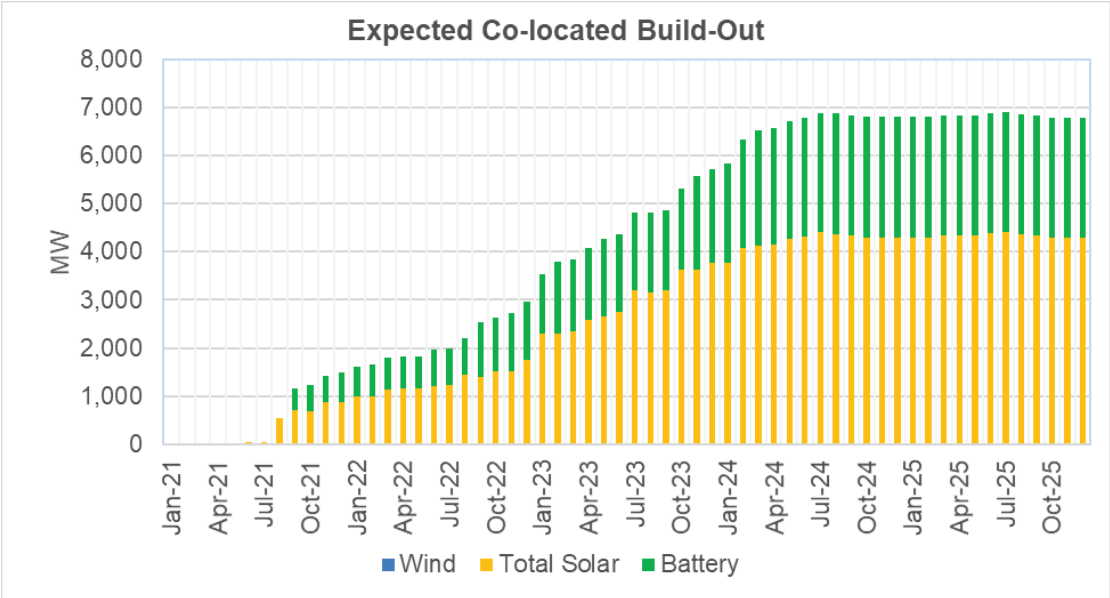


Figure 1b: Expected buildout of Co-Located Resources for 2021 through 2025



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 1-minute wind profiles for 2023, the ISO used the following formula:

$$2023W_{Mth_Sim_1min} = 2021W_{Act_1min} * \frac{2023W_{Mth\ Capacity}}{2021W_{Mth\ Capacity}}$$

Similarly, to develop one-minute transmission connected solar profiles for 2023, the ISO used the actual one-minute profiles for 2021 using the following formula:

$$2023S_{Mth_Sim_1min} = 2021S_{Act_1min} * \frac{2023S_{Mth\ Capacity}}{2021S_{Mth\ Capacity}}$$

Given the amount of incremental wind and solar resources expected to come on line, this approach maintains the load/wind/solar correlation for subsequent years.

4.2 Building Minute-by-Minute Net Load Profiles

The ISO used the CEC 2021 Integrated Energy Policy Report (IEPR) 1-in-2 hourly managed net load forecast (CAISO - Mid Baseline- AAEE Scenario 3 – AAFS Scenario 3 to develop minute-by-minute load forecasts for each month[11]. The ISO first scaled the actual load for each minute of each hour of 2021 using an expected CEC's load growth factor for the corresponding hour.

$$2023L_{Mth,Day,Hour_Sim_1min} = 2021L_{Mth,Day,Hour_Act_1min} * \frac{2023L_{Mth,Day,Hour_Forecast}}{2021L_{Mth,Day,Hour_Actual}}$$

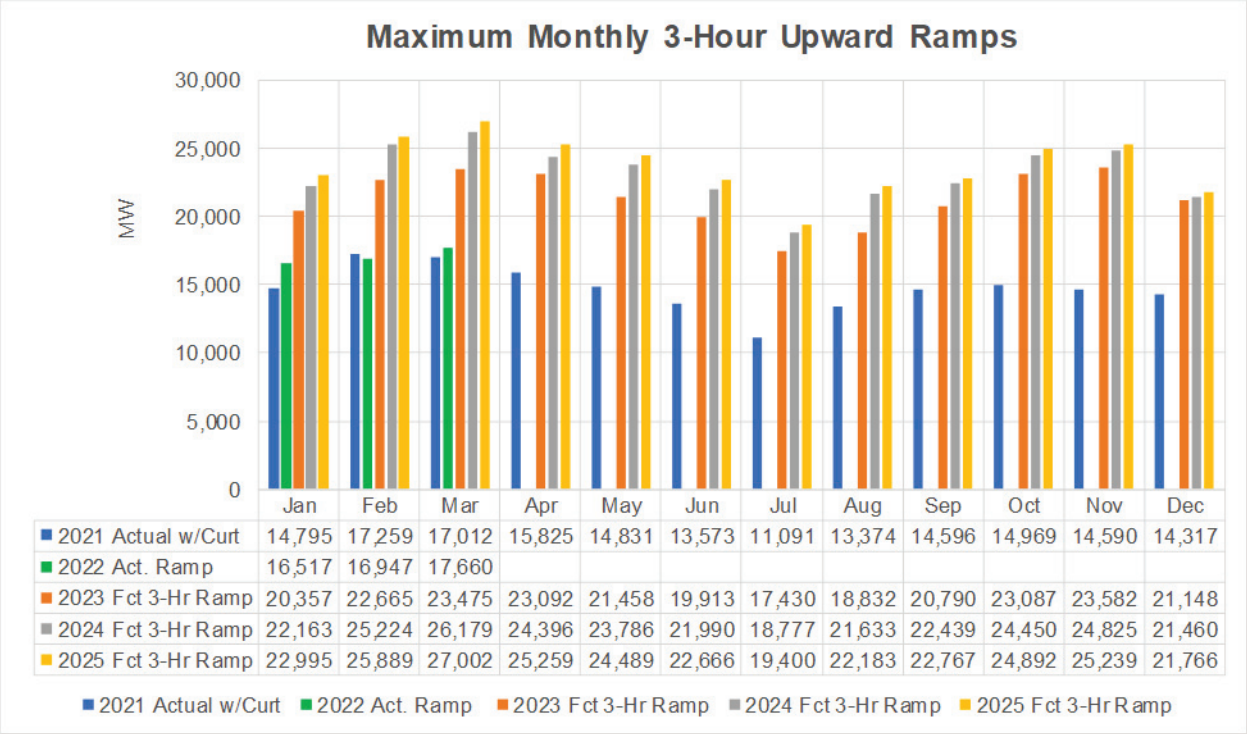
Using this load forecast and the expected wind and solar profiles developed in Section 4.1, the ISO then developed the minute-by-minute net load profiles for subsequent years by aligning weekdays and weekends within each month.

[11] https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report-update-0

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

The ISO, using the net load forecast developed in Section 4, calculated the maximum three-hour net load ramp for each month of 2023 through 2025. Figure 2 shows the expected ISO system-wide largest three-hour net load ramp for each month of 2023 through 2025 compared with each month of the actual three-hour net load ramp for 2021 and 2022 through March.

Figure 2: Expected ISO System Maximum Monthly Three-Hour Net Load Ramps



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021 Actual w/Curt	14,795	17,259	17,012	15,825	14,831	13,573	11,091	13,374	14,596	14,969	14,590	14,317
2022 Act. Ramp	16,517	16,947	17,660									
2023 Fct 3-Hr Ramp	20,357	22,665	23,475	23,092	21,458	19,913	17,430	18,832	20,790	23,087	23,582	21,148
2024 Fct 3-Hr Ramp	22,163	25,224	26,179	24,396	23,786	21,990	18,777	21,633	22,439	24,450	24,825	21,460
2025 Fct 3-Hr Ramp	22,995	25,889	27,002	25,259	24,489	22,666	19,400	22,183	22,767	24,892	25,239	21,766

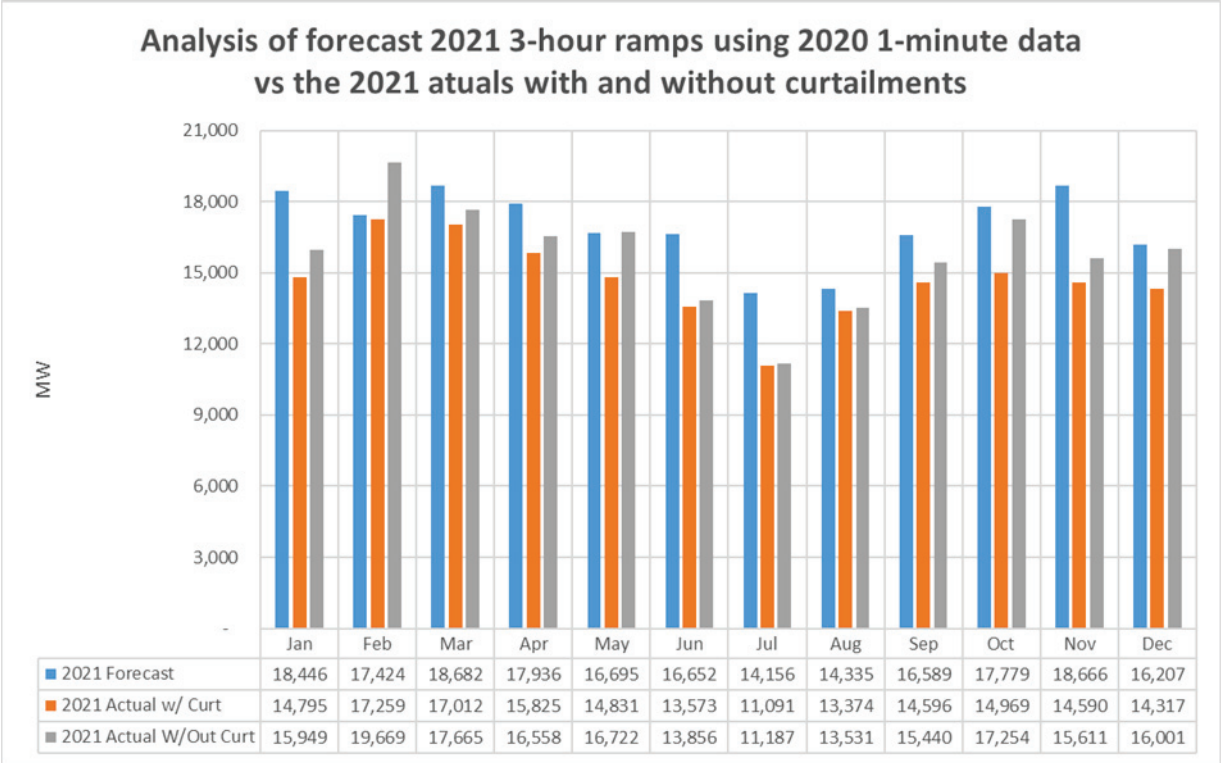
As shown in Figure 2, based on the LSEs submittal and the CEC's load forecast, the forecast maximum upward three-hour monthly ramps for the non-summer months of 2023 are higher than those predicted for the summer months, which is consistent with historical trends. For 2023, the maximum three-hour upward ramp of approximately 23,582 MW is expected to occur in November and the minimum three-hour upward ramp of approximately 17,430 MW is expected to occur in July.

Incremental resources dynamically scheduled into the ISO for 2023, 2024 and 2025 are included in the calculation of the three-hour ramp forecast because dynamically scheduled resources in the actual 2021 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 "belly of the duck". The impact of curtailments on the three-hour ramp is shown in Figure 3. It is important to note that the actual three-hour net load ramps include real-time

curtailments as the actual 1-minute wind and solar data used to determine the forecast three-hour monthly ramps include curtailments[12]. As shown in Figure 3, curtailments can reduce the observed three-hour ramp compared to the actuals where curtailments are not included. Thus, in future years, curtailment of renewable resources in real-time is expected to continue to reduce the actual three-hour ramps.

Figure 3: The ISO 2021 Expected Maximum Monthly 3-Hour Ramp vs 2021 Actuals With and Without Curtailments

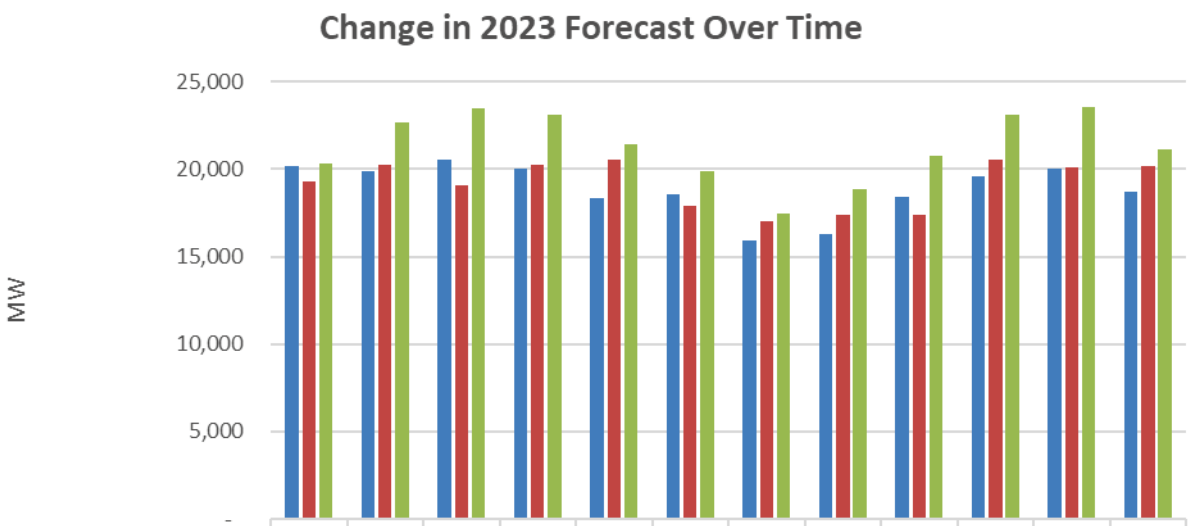


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021 Forecast	18,446	17,424	18,682	17,936	16,695	16,652	14,156	14,335	16,589	17,779	18,666	16,207
2021 Actual w/ Curt	14,795	17,259	17,012	15,825	14,831	13,573	11,091	13,374	14,596	14,969	14,590	14,317
2021 Actual W/Out Curt	15,949	19,669	17,665	16,558	16,722	13,856	11,187	13,531	15,440	17,254	15,611	16,001

Other factors that can impact the three-hour ramp include tempertaures and cloud cover. January 2021 featured above normal temperatures across the state lead to higher mid-day loads and likely resulted in a lower three-hour ramp, which is shown above. The summer months of June through August across the state had above normal overnight temperatures. Warm overnights can act to keep morning loads elevated, which in turn can keep the midday loads elevated and act to reduce the three-hour ramp compared to the forecast. Finally, October through December 2021 had increased cloud cover and above normal precipitation for a large portion 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.

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

Figure 4: Comparing the Change in the 2023 3-hour Ramp Forecast From 2020-2022



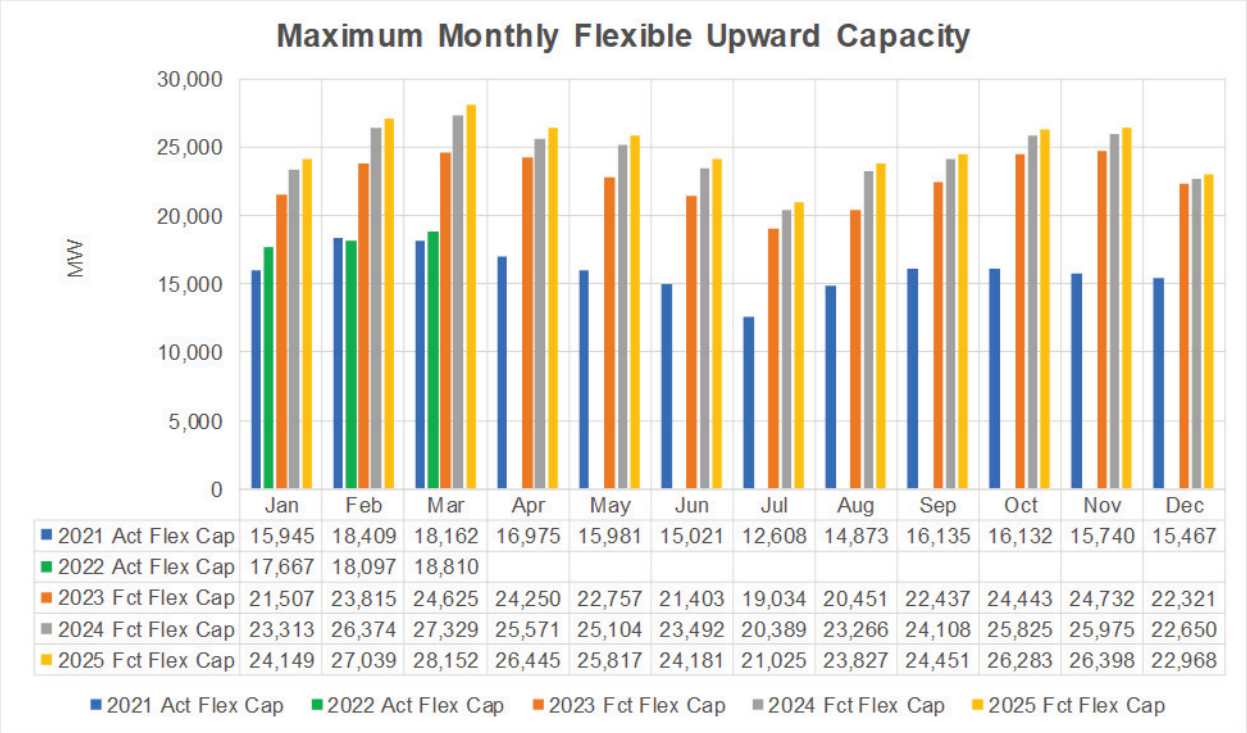
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020 Forecast for 2023	20,167	19,890	20,530	20,054	18,336	18,560	15,910	16,281	18,415	19,613	20,052	18,736
2021 Forecast for 2023	19,283	20,241	19,110	20,228	20,519	17,877	17,033	17,363	17,358	20,568	20,087	20,205
2022 Forecast for 2023	20,357	22,665	23,475	23,092	21,458	19,913	17,430	18,832	20,790	23,087	23,582	21,148

Figure 4 above shows the change in the 2023 three-hour ramp forecast over time. For all months, the 2022 forecast for 2023 increased compared to the 2021 forecast. This is partly due to the inclusion of hybrid renewable components in the 2023 study, which total to 608 MW by the end of 2023. Other factors that have contributed to an increase in the 2023 three-hour ramp forecast include an increase in the peak and ramp CEC forecast, additional co-located and traditional VERs in survey submittals, as well as weather and curtailment variability.

To determine the monthly flexible capacity needs for 2023, 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 2023 and advisory needs for 2024 and 2025. The monthly flexible capacity needs for 2023 together with the actual monthly flexible capacity needed for 2021 is shown in Figure 5 below.

As shown in Figure 5, the forecast flexible capacity for all months for years 2023-2025 are higher than the actual flexible capacity needs in 2021 and January through March of 2022.

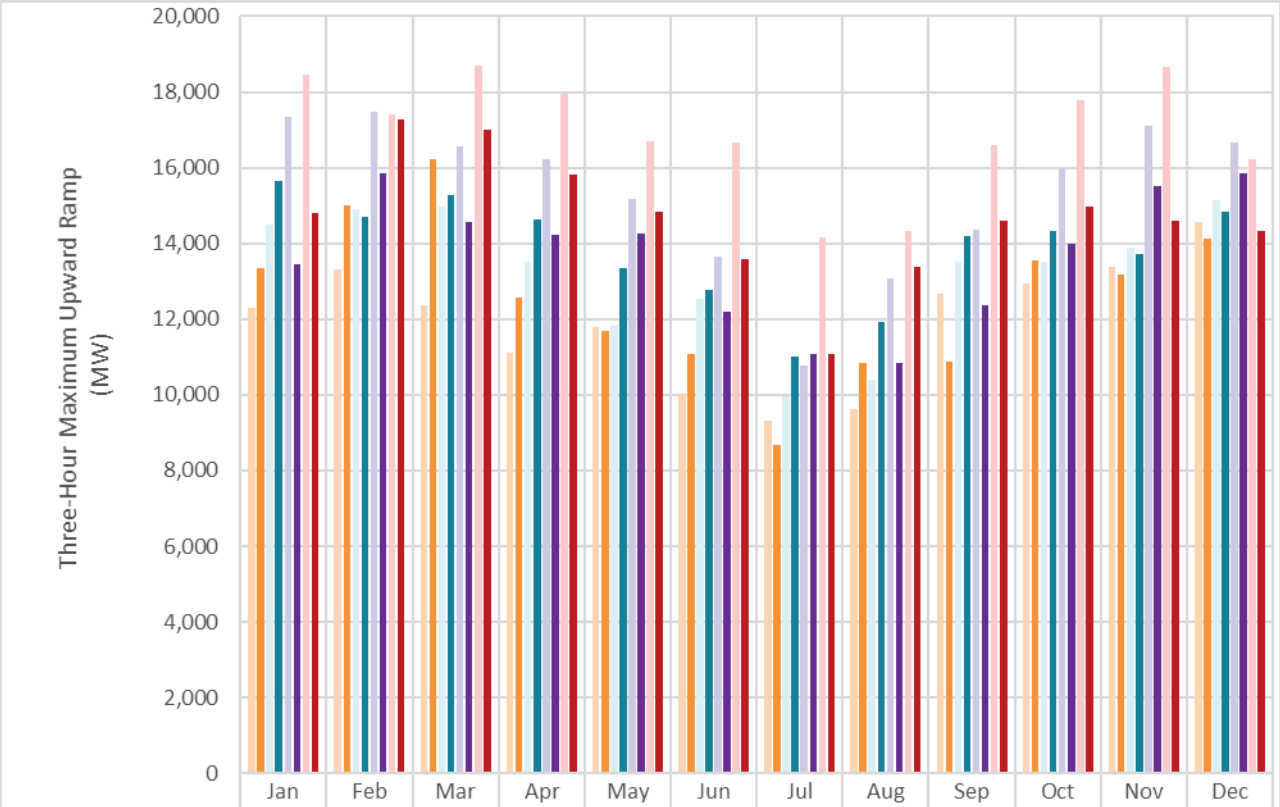
Figure 5: The ISO Monthly Maximum Three-Hour Flexible Capacity Requirements



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021 Act Flex Cap	15,945	18,409	18,162	16,975	15,981	15,021	12,608	14,873	16,135	16,132	15,740	15,467
2022 Act Flex Cap	17,667	18,097	18,810									
2023 Fct Flex Cap	21,507	23,815	24,625	24,250	22,757	21,403	19,034	20,451	22,437	24,443	24,732	22,321
2024 Fct Flex Cap	23,313	26,374	27,329	25,571	25,104	23,492	20,389	23,266	24,108	25,825	25,975	22,650
2025 Fct Flex Cap	24,149	27,039	28,152	26,445	25,817	24,181	21,025	23,827	24,451	26,283	26,398	22,968

In Figure 3 above, a comparison between the three-hour ramp actual with and without curtailments is shown for 2021, and for most months there is a 0-10% impact on the three-hour ramp actuals when curtailments are included. An expanded accuracy analysis of the three-hour ramp forecast for years 2018-2021 is shown in Figure 6. The ramp forecast for each year was created from the previous year's 1-minute actual load, wind, and solar data. For example, the 2021 monthly forecast bars were created in 2020 using actual 2019's 1-minute load, wind and solar data. As shown, the monthly three-hour ramp appears to be higher when compared to the actuals.

Figure 6: A comparison of the forecast three-hour ramp to the actual three hour ramp (including curtailments) for years 2018-2021



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018 Forecast	12,282	13,313	12,352	11,111	11,803	10,039	9,326	9,617	12,660	12,954	13,376	14,567
2018 Act + Curtail	13,342	14,988	16,217	12,559	11,672	11,077	8,681	10,835	10,867	13,554	13,165	14,134
2019 Forecast	14,506	14,889	14,971	13,509	11,808	12,524	9,967	10,393	13,511	13,510	13,898	15,129
2019 Act + Curtail	15,639	14,707	15,261	14,636	13,350	12,757	11,002	11,924	14,182	14,340	13,704	14,839
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	13,441	15,840	14,562	14,241	14,274	12,212	11,070	10,848	12,351	14,005	15,512	15,859
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	14,795	17,259	17,012	15,825	14,831	13,573	11,091	13,374	14,596	14,969	14,590	14,317

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[13] 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.

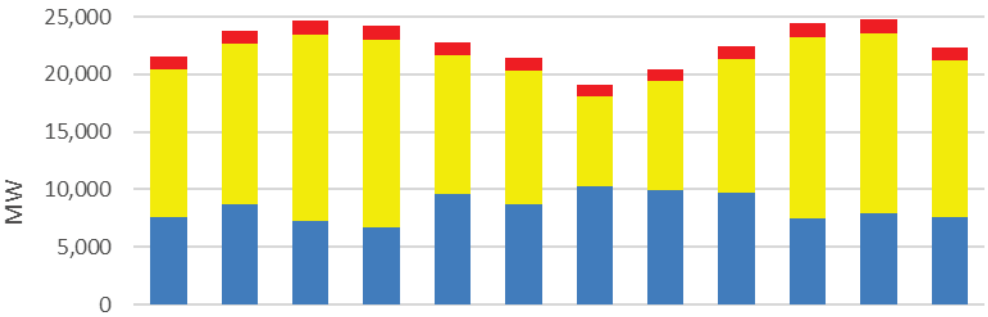
6.1 Calculating the Forecast Percentages Needed in Each Category in Each Month

Based on the categories defined above, the system level needs for 2023 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 established by the maximum three-hour

[13] 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

net load ramp. The calculation of flexible capacity needs for each category for 2023 is shown in Figure 7.

Figure 7: ISO System-Wide Flexible Capacity Monthly Calculation by Category for 2023



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,075	1,191	1,231	1,213	1,138	1,070	952	1,023	1,122	1,222	1,237	1,116
Peak Flexibility	12,79	13,92	16,15	16,36	11,97	11,68	7,828	9,470	11,61	15,78	15,52	13,56
Base Flexibility	7,641	8,700	7,235	6,674	9,649	8,651	10,25	9,959	9,700	7,431	7,969	7,640

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 8 and Figure 9, respectively.

Figure 8: Distribution of Daily Primary Three-hour Net Load Ramps for 2023

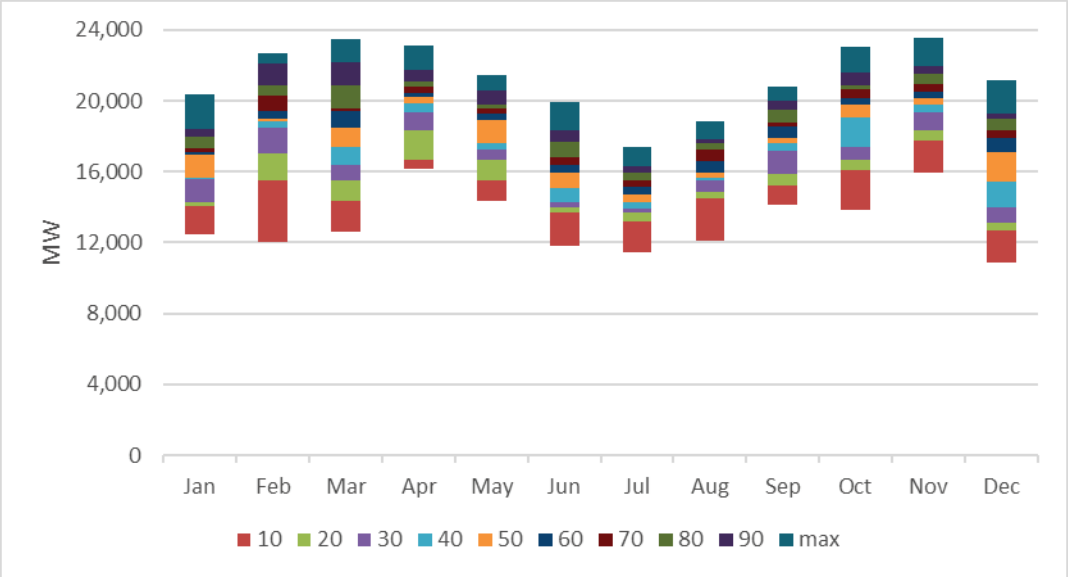
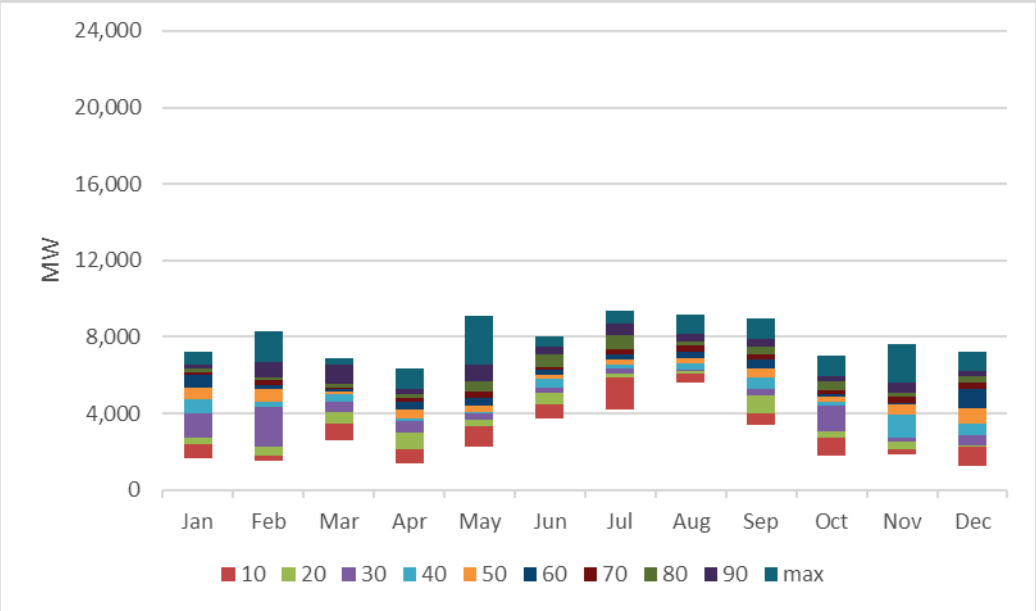


Figure 9: Distribution of Secondary Three-hour Net load Ramps for 2023



As shown in Figure 8 and Figure 9, 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	36%	59%	5%	32%	63%	5%
February	37%	58%	5%	32%	63%	5%
March	29%	66%	5%	32%	63%	5%
April	28%	67%	5%	32%	63%	5%
May	42%	53%	5%	46%	49%	5%
June	40%	55%	5%	46%	49%	5%
July	54%	41%	5%	46%	49%	5%
August	49%	46%	5%	46%	49%	5%
September	43%	52%	5%	46%	49%	5%
October	30%	65%	5%	32%	63%	5%
November	32%	63%	5%	32%	63%	5%
December	34%	61%	5%	32%	63%	5%

As shown in Figure 8, 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 secondary ramp during sunset.

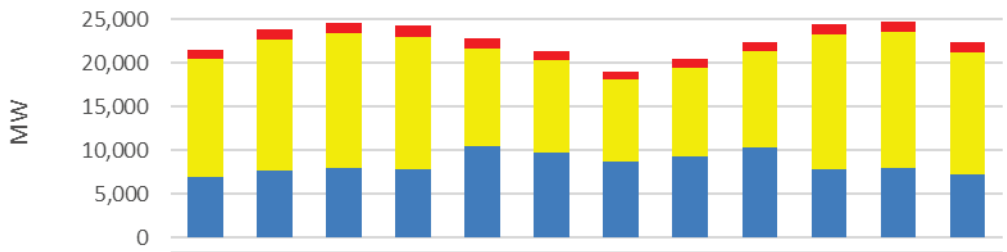
Table 3: Change in peak category weighting over the past three years

Month	2021	2022	2023
January	57.30%	55.06%	62.74%
February	57.30%	55.06%	62.74%
March	57.30%	55.06%	62.74%
April	57.30%	55.06%	62.74%
May	45.62%	45.39%	49.28%
June	45.62%	45.39%	49.28%
July	45.62%	45.39%	49.28%
August	45.62%	45.39%	49.28%
September	45.62%	45.39%	49.28%
October	57.30%	55.06%	62.74%
November	57.30%	55.06%	62.74%
December	57.30%	55.06%	62.74%

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 32 percent of the ISO system flexible capacity need for the non-summer months and 46 percent for the summer months. Peak flexible capacity resources could be used to fulfill 63 percent of non-summer flexibility needs and 46 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 10.

Figure 10: System-wide Flexible Capacity Need in Each Category for 2023 –Adjusted



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,075	1,191	1,231	1,213	1,138	1,070	952	1,023	1,122	1,222	1,237	1,116
Peak Flexibility	13,49	14,94	15,45	15,21	11,21	10,54	9,379	10,07	11,05	15,33	15,51	14,00
Base Flexibility	6,938	7,682	7,944	7,823	10,40	9,786	8,703	9,351	10,25	7,885	7,978	7,201

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 x 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 x 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 x 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

$$\textit{Flex Requirement} = \Delta NL_{2023} + R_{2023}$$

$$= \Delta L_{2023} - \Delta W_{2023} - \Delta S_{2023} + R_{2023}$$

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_{2023} Net Load Ramp Req in 2023,

$\Delta NL_{sc,2023}$ Net Load Ramp Allocation for LSC in 2023,

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

Σ the summation of all LSC.

In 2022, the ISO has forecasts from CEC L_{2023} , survey results from $W_{2023} = \Sigma W_{lsc,2023}$, $S_{2023} = \Sigma S_{lsc,2023}$, all the estimated ramps are ΔL_{2023}, ΔW_{2023}, ΔS_{2023}, plus R_{2023}. Moreover, the ISO has the peak load ratio list from CEC, $\Sigma pl_r_{lsc} = 1$.

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

$$\begin{aligned} \textit{Flex Need} &= \Delta NL_{2023} + \Sigma pl_r_{lsc} * R_{2023} \\ &= \Delta L_{2023} - \frac{\Sigma W_{lsc,2023}}{W_{2023}} * \Delta W_{2022} - \frac{\Sigma S_{lsc,2023}}{S_{2023}} * \Delta S_{2023} + \Sigma pl_r_{lsc} * R_{2023} \end{aligned}$$

Since the ISO has no pre-knowledge of, $\Delta L_{lsc,y+2}$, the load ramp at LSC level in future year $y+2$ at the current year $y = 2021$, the allocation of ΔL_{2023} 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 nontrivial 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 proposes a new formula which best utilizes $\Delta L_{sc,y}$ while the system ΔL_y is not in the denominator,

$$\begin{aligned} \Delta L_{2023} &= \Delta L_{2021} + (\Delta L_{2023} - \Delta L_{2021}) \\ &= \Sigma \Delta L_{lsc,2021} + \frac{\Sigma L^M_{lsc,2021}}{L^M_{2021}} * (\Delta L_{2023} - \Delta L_{2021}), \end{aligned}$$

where ΔL_{2021} is the average load portion of top 5 maximum 2021 three-hour ramps and L^{M}_{2021} is the average load at beginning and the end of points during those top 5 ramps. In 2023, each LSC will receive:

$$\Delta L_{lsc,2021} + \frac{L^{M}_{lsc,2021}}{L^{M}_{2021}} * (\Delta L_{2023} - \Delta L_{2021})$$

Therefore each LSC's contribution $\Delta L_{lsc,2021}$ will be explicitly projected into future year 2023, and any additional increase of $(\Delta L_{2023} - \Delta L_{2021})$ 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 2023. 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 "2023 Flexible Capacity Needs Assessment – 2023 Net Load Data" at:

https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2023

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 2023	Wind contribution 2023	Solar contribution 2023	Total percent 2023
January	45.31%	-1.79%	-52.90%	100%
February	35.55%	-1.16%	-63.29%	100%
March	36.41%	-1.40%	-62.19%	100%
April	37.00%	-2.13%	-60.87%	100%
May	32.42%	-4.25%	-63.33%	100%
June	29.58%	-1.41%	-69.01%	100%
July	25.16%	3.01%	-77.85%	100%
August	29.41%	2.70%	-73.28%	100%
September	30.98%	-0.85%	-68.17%	100%
October	32.54%	-0.64%	-66.82%	100%
November	38.46%	-1.87%	-59.67%	100%
December	42.57%	-0.12%	-57.31%	100%

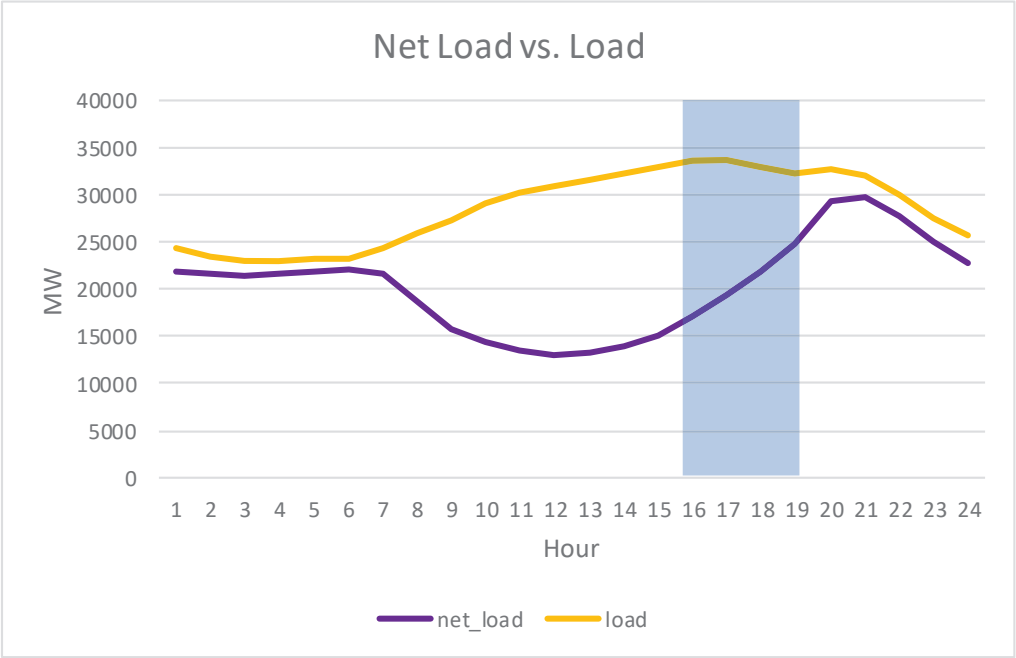
When looking at the contribution to the maximum three-hour continuous net load ramp shown in Table 4, the above total percentage is calculated as Load – Wind – Solar. For example, when looking at July 100 percent contribution is determined by:

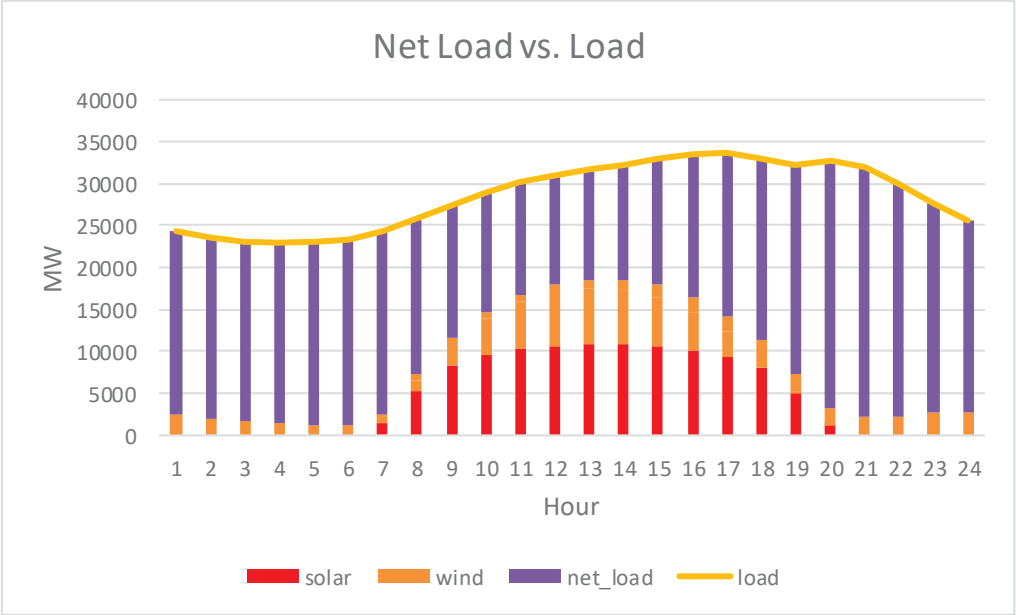
Total Contribution = 25.16%– 3.01%) – (-77.85%) = 100%

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 and August. 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 imbedded in its 2022 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 ***11*** 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 11: Examples of Load Contribution to Net Load Ramp





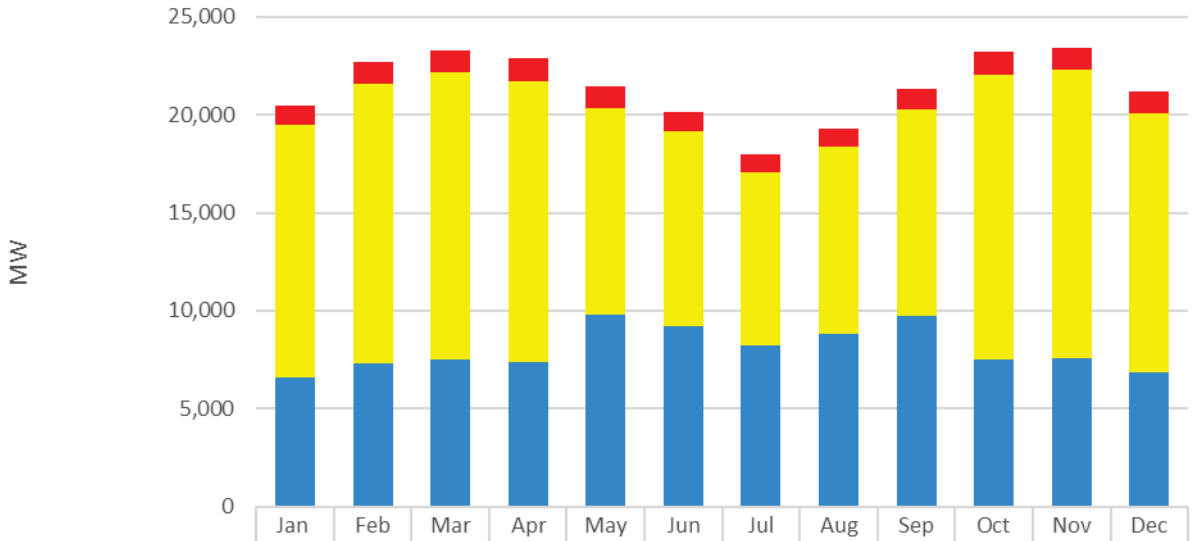
The CPUC allocations are shown in Table 5 and Figure 12. The contributions calculated for other LRAs will only be provided to show the contribution of its jurisdictional LRA as per section 40.10.2.1 of the ISO tariff.

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

Month	Load	Wind	Solar	reserve	Total Allocation
January	8,966	-344	-10,142	1,036	20,488
February	7,913	-248	-13,499	1,036	22,696
March	8,286	-310	-13,681	1,036	23,313
April	8,197	-464	-13,174	1,044	22,879
May	6,667	-860	-12,737	1,170	21,433
June	5,715	-264	-12,856	1,342	20,177
July	4,307	495	-12,714	1,445	17,971
August	5,378	480	-12,961	1,458	19,318
September	6,356	-168	-13,338	1,484	21,346
October	7,293	-140	-14,584	1,221	23,238
November	8,672	-416	-13,325	1,036	23,449
December	8,598	-23	-11,489	1,057	21,168

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 12.

Figure 12: CPUC Flexible Capacity Need in Each Category for 2023



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	1,024	1,135	1,166	1,144	1,072	1,009	899	966	1,067	1,162	1172	1058
Peak Flexibility	12,854	14,240	14,627	14,355	10,561	9,942	8,855	9,519	10,518	14,580	14712	13281
Base Flexiblity	6,609	7,321	7,520	7,380	9,800	9,226	8,217	8,833	9,760	7,496	7564	6828

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 to the stability of ISO. 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 hours in which the maximum monthly average net load ramp are forecast to begin in 2023.

Table 6: Forecasted Starting Hour of the Maximum Three-Hour Net Load Ramp by Month for 2023

	Three Hour Net Load Ramp Start Hour (Hour Ending)					
Month	13:00	14:00	15:00	16:00	17:00	18:00
January			31			
February			17	11		
March			6	5	20	
April				1	29	
May					26	5
June			1	1	28	
July				3	28	
August	1			14	16	
September				28	2	
October			7	24		
November		4	22	4		
December		2	29			

Table 7 below shows an early (HE 15), start of the three-hour ramp pattern for November through February. For the months of March through August, the majority of days have a HE 17 starting time of the three hour net load ramp. The fall shoulder months, September and October, have the starting time concentrated on HE 16.

Table 7: Summary of MOO Hours Proposed by the ISO for 2023

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

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 (AAH)

9.1 Background and Purpose

Prior to the start of each Resource Adequacy compliance year, the ISO analyzes the availability assessment hours by looking at the actual demand observed in previous years alongside the California Energy Commissions (CEC) IEPR forecast for future years. The overall goal of the AAH is to ensure they correspond to the operating periods when high demand conditions typically occur and when the availability of resource adequacy capacity is most cirtical to maintaing system reliability. The AAHs determined annually are published in the Reliability Requirements BPM. For further information you can also reference section 40.9 of the ISO tariff.

9.2 Methodology Overview

To ensure the five consecutive hours correspond to the operating periods when high demand conditions typically occur, and when the availability of resource adequacy capacity is most critical to maintain system reliability, the ISO calculates the top 5% of load hours within each month using an hourly load distribution. To perform this calculation, the ISO utilizes the CEC IEPR information described in Section 2 above. The ISO then bins the IEPR forecast by the year, month and hour.. Following the binning, an analysis is done to determine of the top 5% of load hours within each month using an hourly load distribution. This is done for the previous years actual information, as well as the CEC IEPR forecast for the years needed.

9.3 AAH Final Requirement for 2023 and Estimated Recommendation for 2024 & 2025

For the 2023 AAH final requirement, the CEC Forecast for 2023-2025 and load actuals from 2019-2021 show for March and April the top load hours have shifted from hour-ending (HE) 17-21, which have historically been the AAH for March and Aprilg, to HE 18-22. Due to this, the CAISO proposes the addition of a spring season for the months of March and April with AAH HE18-22 to better align with actual and forecast data, which are consistent in their trends. Please see Table 8**: Count of 2021 actual top 5% of load hours by month** below, which showsthe number of times each hour was in the top 5% of load hours for each month utilizing 2021 actual data.

Table 8: Count of 2021 actual top 5% of load hours by month

	Row Labels	8	9	14	15	16	17	18	19	20	21	22	23
MONTH	Jan	1						10	***17***	7	2		
	Feb							2	***19***	12			
	Mar	2	2						11	***14***	7	1	
	Apr				1	1	2	3	4	8	***13***	3	1
	May						2	5	9	9	***11***	1	
	Jun				2	3	6	7	***8***	5	4	1	
	Jul				1	3	8	***10***	9	6			
	Aug				1	4	7	***11***	9	5			
	Sep				2	6	7	***8***	***8***	3	2		
	Oct			1	1	5	5	6	***7***	***7***	5		
	Nov				1	1	3	13	***15***	3			
	Dec						1	***14***	13	6	3		
	Grand Total	**3**	**2**	**1**	**9**	**23**	**41**	**89**	**129**	**85**	**47**	**6**	**1**

In addition to Table 8**: Count of 2021 actual top 5% of load hours by month** above comparing top 5% of load hours within the 2021 actuals, Figure 13a and Figure 14b below show the March and April actuals from 2019-2021 in comparison to the 2023 and 2025 CEC IEPR Forecast. This provides additional supporting evidence of the shift in the top load hours observed during the months of March and April.

Figure 13a: Comparing the March 2019, 2020 and 2021 actuals to the CEC 2023 and 2025 forecasts

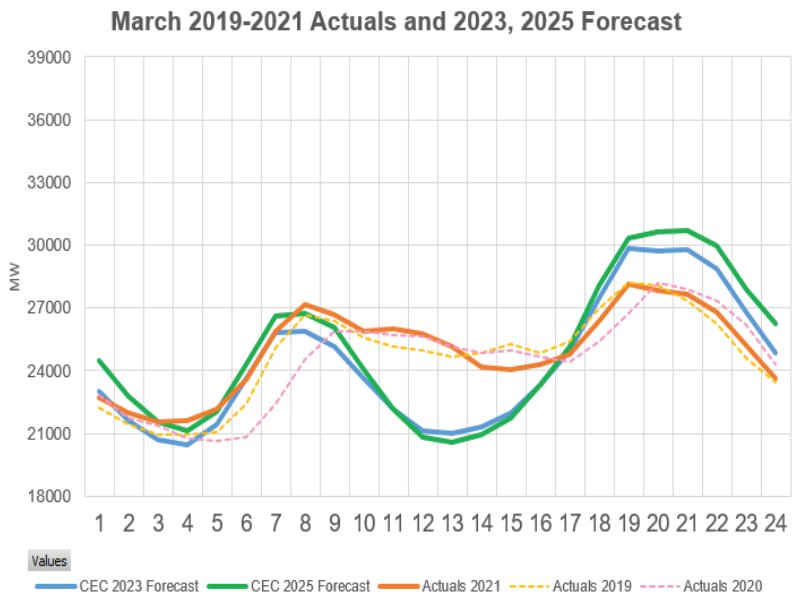
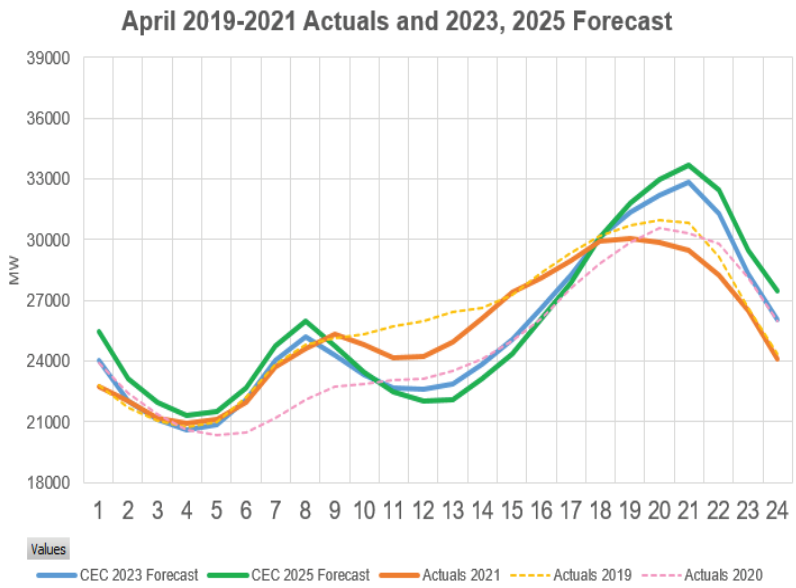


Figure 14b: Comparing the April 2019, 2020 and 2021 actuals to the CEC 2023 and 2025 forecasts



The remainder of the months for Winter and Summer season will still remain at HE 17-21. For further information on load evolution for all other months please see the Draft and Final 2023 AAH Presentation posted.

A final piece to note is that it has been observed that May appears to be on the border of needing a change to HE 18-22.Due to this, the ISO continues to closely watch the May month to see if further change is needed in future AAH determinations. For the ISOs final recommendation for the 2023 AAH, and estimates for 2024-2025, please see Table 9: **Final AAH recommendations for**

the winter and summer (left), and spring (right) seasonsand Table 10**: Changes to the AAH seasons beginning in 2023** below.

Table 9: Final AAH recommendations for the winter and summer (left), and spring (right) seasons

Winter and Summer Season Recommendation

Jan-Feb, Nov-Dec; May-Oct

Year	Start	End
2022 (Final)	HE 17	HE 21
2023 (Final)	HE 17	HE 21
2024 (Estimate)*	HE 17	HE 21
2025 (Estimate)*	HE 17	HE 21

* Monitoring May for potential shift to Spring season for 2024-2025

Spring Season Recommendation

Mar-Apr

Year	Start	End
2022 (Final)	HE 17	HE 21
2023 (Final)	HE 18	HE 22
2024 (Estimate)	HE 18	HE 22
2025 (Estimate)	HE 18	HE 22

Table 10: Changes to the AAH seasons beginning in 2023

Month	Season
Jan	winter
Feb	winter
Mar	spring
Apr	spring
May	summer
Jun	summer
Jul	summer
Aug	summer
Sep	summer
Oct	summer
Nov	winter
Dec	winter

The ISO will continue to monitor the load forecast and actual changes and provide further updates, if needed, in next years assessment for 2024, 2025, and 2026.

10. Next Steps

The ISO plans to publish the updated requirements for the final Flexible Capacity Needs Assessment and Availability Assessment Hours by May 27, 2022. The 2024 Flexible Capacity Needs Assessment to establish the ISO system flexible capacity needs for 2024 will begin in early 2023. The ISO will continue to assess the modeling approach used for distributed solar resources, further review methods to address year-to-year volatility, and account for potential controllability of some variable energy resources.

11. Comments

Comments submitted related to the 2023 Flexible Capacity study are available for viewing at: https://stakeholdercenter.caiso.com/Comments/AllComments/9b5da24e-252f-46c4-b15e-be4478491c8c. The CAISO received three comments. Replies to the comments are below.

11.1 California Community Choice Association (California CCA)

We appreciate California Community Choice Association (CCA) detailed comments on the increases seen between the 2022 and 2023 requirements. The main contribution to the requirement is the growth the ISO is seeing in co-located and hybrid solar resources. When looking at Figure 1a**: Expected buildout of Hybrid Resources for 2021 through 2025** and Figure 1a**: Expected buildout of Hybrid Resources for 2021 through 2025**b, you can see that the growth in the sum of co-located and hybrid solar sums between 2,748–4,377 MWs, as compared to 5-880 MWs in 2021. In addition, we do see impacts from the 3-hour demand ramp in the CEC 2023 Forecast, which is on average ~500 MW higher for 2023 compared to the previous CEC forecast.

11.2 California Department of Water Resources (CDWR)

We appreciate California Department of Water Resources comments to the annual Flex RA process. As the ISO modifies the Flexible Resource Adequacy program within the RA Enhancements Policy initiative the ISO encourages CDWR to submit suggestions and thoughts to appropriately account of the dispatchable pumps within the requirement and/or accredidation formulation process.

11.3 California Public Utilities Commission – Public Advocates Office

We appreciate the California Public Utilities Commission – Public Advocates Office comments as it relates to adding a section on Availability Asssessment Hours (AAH) into the written paper on Final Flexible Capacity Needs Assessment for 2023. This section has been added above as seen in Section 9.

California ISO

Final Availability Assessment Hours

Jessica Taheri
Sr. Energy Meteorologist
Short-Term Forecasting

May 17, 2022

Availability assessment hours: Background and purpose

- Concept originally developed as part of the ISO standard capacity product (SCP)
  - Maintained as part of Reliability Service Initiative – Phase 1 (i.e. RA Availability Incentive Mechanism, or RAAIM)
- Determine the hours of greatest need to maximize the effectiveness of the availability incentive structure
  - Resources are rewarded for availability during hours of greatest need
  - Hours determined annually by ISO and published in the BPM
    - See section 40.9 of the ISO Tariff

Methodology overview of system/local availability assessment hours

- Used CEC IEPR data described in previous slides to obtain:
  - Hourly Average Load
    - By Hour
    - By Month
    - Years 2021-2025
- Calculated:
  - Top 5% of Load Hours within each month using an hourly load distribution
  - Years 2023 - 2025

Change to AAH Seasons

Previous years

Month	Season
Jan	winter
Feb	winter
Mar	winter
Apr	summer
May	summer
Jun	summer
Jul	summer
Aug	summer
Sep	summer
Oct	summer
Nov	winter
Dec	winter

2023-2025

Month	Season
Jan	winter
Feb	winter
Mar	spring
Apr	spring
May	summer
Jun	summer
Jul	summer
Aug	summer
Sep	summer
Oct	summer
Nov	winter
Dec	winter

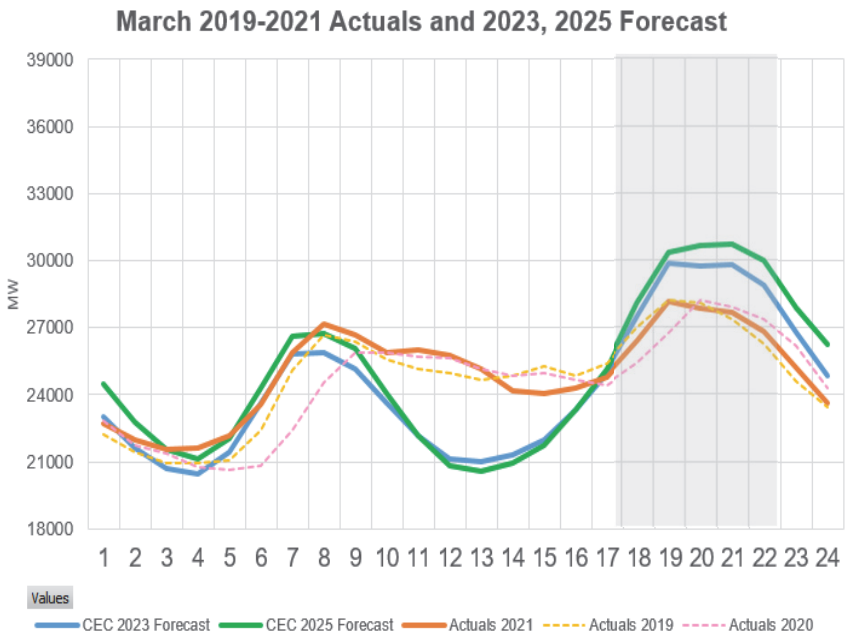
Forecast and actual data supports change in top 5% of load hours for March and April

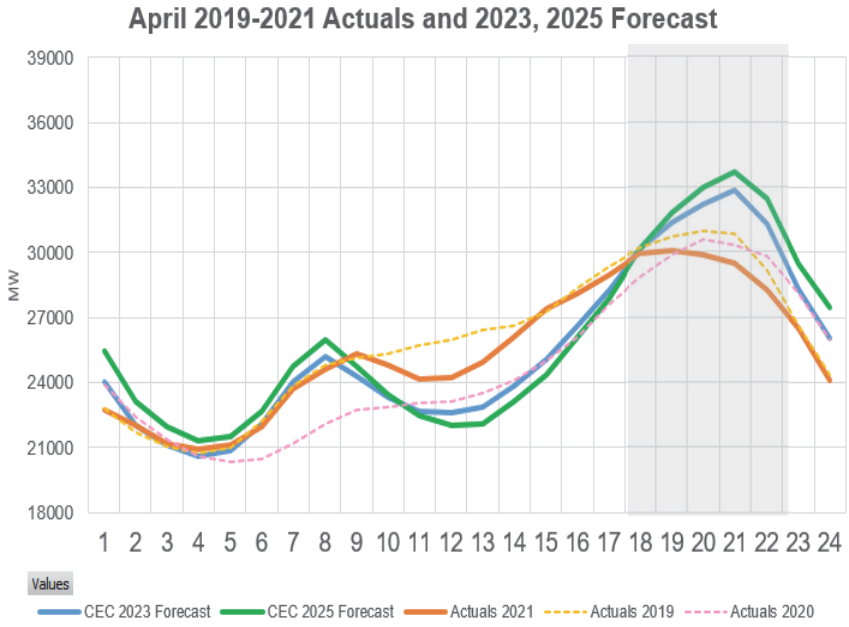
- CEC Forecast for 2023-2025 and load actuals from 2019-2021 show for March and April the top load hours have shifted to HE 18-22
  - Historically these months had HE 17-21 as their AAH
- CAISO proposes addition of Spring season to better align with actual and forecast data, which are consistent in their trends

Number of times each hour was in the top 5% of load hours for each month – 2021 Actual

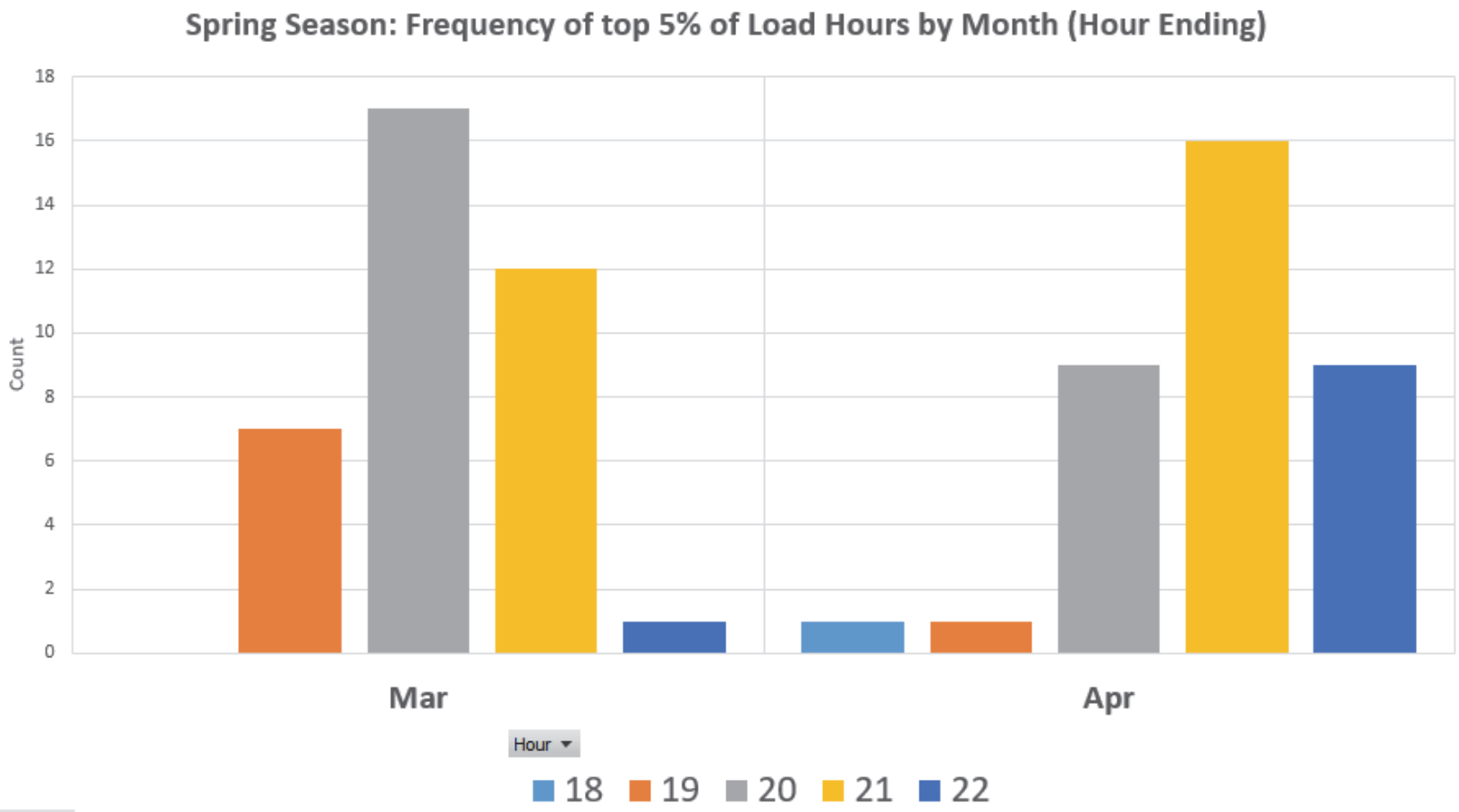
	Row Labels	8	9	14	15	16	17	18	19	20	21	22	23
MONTH	Jan	1						10	***17***	7	2		
	Feb							2	***19***	12			
	Mar	2	2						11	***14***	7	1	
	Apr				1	1	2	3	4	8	***13***	3	1
	May						2	5	9	9	***11***	1	
	Jun				2	3	6	7	***8***	5	4	1	
	Jul				1	3	8	***10***	9	6			
	Aug				1	4	7	***11***	9	5			
	Sep				2	6	7	***8***	***8***	3	2		
	Oct			1	1	5	5	6	***7***	***7***	5		
	Nov				1	1	3	13	***15***	3			
	Dec						1	***14***	13	6	3		
	Grand Total	**3**	**2**	**1**	**9**	**23**	**41**	**89**	**129**	**85**	**47**	**6**	**1**

CEC forecast and previous 3 years of actuals indicate a shift in top load hours for March and April

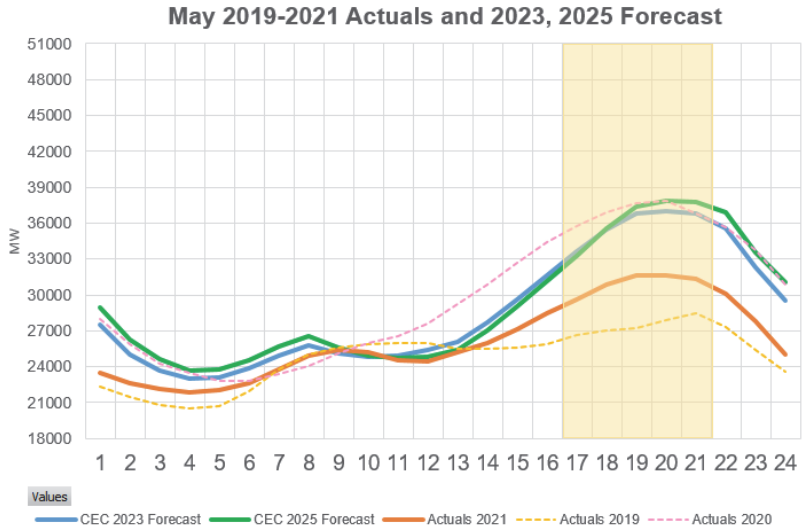


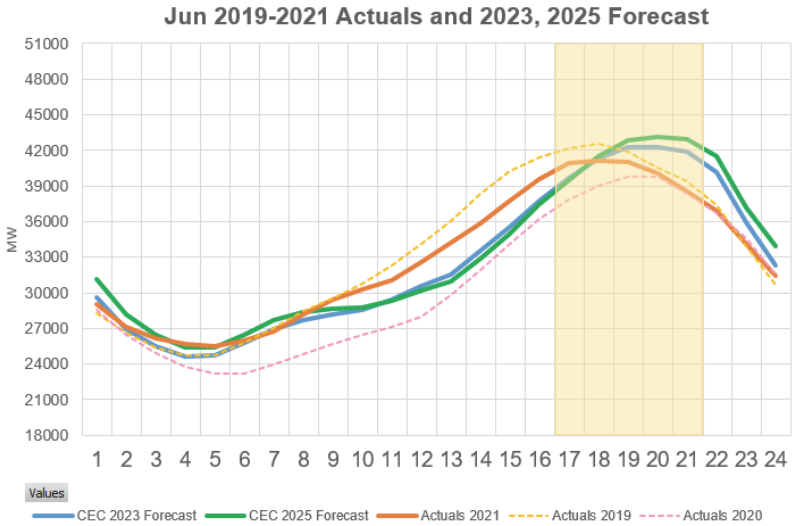


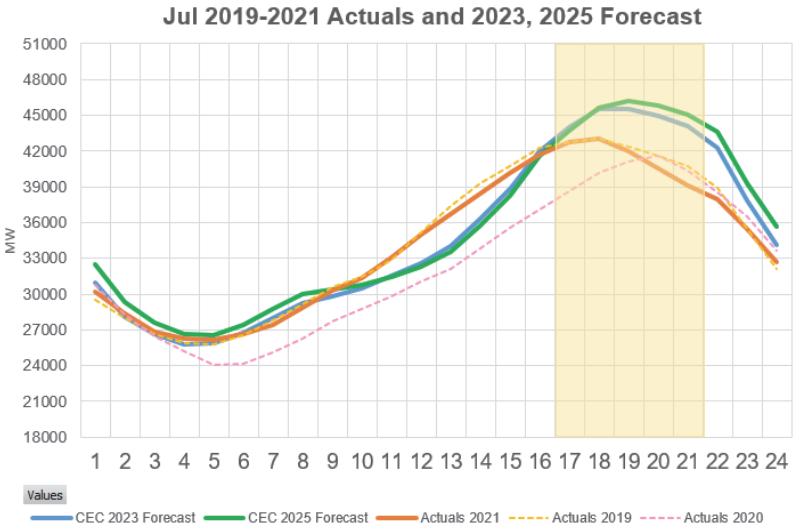
Spring Season
2023 top 5% of load hours (HE)



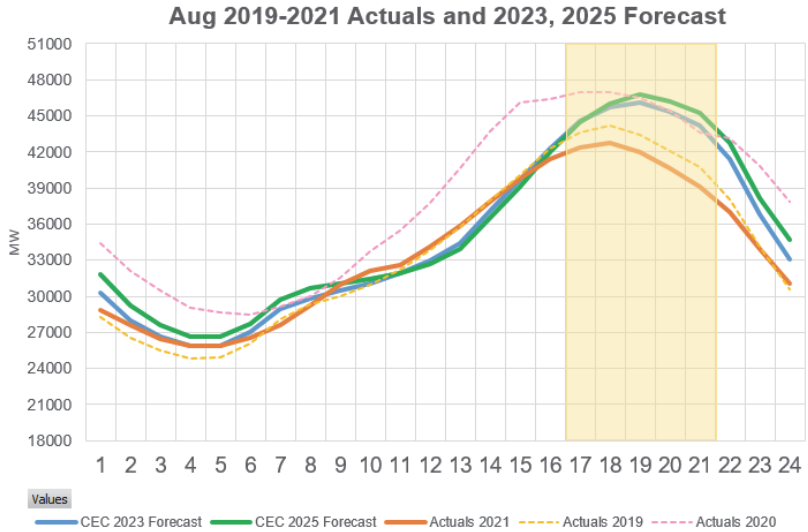
Expected load shape evolution: Summer season

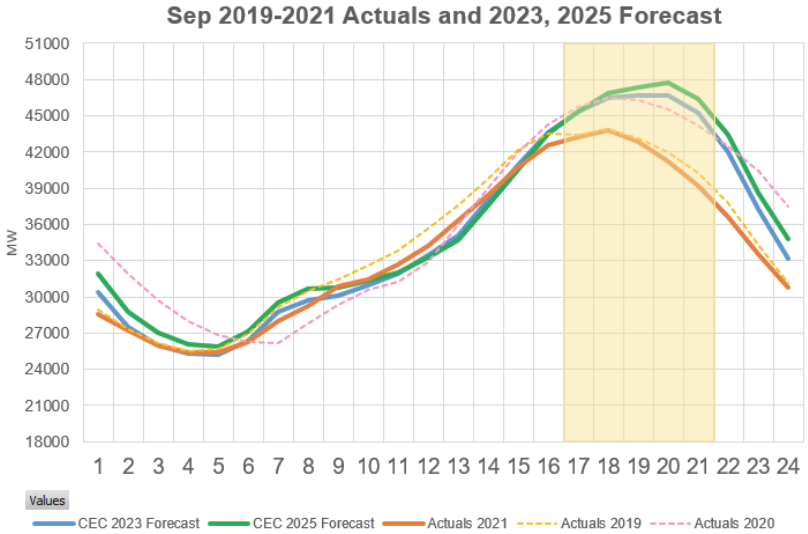


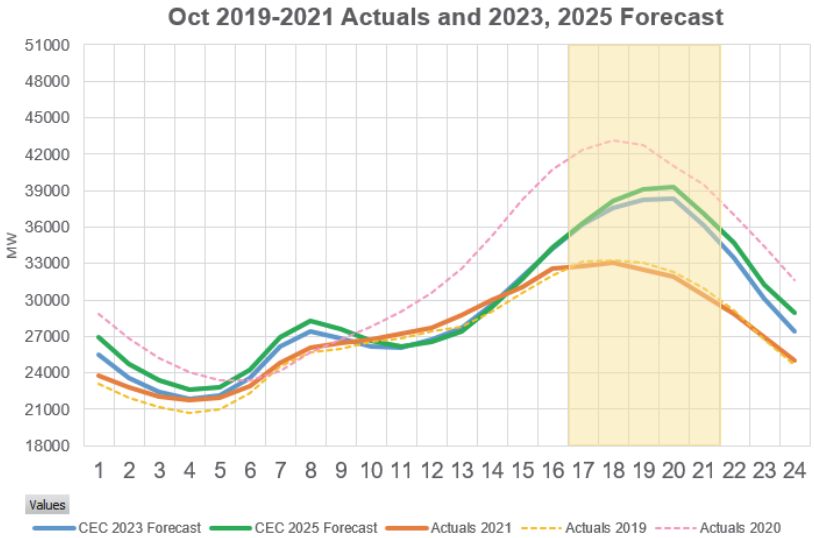




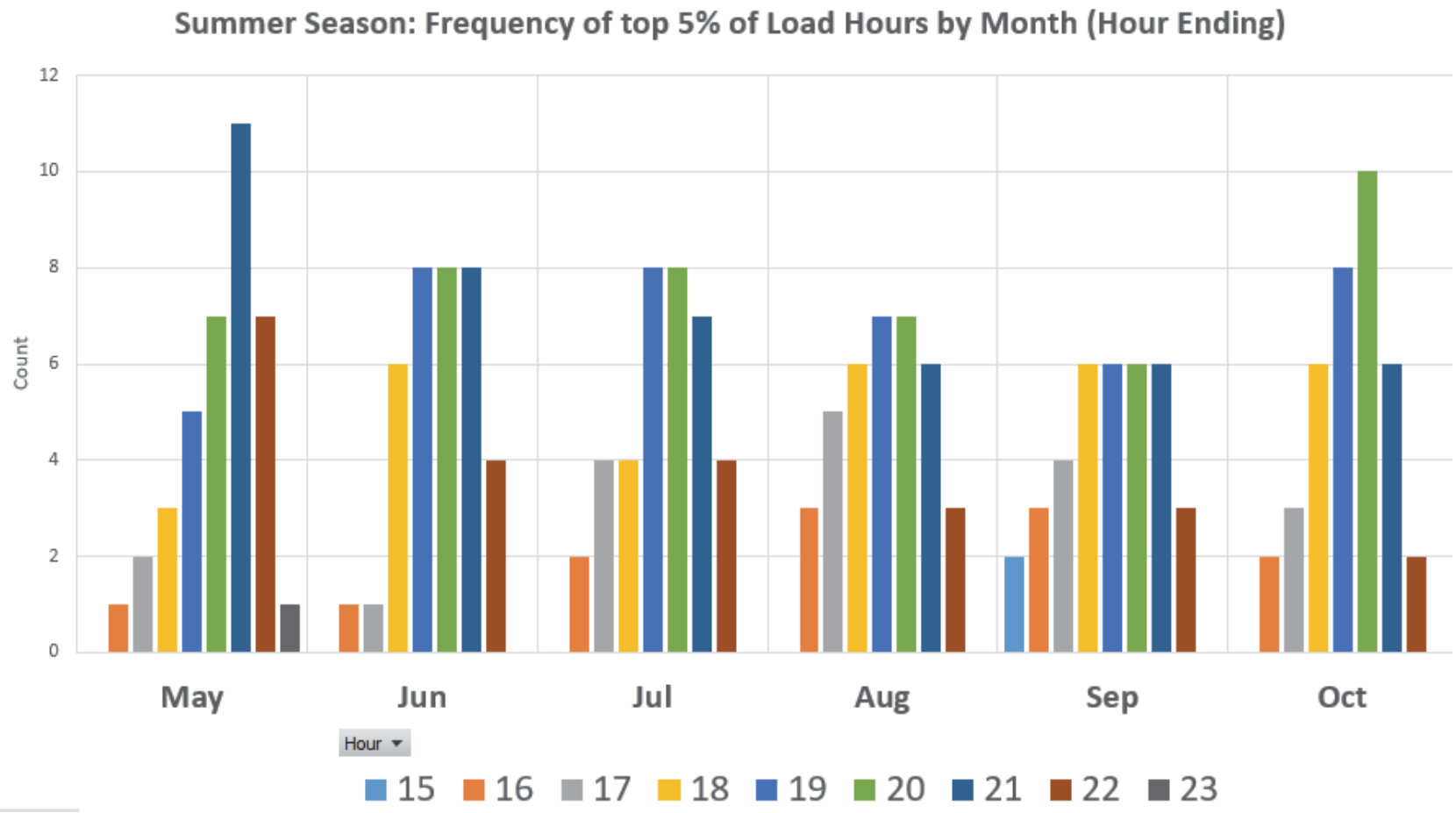
Expected load shape evolution: Summer season



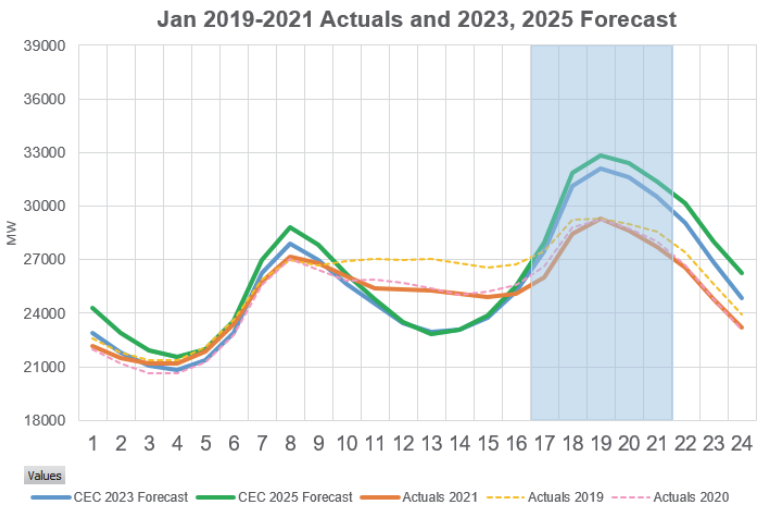


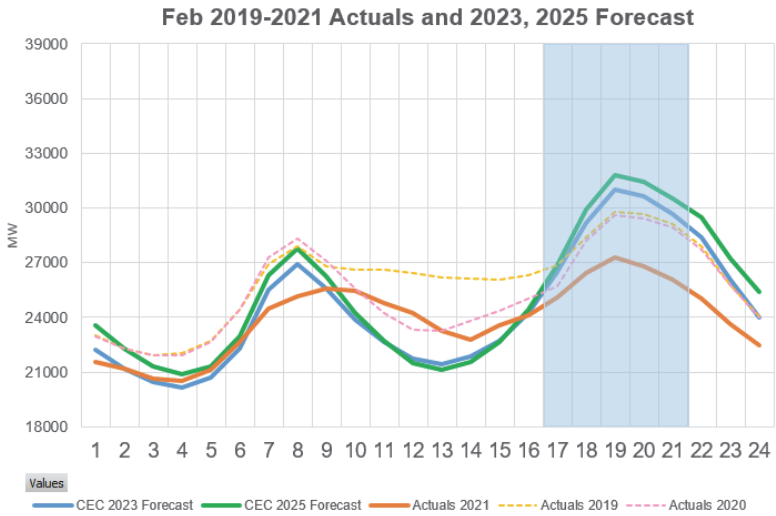


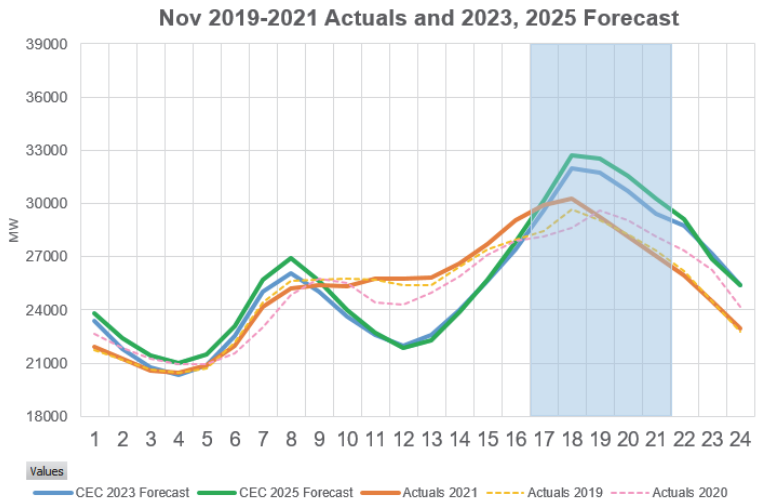
Summer Season
2023 top 5% of load hours (in HE)

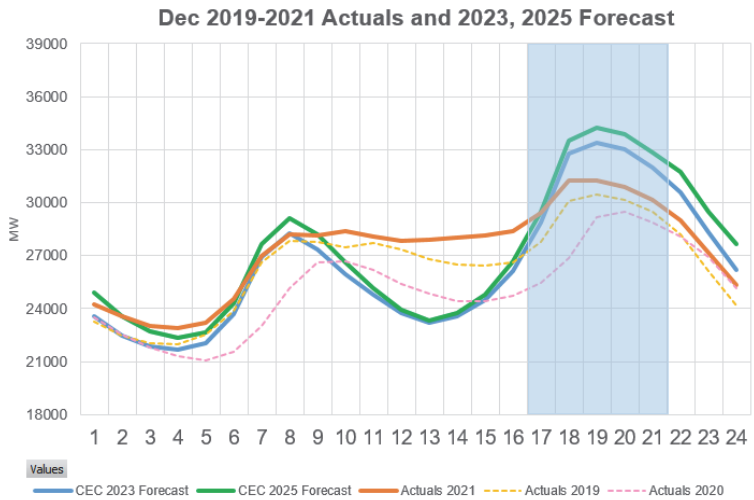


Expected load shape evolution: Winter season

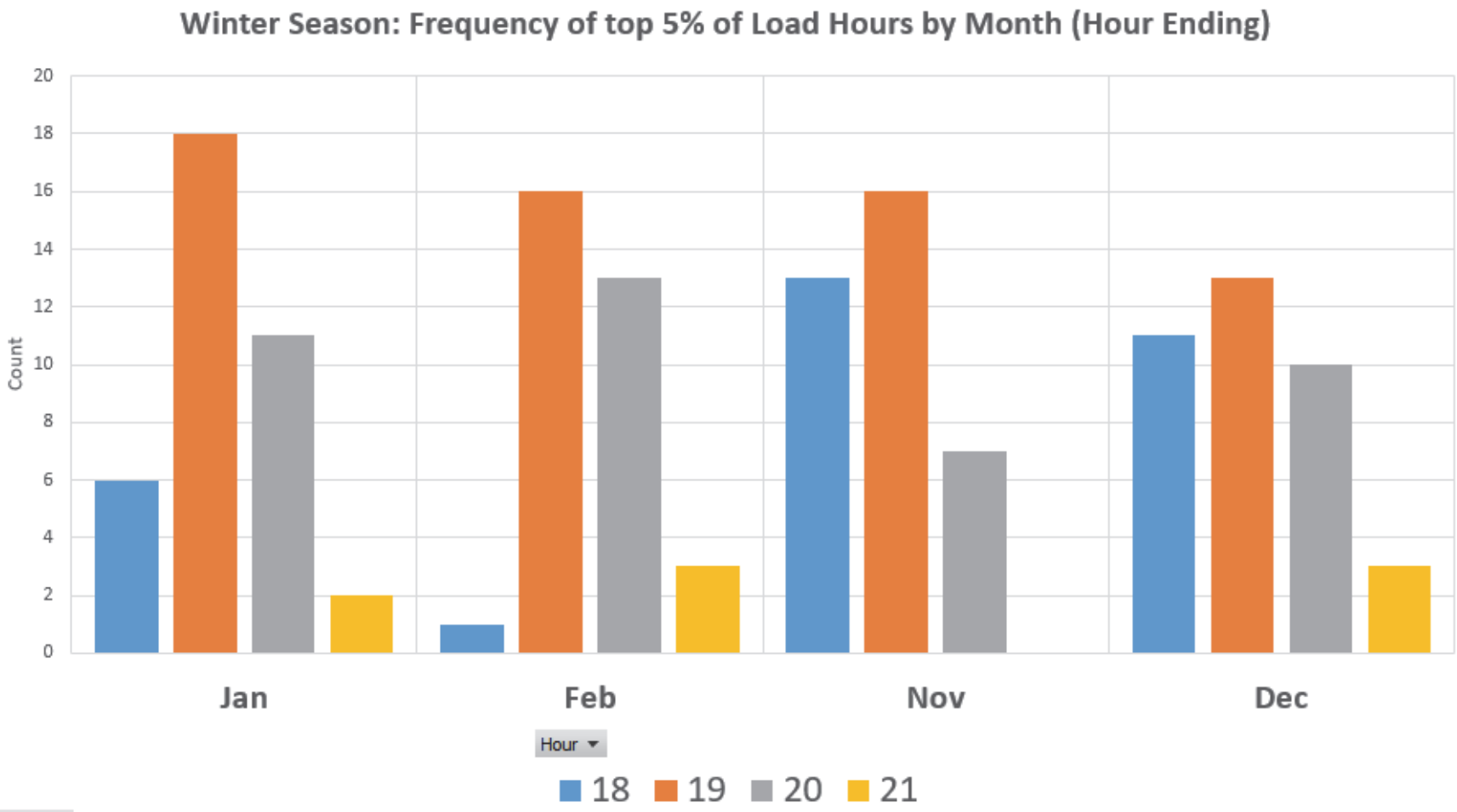








Winter Season
2023 top 5% of load hours (HE)



Availability assessment hours final recommendation

Winter and Summer Season Recommendation

Jan-Feb, Nov-Dec; May-Oct

Year	Start	End
2022 (Final)	HE 17	HE 21
2023 (Final)	HE 17	HE 21
2024 (Estimate)*	HE 17	HE 21
2025 (Estimate)*	HE 17	HE 21

* Monitoring May for potential shift to Spring season for 2024-2025

Spring Season Recommendation

Mar-Apr

Year	Start	End
2022 (Final)	HE 17	HE 21
2023 (Final)	HE 18	HE 22
2024 (Estimate)	HE 18	HE 22
2025 (Estimate)	HE 18	HE 22

Reliability Requirements; Section 7 – BPM Updates Needed

2023 System and Local Resource Adequacy Availability Assessment Hours

Analysis employed: Top 5% of load hours using average hourly load

Spring: March 1 – April 30
Availability Assessment Hours: 5pm – 10pm (HE18 – HE22)

Summer: May 1 - October 31
Availability Assessment Hours: 4pm – 9pm (HE17 – HE21)

Winter: November 1 - February 28
Availability Assessment Hours: 4pm – 9pm (HE17 – HE21)

2023 Flexible Resource Adequacy Availability Assessment Hours and must offer obligation hours

Flexible RA Capacity Type	Category Designation	Required Bidding Hours	Required Bidding Days
January – February November – December			
Base Ramping	Category 1	5:00am to 10:00pm (HE6-HE22)	All days
Peak Ramping	Category 2	2:00pm to 7:00pm (HE15-HE19)	All days
Super-Peak Ramping	Category 3	2:00pm to 7:00pm (HE15-HE19)	Non-Holiday Weekdays*
March – August			
Base Ramping	Category 1	5:00am to 10:00pm (HE6-HE22)	All days
Peak Ramping	Category 2	4:00pm to 9:00pm (HE17-HE21)	All days
Super-Peak Ramping	Category 3	4:00pm to 9:00pm (HE17-HE21)	Non-Holiday Weekdays*
September – October			
Base Ramping	Category 1	5:00am to 10:00pm (HE6-HE22)	All days
Peak Ramping	Category 2	3:00pm to 8:00pm (HE16-HE20)	All days
Super-Peak Ramping	Category 3	3:00pm to 8:00pm (HE16-HE20)	Non-Holiday Weekdays*

ATTACHMENT B

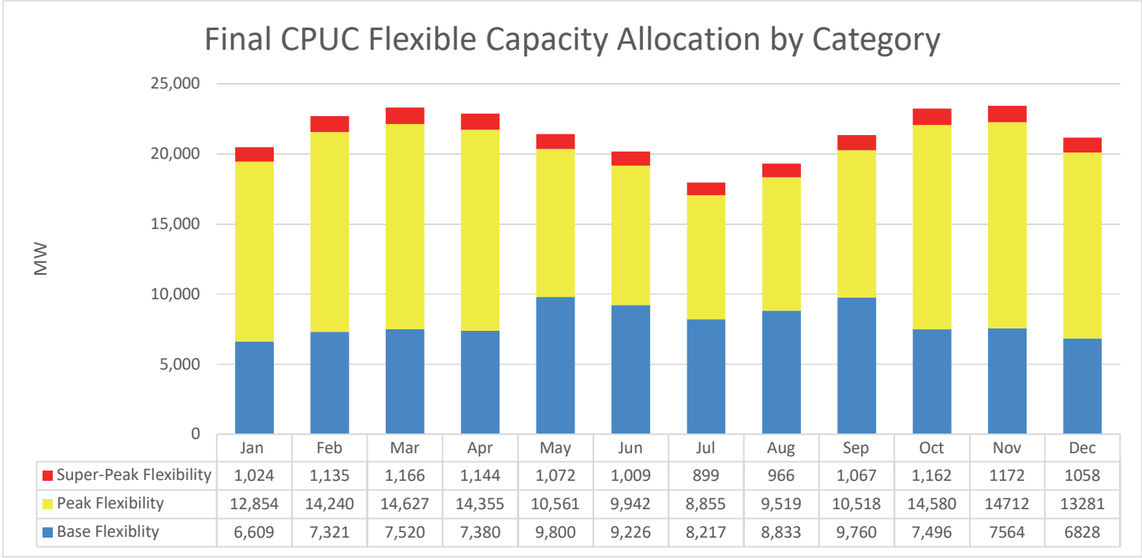
Flexible Capacity Allocation Spreadsheet

Percent contribution to 2023 3-hour net load ramp*

	3-hour net load ramp 2023	Reserve 2023	Flex_Req_ 2023	Month	Load contribution 2023	Solar PV contribution 2023	Wind contribution 2023	Total percent 2023
1	20357	1150	21,507	1	45%	-53%	-2%	100%
2	22665	1150	23,815	2	36%	-63%	-1%	100%
3	23475	1150	24,625	3	36%	-62%	-1%	100%
4	23092	1159	24,250	4	37%	-61%	-2%	100%
5	21458	1299	22,757	5	32%	-63%	-4%	100%
6	19913	1490	21,403	6	30%	-69%	-1%	100%
7	17430	1604	19,034	7	25%	-78%	3%	100%
8	18832	1619	20,451	8	29%	-73%	3%	100%
9	20790	1647	22,437	9	31%	-68%	-1%	100%
10	23087	1355	24,443	10	33%	-67%	-1%	100%
11	23582	1150	24,732	11	38%	-60%	-2%	100%
12	21148	1174	22,321	12	43%	-57%	0%	100%

	2023						
	Δ PV Fixed	Δ Wind	Δ Load MW	Peak Load Ration Share 2023	Δ PV Fixed MW	Δ Wind MW	Net Load Allocation MW
Jan	94.17%	94.52%	8966	90.07%	-10142	-344	19452
Feb	94.11%	94.56%	7913	90.07%	-13499	-248	21661
Mar	93.71%	94.28%	8286	90.07%	-13681	-310	22277
Apr	93.73%	94.33%	8197	90.07%	-13174	-464	21835
May	93.73%	94.34%	6667	90.07%	-12737	-860	20263
Jun	93.55%	94.19%	5715	90.07%	-12856	-264	18835
Jul	93.70%	94.37%	4307	90.07%	-12714	495	16526
Aug	93.91%	94.45%	5378	90.07%	-12961	480	17859
Sep	94.12%	94.56%	6356	90.07%	-13338	-168	19862
Oct	94.54%	94.67%	7293	90.07%	-14584	-140	22017
Nov	94.69%	94.60%	8672	90.07%	-13325	-416	22413
Dec	94.79%	94.58%	8598	90.07%	-11489	-23	20110

Reserve 2023	Peak Load Ration Share 2023	Reserve Share	Total Allocation
1150	90.07%	1036	20488
1150	90.07%	1036	22696
1150	90.07%	1036	23313
1159	90.07%	1044	22879
1299	90.07%	1170	21433
1490	90.07%	1342	20177
1604	90.07%	1445	17971
1619	90.07%	1458	19318
1647	90.07%	1484	21346
1355	90.07%	1221	23238
1150	90.07%	1036	23449
1174	90.07%	1057	21168



Cat 1 non-summer	0.322583
Cat 1 summer	0.457243

	Base Category percent	Base Flexiblity	Peak Flexibility	Super-Peak Flexibility	Total
Jan	32%	6,609	12,854	1,024	20,488
Feb	32%	7,321	14,240	1,135	22,696
Mar	32%	7,520	14,627	1,166	23,313
Apr	32%	7,380	14,355	1,144	22,879
May	46%	9,800	10,561	1,072	21,433
Jun	46%	9,226	9,942	1,009	20,177
Jul	46%	8,217	8,855	899	17,971
Aug	46%	8,833	9,519	966	19,318
Sep	46%	9,760	10,518	1,067	21,346
Oct	32%	7,496	14,580	1,162	23,238
Nov	32%	7564	14712	1172	23449
Dec	32%	6828	13281	1058	21168

ATTACHMENT C

Notice of Availability

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Refinements, and Establish Forward Resource Adequacy Procurement Obligations.	Rulemaking 19-11-009 (Filed November 7, 2019)

CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION NOTICE OF AVAILABILITY FINAL 2023 FLEXIBLE CAPACITY NEEDS ASSESSMENT AND FINAL 2023 AVAILABILITY ASSESSMENT HOURS

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dzlotlow@caiso.com

Attorneys for the California Independent
System Operator Corporation

Dated: May 17, 2022

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations	Rulemaking 21-10-002 (Filed October 7, 2021)

CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION
NOTICE OF AVAILABILITY
FINAL 2023 FLEXIBLE CAPACITY NEEDS ASSESSMENT AND
FINAL 2023 AVAILABILITY ASSESSMENT HOURS

Pursuant to the December 2, 2021 Assigned Commissioner's Scoping Memo and Ruling and the April 28, 2022 Administrative Law Judge E-mail Ruling Modifying Schedule for Flexible Capacity Requirement Issues, the California Independent System Operator Corporation (CAISO) provides notice to the service list for Rulemaking 21-10-002 that its 2023 Final Flexible Capacity Needs Assessment, which includes 2023 Final Availability Assessment Hours, has been posted publicly on the CAISO's website.

The 2023 Final Flexible Capacity Needs Assessment is included in the CAISO's filing as Attachment A and is also available at: http://www.caiso.com/InitiativeDocuments/Final2023FlexibleCapacityNeedsAssessment.pdf. In addition to providing the assessment, the CAISO's filing also includes as Attachment B a spreadsheet that reflects how much total flexible capacity should be allocated amongst the Commission's jurisdictional load serving entities.

The 2023 Flexible Capacity Needs Assessment and 2023 Availability Assessment Hours have been vetted through the CAISO's annual flexible capacity needs assessment stakeholder process.[1] The CAISO posted a draft Final Flexible Capacity Needs Assessment and draft 2023

[1] See CAISO Flexible capacity needs assessment – 2023 stakeholder page here: https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Flexible-capacity-needs-assessment-2023

Availability Assessment Hours on April 14, 2022. The draft Availability Assessment Hours proposed the creation of an additional "spring" season for March and April 2023-2025. The CAISO received three stakeholder comments[2] on the draft report and draft assessment hours on April 28, 2022, with no objections to the addition of a new spring season. There were no changes to the 2023 flexible capacity requirements or allocations between the draft and final reports. In addition, the recommendation for the 2023 Availability Assessment Hours remains the same in the final report as in the draft presentation.

The CAISO recommends the Commission allocate the total 2023 flexible capacity requirements reflected in Attachment B amongst its jurisdictional load serving entities and looks forward to consulting with the Commission as the CAISO establishes the 2023 availability assessment hours.

Respectfully submitted,

By: *<u>/s/ David S. Zlotlow</u>*

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[2] See stakeholder comments on draft Final Flexible Capacity Needs Assessment and draft 2023 Availability Assessment Hours here: https://stakeholdercenter.caiso.com/Comments/AllComments/9b5da24e-252f-46c4-b15e-be4478491c8c