Final 2014 Flexible Capacity Needs Assessment

May 1, 2014

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1. Introduction

The ISO committed in its Flexible Resource Adequacy Criteria and Must-Offer Obligation ("FRAC-MOO") stakeholder initiative and in the CPUC annual Resource Adequacy proceeding (R.11-10-023) to conduct an annual flexible capacity needs assessment. In fulfillment of this commitment, the ISO presents this final flexible capacity needs assessment outlining the ISO's forecast flexible capacity needs in 2015. The ISO presented the preliminary findings at the CPUC's April 9, 2014 Resource Adequacy workshop (proceeding R.11-10-023), hosted a conference call to review the results with all stakeholders on April 18, 2014, and received comments from stakeholders on April 25, 2014. The ISO addresses these comments throughout this final flexible capacity needs assessment.

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

The ISO will use these results to allocate shares of the system flexible capacity[1] need to each of the LRAs responsible for load in the ISO balancing authority area consistent with the allocation methodology detailed in the ISO's FRAC-MOO Revised Draft Final Proposal, section 5.1.2.[2] The ISO will provide each Local Regulatory Authority with its share of the ISO's flexible capacity need.

2. Summary

The ISO determines the quantity of flexible capacity needed to reliably address the various flexibility and ramping needs for the upcoming resource adequacy year and publishes this finding through this flexible capacity needs assessment. To calculate the flexible capacity needs, the ISO uses the calculation method developed in the Flexible Resource Adequacy Criteria and Must-Offer Obligation stakeholder initiative.[3] This methodology includes ISO determining seasonal amounts of three flexible capacity categories as well as seasonal must-offer obligations for two of these flexible capacity categories.

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[1] The ISO's tariff filing on the flexible resource adequacy criteria and must-offer obligation will include provisions to implement the defined categories, and is subject to approval by the Federal Energy Regulatory Commission.

[2] The FRAC-MOO revised Draft Final Proposal is available at http://www.caiso.com/Documents/RevisedDraftFinalProposal-FlexibleRACriteriaMustOfferObligation-Clean.pdf

[3] Other LRAs are not discussed due to confidentiality concerns.

The following is a summary of the results of the ISO's flexible capacity needs assessment for 2015.

1) System-wide flexible capacity needs are greatest in the non-summer months and range from 7,520 MW in May to 11,212 MW in December.

2) The minimum amount of flexible capacity needed from the "base flexibility" category is 68 percent of the total amount of flexible capacity in the summer months (May – September) and 74 percent of the total amount of flexible capacity for the non-summer months (October – April).

3) The ISO will establish 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 7:00 a.m. to 12:00 p.m. during May through September, and 3:00 p.m. to 8:00 p.m. during January through May and October through December.

3. Defining the ISO System-Wide Flexible Capacity Need

Based on the methodology described in the ISO's FRAC-MOO Revised Draft Final Proposal and the ISO's April 5, 2013 filing in the CPUC RA proceeding (R.11-10-023), 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

ε = Annually adjustable error term to account for load forecast errors and variability methodology

For the 2015 RA compliance year, the ISO will continue to set 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) Forecast minute-by-minute net-load using all expected and existing wind and solar resources and the most recent year of actual load, as adjusted for load growth

2) Calculate the monthly system-level 3-hour net-load ramps needs using forecast minute-to-minute net-load forecast;

3) Calculate the percentages needed in each category in each month;

   a. Add the contingency requirements into the categories proportionally to the percentages established calculated in step 3

4) Analyze the distributions of both largest three-hour net-load ramps for the primary and secondary net load ramps to determine appropriate seasonal demarcations;

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

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

The methodology employed by the ISO to assess the flexible capacity need for 2014 is specified in the ISO's FRAC-MOO revised draft final proposal and is comparable to the methodology proposed in the 2013 assessment. This methodology is also described in detail in the ISO's Initial Comments on Workshop issues filed at the CPUC in the resource adequacy proceeding on April 5, 2013.[4] However, this methodology allows the ISO make enhancements and assumptions as new information becomes available and experience allows. Based on experience gained through the previous iteration of this study process, the ISO has made minor enhancements to the methodology used for the 2014 Flexible Capacity Needs Assessment. The following section details the methodology employed by the ISO as well as the assumptions used and their implication on the results.

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 about the expected build-out of the fleet of variable energy resources. Once this data was collected from all LSE's the ISO constructed the forecast minute-by-minute net load curves for 2015 and 2016. This section provides details on the data collection process and the development of the net load curves.

4.1 Building the Forecasted Variable Energy Resource Portfolio

To collect this data, the ISO sent a data request on March 6, 2014 to the scheduling

[4] Available at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M064/K140/64140277.PDF

coordinators for all LSEs representing load in the ISO balancing area. This data request asked for information on each wind, solar, and distributed wind and solar resource that is owned, in whole or in part, by the Load Serving Entity or under contractual commitment to the Load Serving Entity for all or a portion of its capacity. As part of the data request, the ISO asked for information on resources internal and external to the ISO. For resources that are external to the ISO, additional information was requested as to whether the resource is or will be a dynamic system resource or pseudo-tie resource. The ISO only included external resources in the flexible capacity requirements assessment if they were dynamic system resources or pseudo-tie resources. Conversely, in the flexible capacity assessment conducted in 2013, the ISO assumed all external variable energy resources were dynamically scheduled into the ISO.

The ISO received responses from most of the scheduling coordinators it sent the data request to, representing the vast majority of load in the ISO balancing area. Based on ISO review of these submissions, it appears that the information submitted in response to the data request represents all wind, solar, and distributed wind and solar resources that are owned, in whole or in part, by the Load Serving Entity or under contractual commitment to the Load Serving Entity for all or a portion of its capacity within the ISO balancing area.

Using the LSEs' data, the ISO simulated the variable energy resources' output to produce forecast minute-by-minute net-load curves[5] for 2015 and 2016. The forecasted aggregated variable energy resource fleet capacity is provided in Table 1.

Table 1: Total ISO System Variable Energy Resource Capacity (Net Dependable Capacity-MW)[6]

Resource Type	Existing (2013) MW	2014 MW	2015 MW	2016 MW
ISO Solar PV	4,173	4,504	5,700	6,200
ISO Solar Thermal	419	1,058	1,183	1,183
ISO Wind	5,351	5,728	5,578	5,578
Distributed PV	1,280	1,971	2,353	2,740
Total Variable Energy Resource Capacity in the 2014 Flexible Capacity Needs Assessment[7]	*11,223*	*13,261*	*14,814*	*15,701*
Non ISO Resources All external VERS firmed by external BAA	398	398	398	398
Total internal and external VERs	11,621	13,659	15,212	16,099
Incremental New Additions in Each Year		2,038	1,553	887
Final estimated Variable Energy Resource Capacity used in the 2013 Flexible Capacity Needs Assessment (for comparison purposes)	11,906	14,374	15,779	17,382

5 Net-load load is defined as load minus wind minus solar.

6 Data shown is for December of the corresponding year. Variable energy resources have been aggregated across the ISO system to avoid concerns regarding the release of confidential information.

7 Includes all internal and dynamically scheduled variable energy resources

While Table 1 aggregates the variable energy resources system wide, the ISO conducted the assessment using location-specific information. This ensured that the assessment captured the geographic diversity benefits. Additionally, for existing solar and wind resources, the ISO used the most recent full year of actual solar output data available, which was 2013. For future wind resources, the overall wind production for each minute of the most recent year was scaled by the expected future capacity divided by the installed wind capacity of the most recent year. Specifically, to develop the wind profiles for wind resources, the ISO used the following formula:

$$2014\ W_{1\text{-}min} = 2013W_{Actual\_1\text{-}min} * 2014W_{Installed\ Capacity}/2013W_{Installed\ Capacity}$$

Given the small amount of incremental wind resources coming on line, this approach allows the ISO to maintain the load/wind correlation for over 94% of the forecasted wind capacity output.

In the case of solar resources production profiles, for future years, the ISO assumptions were primarily based on the location of the new resources. If a resource is located in a Competitive Renewable Energy Zone ("CREZ") where similar technologies exist, then the ISO developed an output profile for the new resource that mirrors the output demonstrated by the most current actual solar output data. For example, if there is an existing 50 MW solar PV resource in a CREZ, and a new 25 MW solar PV is scheduled to come on-line during the assessment year in the same CREZ, then the ISO scaled up the output of the 50 MW resources by an additional 50% to account for the new resource. For solar resources located in new CREZs, the ISO developed production profiles using NRELs dataset for specific locations based on expected installed capacity. The ISO used this methodology to maximize the correlation between the load and wind production profiles for a particular year for the vast majority of variable energy resources.

4.2 Building Minute-by-Minute Net Load Curves

The ISO used the CEC 2013 Integrated Energy Policy Report (IEPR) 1-in-2 monthly peak load forecast (Mid Demand Scenario, with no additional achievable energy efficiency) to develop minute-by-minute load forecasts for each month. The ISO scaled the actual load for each minute of each month of 2013 using an expected load growth factor of the monthly peak forecast divided by the actual 2013 monthly peak. This is slightly different from the methodology used in the 2013 assessment in which the same growth rate was applied to each minute of each month. The current methodology results in a lower growth of peak load in the shoulder months as opposed to the same growth rate as the peak month.

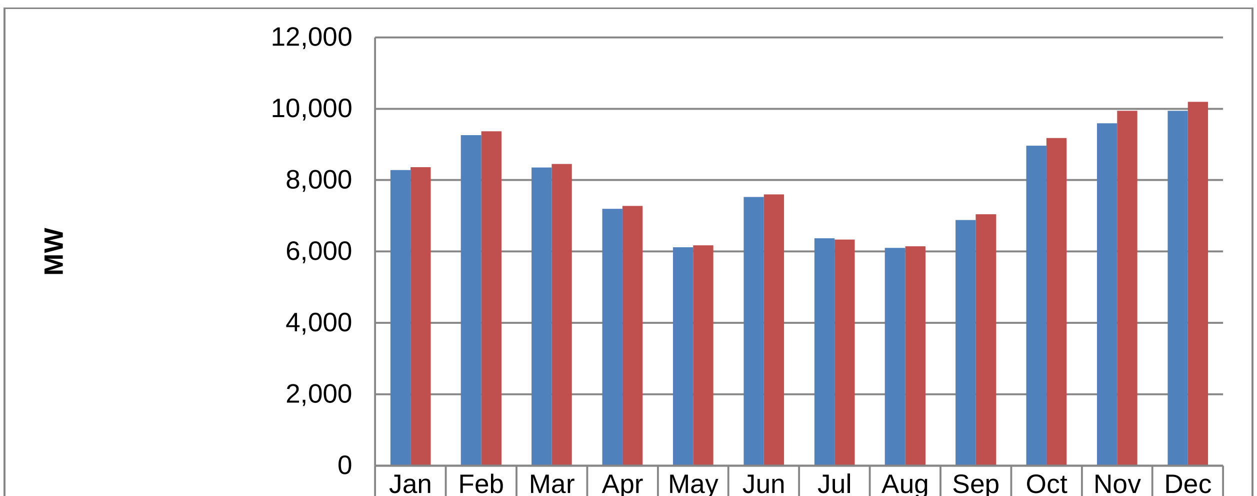
In response to the ISO's Preliminary Flexible Capacity Needs Assessment, Sierra Club asserts that the ISO should include an additional 597 MW of achievable energy efficiency in the assessment of the flexible capacity needs. The ISO used a "no additional achievable energy efficiency scenario.” Integrating resources such as energy efficiency into the ISO flexible capacity needs assessment requires assumptions about how the energy efficiency resource gains affects load on a minute-by-minute basis. For example, while energy efficiency may reduce system peak, further analysis is needed to determine the load shape impacts of any additional achievable energy efficiency or, stated differently, what effect energy efficiency has on the “belly of the duck.”[8] For example, it is likely that a reduction in the net-load at the head of the duck will be matched by a comparable drop in the belly.

With this forecasted load, and expected wind and solar expansions, the ISO developed the minute-by-minute load, wind, and solar profiles. These profiles are aligned and the output of the wind and solar resources are subtracted from the load to generate the minute-by-minute net-load curves necessary to conduct the flexible capacity needs assessment.

5. Calculating the Monthly Maximum Three-Hour Net-Load Ramps Plus 3.5 Percent Expected Peak-Load

The ISO, using the net-load forecast developed in Section 4, calculated the maximum three-hour net-load ramp for each month. The ISO system-wide, largest three-hour net-load ramps for each month are detailed in Figure 1.

Figure 1: ISO System Maximum 3-hour Net-Load Ramps



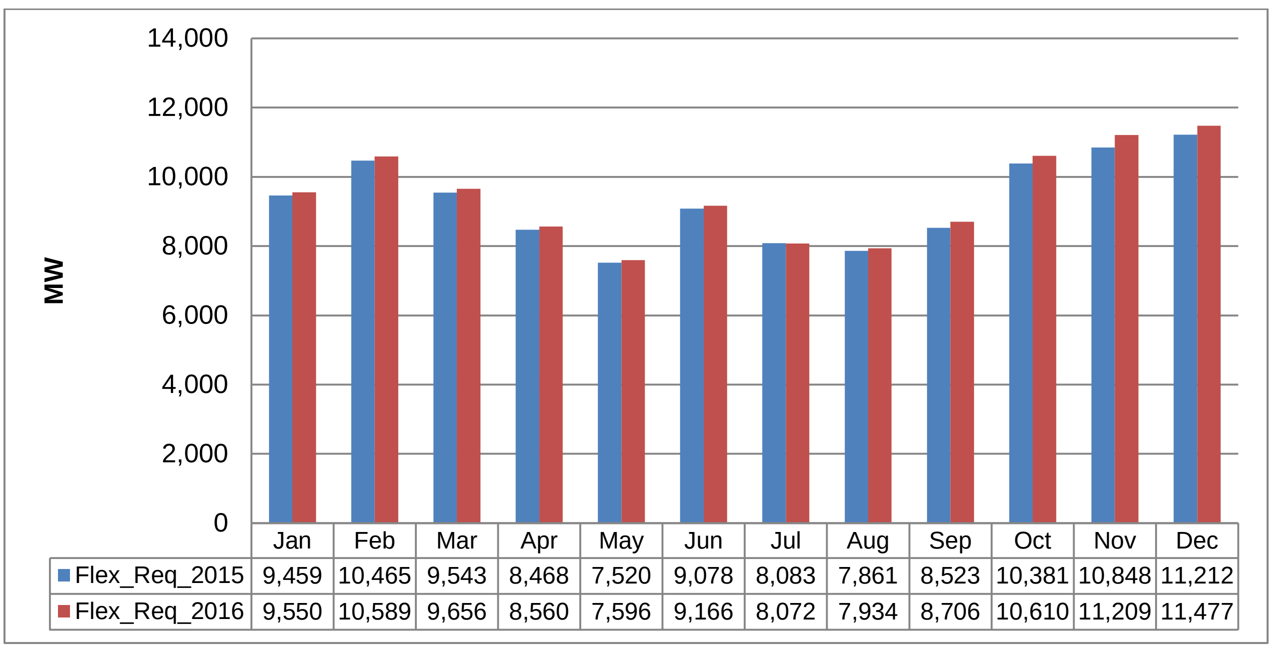
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max of 3_hr_ramp_2015	8286	9257	8351	7198	6117	7530	6366	6098	6881	8965	9595	9940
Max of 3_hr_ramp_2016	8363	9367	8450	7275	6176	7600	6334	6150	7044	9177	9940	10190

[8] For example, it is likely that a reduction in the net load at the head of the duck will be matched by a comparable drop in the belly. This would result in no reduction of the three-hour maximum net-load ramps.

The results for the non-summer months of 2014 are lower than predicted in the previous forecast the ISO made for 2014 in the flexible capacity need study it conducted in 2013. This is due, at least in part, to lower than forecast variable energy resource additions as shown in Table 1, above. These lower than forecast variable resource additions has also reduced the year-over-year increases shown relative to the 2013 assessment (i.e. smaller increases between 2015 and 2016 when compared with the 2013 study). As noted above in section 4.2, the ISO used the CEC 2013 IEPR 1-in-2 monthly peak load forecast to develop minute-by-minute load forecasts for each month. The 2013 IEPR forecast shows higher peak summer load in 2015 than the 2012 IEPR forecast. This higher forecast peak load during summer months corresponds with the increased largest 3-hour contiguous ramps. Additionally, the ISO system experienced extreme temperatures in late June 2013 that lasted almost an entire week. The 3-hour needs for June are set based on extreme morning ramping needs to address steep increases in load during this heat wave. As such, June, in particular, shows a significant increase from the 2013 flexible capacity assessment.

Finally, the ISO summed the monthly largest three hour contiguous ramps and 3.5 percent of the forecast peak-load for each month.[9] This sum yields the ISO system-wide flexible capacity needs for 2015 and 2016. These totals are shown in Figure 2 below.

Figure 2: ISO System Maximum 3-Hour Net-Load Ramps Plus 3.5 Percent of Forecast Peak Load



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flex_Req_2015	9,459	10,465	9,543	8,468	7,520	9,078	8,083	7,861	8,523	10,381	10,848	11,212
Flex_Req_2016	9,550	10,589	9,656	8,560	7,596	9,166	8,072	7,934	8,706	10,610	11,209	11,477

[9] The most sever single contingency was always less than 3.5 expected peak-load.

6. Calculating the Seasonal percentages Needed in Each Category

As described in ISO's FRAC-MOO Revised Draft Final Proposal, sections 5.2-5.5, the ISO has 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 define 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 under the "Base Flexibility" category and may only be counted under the "Peak Flexibility" or "Super-Peak Flexibility categories, depending on their characteristics. While there is no limit to the amount of resources that meet the "Base Flexibility" criteria that can be used to meet the system's flexible capacity, there is 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. This section describes the ISO's calculation of these maximum amounts.

These flexible capacity categories determined as follows:

Base Flexibility: Operational needs determined by the magnitude of the largest 3-hour secondary net-load[10] ramp

Peak Flexibility: Operational need determined by the difference between 95 percent of the maximum 3-hour net-load ramp and the largest 3-hour secondary net-load ramp

Super-Peak Flexibility: Operational need determined by five percent of the maximum 3-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 the quantities needed in each flexible capacity category, the ISO conducted a three-step assessment process:

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

[10] The largest daily secondary 3-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 3-hour net-load ramp occurs between 5:00 p.m. and 8:00 p.m., then the largest secondary ramp would be determined by the largest morning 3-hour net-load ramp.

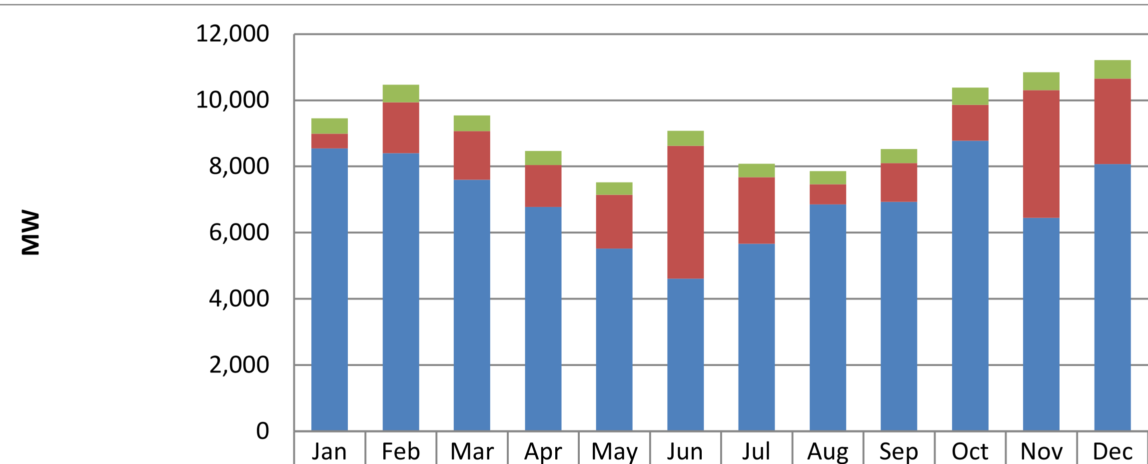
The remainder of this section focuses on ISO's processes for determining the seasonal percentages needed in each category.

In comments AReM states that the ISO not only needs to publish an Effective Flexible Capacity (EFC) list, but it should also indicate what categories of flexible capacity a resource can provide. The ISO will publish an EFC list, but will rely on the resource owners to determine what category or categories of flexible capacity may be appropriate for their resource and what must-offer obligation they are willing to accept.

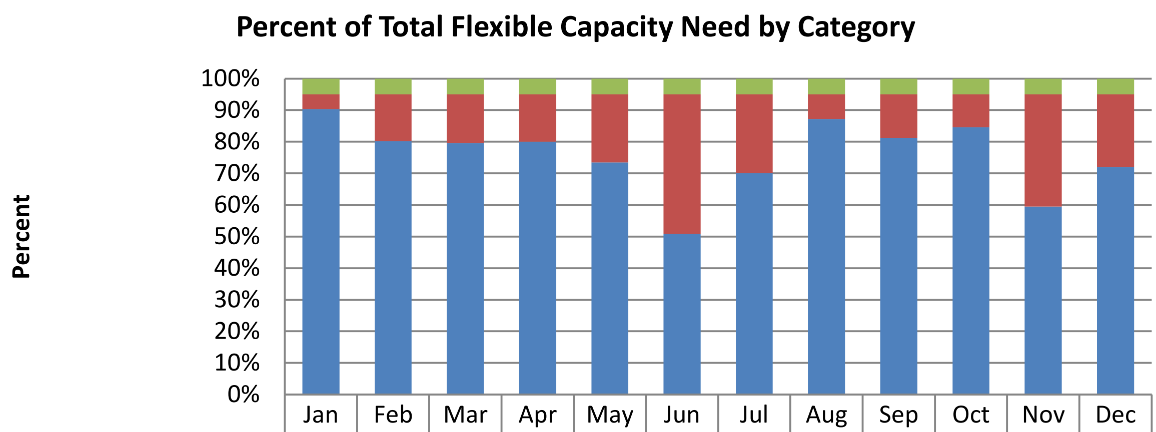
6.1 Calculating the Forecast Percentages Needed in Each Category in Each Month

Based on the categories defined above, the ISO calculated the system level needs for 2015 based only on the maximum monthly 3-hour net-load calculation. Then the ISO calculated the quantity needed in each category in each month based on the above descriptions. The ISO then added the contingency requirements into the categories proportionally to the percentages established by the maximum 3-hour net load ramp. For example, for the month of January, the ISO added 90 percent of the contingency reserves portion into the category 1, 5 percent into category 2, and the final 5 percent into category 3. The calculation of flexible capacity needs for each category is shown in Figure 3.

Figure 3: ISO System-Wide Flexible Capacity Monthly Calculation by Category for 2015



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	473	523	477	423	376	454	404	393	426	519	542	561
Peak Flexibility	442	1,545	1,467	1,270	1,622	4,006	2,008	609	1,170	1,086	3,855	2,580
Base Flexibility	8,544	8,397	7,598	6,775	5,521	4,618	5,671	6,858	6,928	8,776	6,451	8,072



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Peak Flexibility	5%	15%	15%	15%	22%	44%	25%	8%	14%	10%	36%	23%
Base Flexibility	90%	80%	80%	80%	73%	51%	70%	87%	81%	85%	59%	72%

6.2 Analyzing Ramp distributions to Determine Appropriate Seasonal Demarcations

To determine the seasonal percentages for each category, the ISO analyzed the distributions of both 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 that is needed. While this year’s assessment focused on the data produced in this study process, the ISO also referred back to last year’s assessment to confirm that the patterns persist. The primary and secondary net-load ramp distributions are shown for each month in figures 4 and 5 respectively.

Figure 4: Distribution of Daily Primary

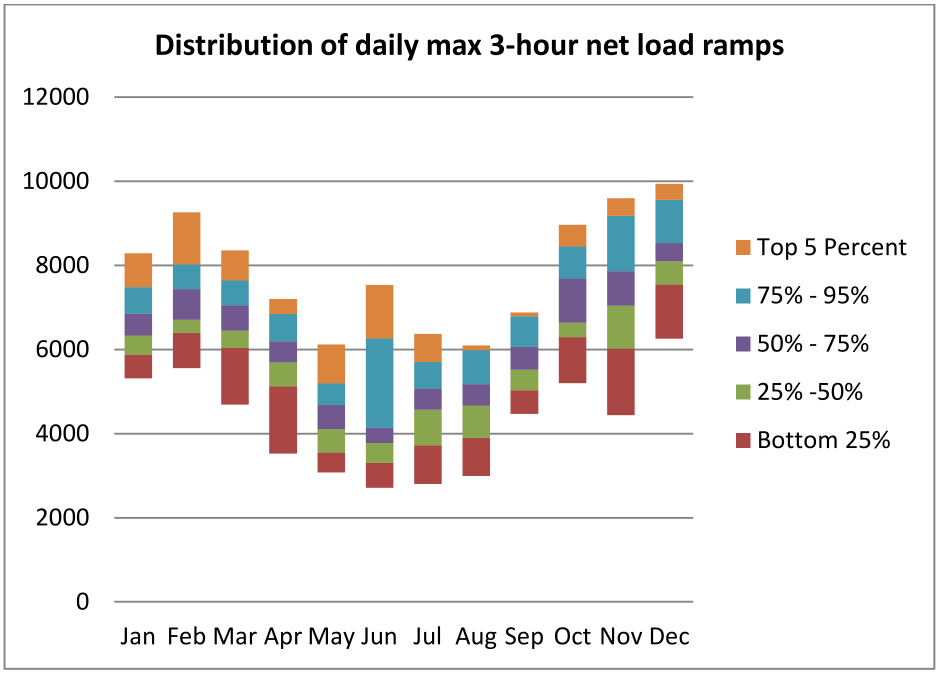
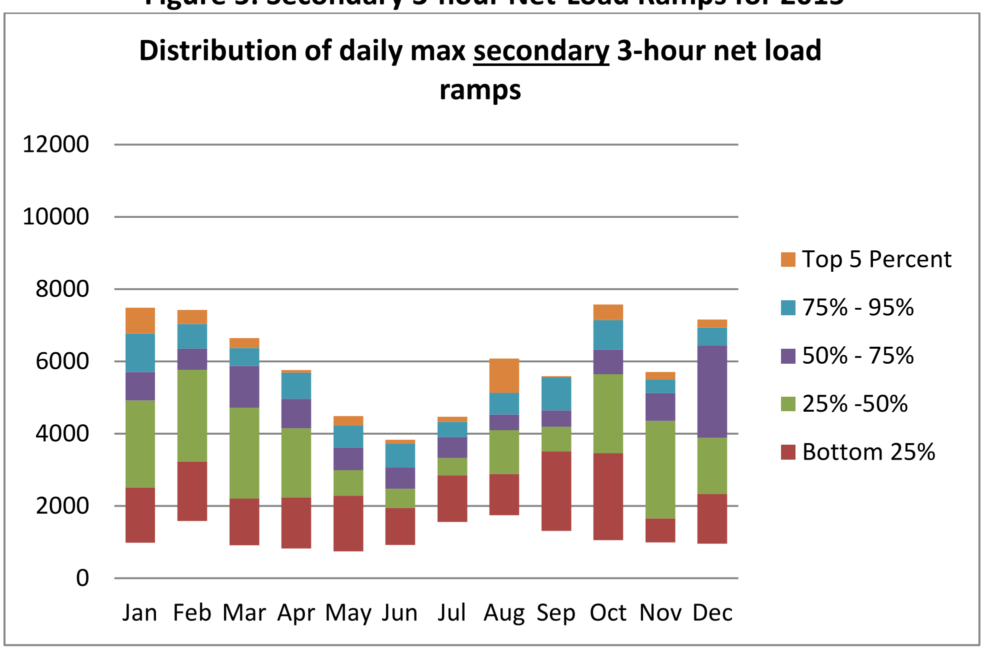


Figure 5: Secondary 3-hour Net-Load Ramps for 2015



As Figure 5 shows, the distribution (i.e. the width of the distribution for each month) of the daily maximum 3-hour net-load ramps is reasonably consistent across the year. However, the same cannot be said for the daily secondary 3-hour net load ramps. This distribution indicates two things. First, given the breadth of this distribution, it is unlikely that all base flexible capacity resources will be used for two ramps every day. The base flexibility resources were designed to address days with two separate significant net load ramps. The distributions of these secondary net-load ramps indicates that the ISO need not set seasonal percentages in the base flexibility category at the percentage of the higher month within that season. Second, because there are still numerous bimodal ramping days in the distribution, many of the base flexibility resources will still be needed to address bimodal ramping needs. Accordingly, the ISO cannot discount this level too much.

Figure 3 does not show any clear delineation that would allow the year to be partitioned into seasons for purpose of seasonal allocations. However, Figure 5 shows a distinct seasonal difference. In that regard, the distributions of the secondary net-load ramps from May through September are much more compact than the secondary net-load ramps in the other months. This distribution change is a reflection of changes in the seasons and weather patterns. Accordingly, the ISO proposes to divide the flexible capacity needs contribution into two seasons that mirror the existing summer (May through September) and non-summer (January through April and October through December) seasons used for resource adequacy.[11] 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 a given 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 conditions, it is reasonable to breakout the flexibility categories by season. Because the main differences in weather in the ISO system are between the 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.

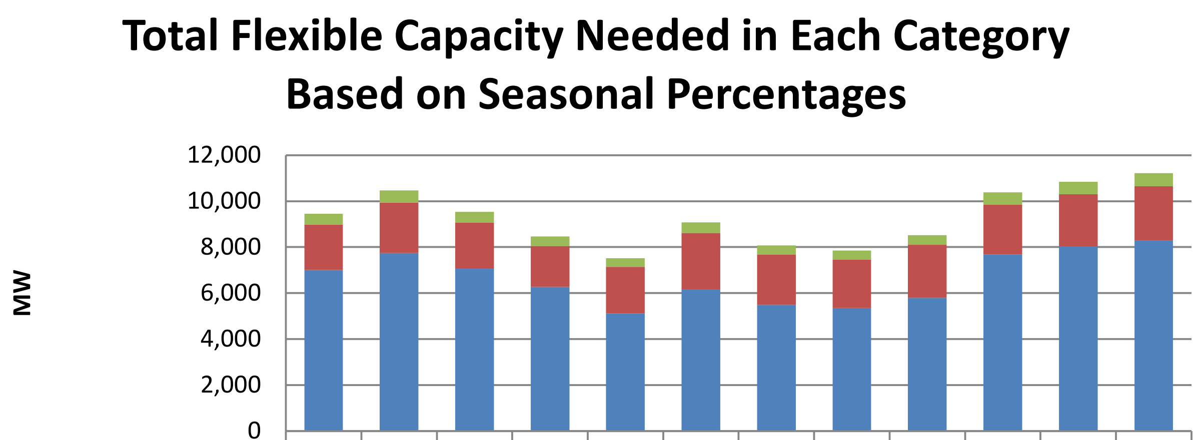
6.3 Calculate a simple average of the percent of base flexibility needs from all months within a season

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 68

[11] The ISO also reviewed the results of the initial calculations for categories used in the 2013 Flexible Capacity Needs Assessment to determine if the categories aligned with the previous assessment as well.

percent of the ISO system flexible capacity need for the summer months and 74 percent for the non-summer months. Given this proposal, peak flexible capacity resources could be used to fulfill up to 32 percent of summer flexibility needs and 26 percent of non-flexible capacity needs. The super-peak flexibility category is fixed at a maximum five percent across the year. The ISO's proposed system-wide flexible capacity categories are provided in Figure 6.

Figure 6: System-wide Flexible Capacity Need in Each Category for 2015



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	473	523	477	423	376	454	404	393	426	519	542	561
Peak Flexibility	1,986	2,198	2,004	1,778	2,030	2,451	2,182	2,122	2,301	2,180	2,278	2,354
Base Flexibility	6,999	7,744	7,062	6,266	5,114	6,173	5,496	5,345	5,796	7,682	8,028	8,297

7. Allocating the Flexible Capacity Needs to Local Regulatory Authorities

The ISO developed, as part of the FRAC-MOO stakeholder initiative, a methodology for determining the contribution to the system flexible capacity need of the LSEs under each local regulatory authority. The ISO's proposed allocation methodology is based on the contribution of a local regulatory authority's LSEs to the maximum 3-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 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 3-hour net load changes x ISO total change in wind output during the largest 3-hour net load change

4) Δ Solar PV – LRA's average percent contribution to changes in solar PV output during the five greatest forecasted 3-hour net load changes x total change in solar PV output during the largest 3-hour net load change

5) Δ Solar Thermal – LRA's average percent contribution to changes in solar PV output during the five greatest forecasted 3-hour net load changes x total change in solar thermal output during the largest 3-hour net load change

These amounts are combined using the equation below to determine the CPUC's contribution to the flexible capacity need.

Contribution = Δ Load – Δ Wind Output – Δ Solar PV – Δ Solar Thermal + (3.5% * Expected Peak * Peak Load Ratio Share)

The ISO has made available all non-confidential working papers and data that the ISO relied on for the Final 2014 Flexible Capacity Needs Assessment.[12] Specifically, the ISO has released materials and data used for making the monthly flexible capacity needs determination, the CPUC contribution to the change in load, and seasonal determinations for each flexible capacity category. This data is available at http://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleCapacityRequirements.aspx.

Table 2 shows the final calculations of the individual contributions of each of the inputs to the calculation of the maximum 3-hour continuous net-load ramp at a system level. The solar PV and solar thermal components are combined.

[12] The ISO is not able to release CREZ specific data at this time due to data confidentiality.

Table 2: Contribution to Maximum 3-hour Continuous Net-Load Ramp[13]

	Average of Load contribution 2015	Average of solar contribution 2015	Average of Wind contribution 2015	Average of Load contribution 2016	Average of solar contribution 2016	Average of Wind contribution 2016
January	79%	17%	4%	79%	17%	4%
February	71%	27%	3%	71%	27%	3%
March	64%	25%	10%	64%	25%	10%
April	62%	30%	8%	62%	30%	8%
May	53%	35%	12%	53%	35%	12%
June	96%	-8%	13%	96%	-8%	13%
July	111%	-28%	18%	112%	-29%	17%
August	99%	-6%	7%	99%	-5%	7%
September	51%	52%	-3%	51%	52%	-3%
October	62%	32%	6%	65%	28%	8%
November	61%	38%	1%	59%	40%	1%
December	68%	31%	1%	67%	31%	1%

As Table 2 shows, Δ Load is the largest contributor to the net-load ramp during the summer months, where solar resources help to mitigate the need. This is because the most significant net-load ramps occur in the morning during summer months when solar output is increasing and therefore counteracting the ramp attributable to load only. However, in non-summer months, when the largest 3-hour net-load ramps tend to occur in the evenings, solar resources contribution to the 3-hour net load ramps can be significant.

Consistent with the ISO's flexible capacity needs allocation methodology, the ISO used 2013 actual load data to determine each local regulatory authority's contribution to the Δ load component. The ISO calculated minute-by-minute net load curves for the 2013. Then, using the same methodology used for determining the maximum 3-hour continuous net-load ramp described above, the ISO calculated the maximum three-hour net load ramps for 2013 and applied the Δ load calculation methodology described above. The ISO used settlements data to determine the LRA's contribution the Δ load component. This data is generated in 10-minute increments. This number may be the same for some LSEs over the entire hour. The ISO smoothed these observations by using a 60-minute rolling average of the load data. This allowed the ISO to simulate a continuous ramp using actual settled load data.

[13] A given component in the contribution calculation could be increasing or decreasing the three-hour maximum net-load ramp. Therefore, no specific component is capped at 100 percent.

Based on this calculation methodology, the ISO has determined the flexible capacity need caused by CPUC jurisdictional LSEs.[14] Table 3 shows the CPUC jurisdictional LSEs' relative contribution to each of the each of the factors (Δ load, Δ wind output, Δ solar PV, and Δ solar thermal) included in the allocation methodology.

Table 3: CPUC Jurisdictional LSEs' Contribution to Flexible Capacity Needs[15]

		2015			2016		
	Δ Load	Δ PV Fixed	Δ Solar Thermal	Δ Wind	Δ PV Fixed	Δ Solar Thermal	Δ Wind
January	94%	100%	100%	95%	99%	100%	94%
February	95%	100%	100%	87%	99%	100%	86%
March	95%	100%	100%	92%	99%	100%	91%
April	96%	100%	100%	72%	99%	100%	71%
May	96%	100%	100%	83%	99%	100%	82%
June	96%	100%	100%	94%	99%	100%	93%
July	98%	100%	100%	88%	99%	100%	87%
August	98%	100%	100%	69%	99%	100%	68%
September	94%	100%	100%	115%	99%	100%	114%
October	93%	100%	100%	87%	99%	100%	86%
November	96%	100%	100%	75%	99%	100%	74%
December	99%	100%	100%	92%	99%	100%	91%

Finally, the ISO multiplied the flexible capacity needs from Figure 2 and the contribution to each factor to determine the relative contribution of each component at a system level. The resultant numbers are then multiplied by the Local Regulatory Authority's calculated contribution to each individual component. Finally, the 3.5 percent expected peak load times the LRA's peak load ratio share is added.

The ISO, in reviewing the preliminary flexible capacity needs assessment results, identified two items within the flexible capacity needs contribution calculation for CPUC jurisdictional load-serving entities that required modification and adjustments to the CPUC's jurisdictional load-serving entities' contribution as calculated in these final assessment results. First, the ISO identified non-CPUC variable energy resources that were included in the CPUC calculations. These resources have been removed from the CPUC entities' contribution. Second, there was an incorrect cell reference in Excel spreadsheet calculations used for determining the CPUC's

[14] Because the Energy Division proposal states that the CPUC will allocate flexible capacity requirements to its jurisdictional LSEs based on peak load ratio share, the ISO has not calculated the individual contribution of each LSE.

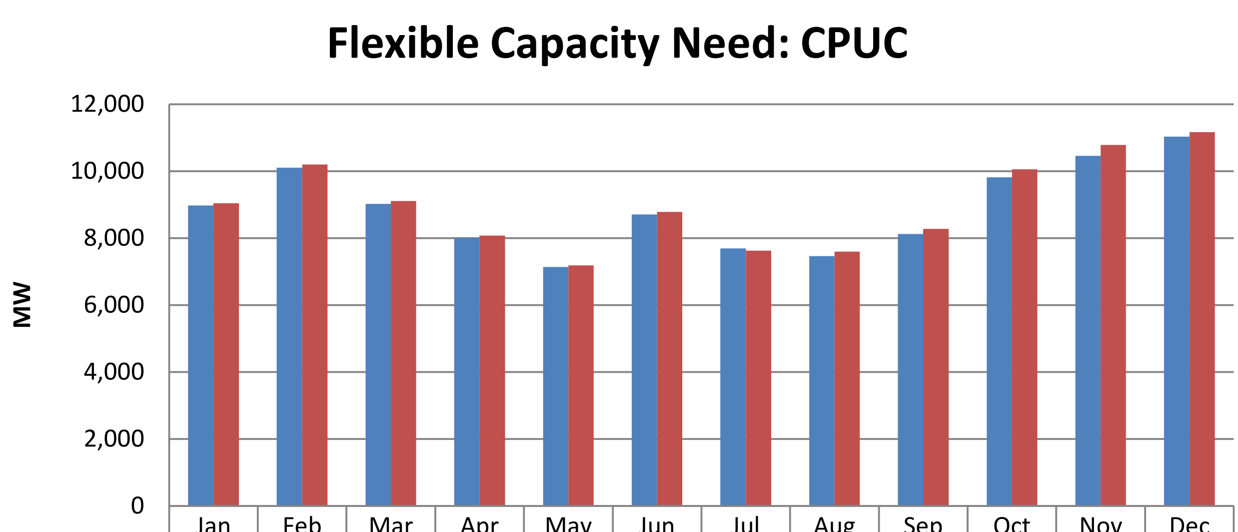
[15] Because of the geographic differences in the output, at some times one LRA's resources are reducing the net-load ramp while another's would be increasing it. As such, no LRA's in a given contribution to a given requirement will be limited to 100 percent.

contribution to Δ Load. Both of these items have been corrected and are reflected in the numbers shown for the CPUC jurisdictional LSEs in Table 4 and Figure 7.

Table 4: CPUC Jurisdictional LSEs' Contribution to Flexible Capacity Needs

	2015					2016				
	Δ Load	Δ Solar	Δ Wind	3.5% expected Peak Load	2015 Total	Δ Load	Δ Solar	Δ Wind	3.5% expected Peak Load	2016 Total
Jan	6,180	1,409	316	1,067	8,972	6,237	1,410	315	1,080	9,043
Feb	6,257	2,499	242	1,100	10,098	6,331	2,508	242	1,112	10,194
Mar	5,081	2,088	772	1,085	9,025	5,141	2,095	772	1,098	9,106
Apr	4,219	2,129	410	1,247	8,006	4,324	2,164	415	1,170	8,073
May	3,103	2,141	613	1,277	7,133	3,133	2,143	611	1,293	7,180
Jun	6,979	-602	922	1,409	8,707	7,044	-603	921	1,426	8,787
Jul	6,899	-1,782	1,014	1,563	7,694	6,927	-1,821	942	1,582	7,629
Aug	5,927	-366	299	1,604	7,465	5,978	-305	297	1,624	7,594
Sep	3,291	3,578	-238	1,495	8,126	3,369	3,632	-242	1,513	8,272
Oct	5,190	2,869	470	1,289	9,817	5,569	2,548	635	1,304	10,056
Nov	5,600	3,646	73	1,141	10,460	5,611	3,943	75	1,155	10,783
Dec	6,704	3,081	92	1,158	11,035	6,772	3,132	93	1,171	11,169

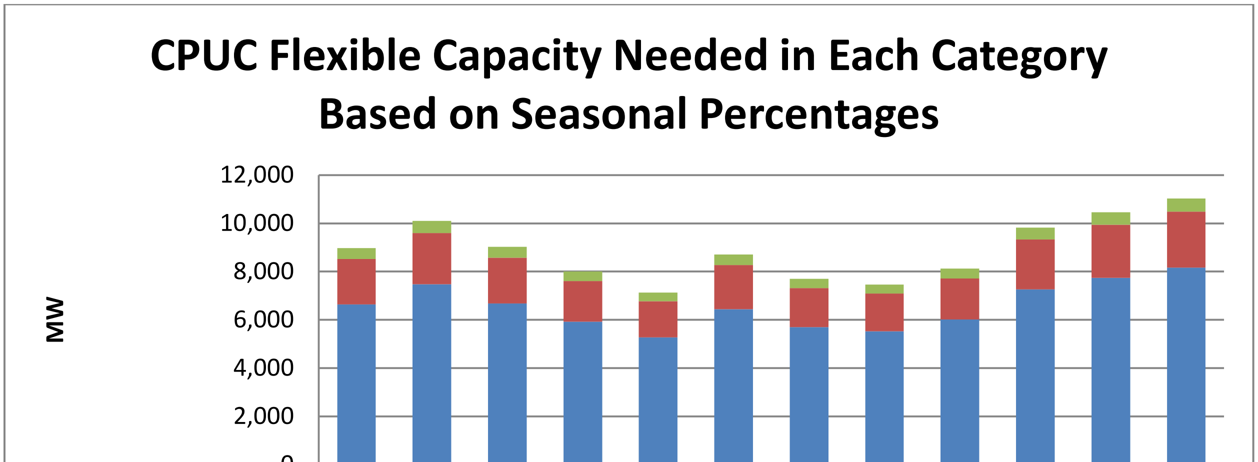
Figure 7: CPUC Jurisdictional LSEs' Contribution to Flexible Capacity Needs



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015 Total	8,972	10,098	9,025	8,006	7,133	8,707	7,694	7,465	8,126	9,817	10,460	11,035
2016 Total	9,043	10,194	9,106	8,073	7,180	8,787	7,629	7,594	8,272	10,056	10,783	11,169

Finally, the ISO applied the seasonal percentage established in section 6 to the CPUC jurisdictional contribution to determine the quantity of flexible capacity needed in each flexible capacity category. These results are detailed in figure 8**.**

Figure 8: CPUC Flexible Capacity Need in Each Category for 2015



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Super-Peak Flexibility	449	505	451	400	357	435	385	373	406	491	523	552
Peak Flexibility	1,884	2,121	1,895	1,681	1,498	1,828	1,616	1,568	1,706	2,062	2,197	2,317
Base Flexiblity	6,639	7,473	6,679	5,924	5,279	6,443	5,693	5,524	6,013	7,265	7,740	8,166

8. Determining the Seasonal Must-Offer Obligations

The ISO's Draft Final Proposal in its stakeholder initiative on flexible resource adequacy criteria and the must-offer obligation also proposed to establish by season the specific hours, comprised of a five-hour period, for which flexible capacity counted in the peak and super-peak categories would be required to submit economic energy bids to the ISO (*i.e.* have an economic bid "must-offer" obligation). Whether the ISO needs peak and super-peak category resources more in the morning or afternoon depends on when the larger of the two ramps occurs. The ISO believes that the average net-load curves for each month provide the most reliable assessment of whether a flexible capacity resource would be greatest benefit in the morning or evening net load ramps. As such, the ISO looked at the average ramp over the day to see if the bigger ramp was in the morning or afternoon and then set the hours for the must-offer obligation accordingly. The ISO calculated the maximum three-hour net load for all months. Table 5 shows the hours in which the maximum monthly average net-load ramp began.

Table 5: Hour in Which Monthly Maximum 3-Hour Net-Load Ramp Began

Month	Starting Hour	Month	Starting Hour
Jan	15	Jul	4
Feb	15	Aug	12
Mar	16	Sep	4
Apr	17	Oct	16
May	17	Nov	14
Jun	4	Dec	14

Given these parameters, the ISO's Draft Final Proposal in its flexible capacity and must-offer obligation stakeholder initiative proposes morning must-offer obligations from May through September and evening must-offer obligations from January through May and October through December.[16] Under the proposal, the ISO will impose a flexible capacity must-offer obligation for peak and super-peak flexible capacity categories for the five-hour periods of 7:00 a.m. to 12:00 p.m. for May through September, and 3:00 p.m. to 8:00 p.m. for January through May and October through December. The average morning and afternoon ramps for May were fairly comparable, with the evening ramps being slightly larger. This demonstrates that May is a transitional month when the ISO's ramping needs shift from the evening hours to the morning hours. However, the ISO believes it is appropriate to align the must-offer obligations with the summer/non-summer demarcation used for the RA program and contributions to the categories described above. Because these months align with the with the summer/non-summer demarcation in the RA program and aforementioned contributions to the categories, the ISO expects that this will also make the procurement process less complicated.

9. Next Steps

This report completes the 2014 flexible capacity assessment that establishes the ISO system flexible capacity needs for 2015. The ISO will commence the flexible capacity needs assessment to establish the ISO system flexible capacity needs for 2016 in late 2014. At that time, the ISO will host a stakeholder meeting to discuss potential enhancements needs assessment methodology as identified in stakeholder comments. Specifically, the ISO will continue to

[16] Of note in this table are May and August. May represents a transition month. While the average net-load ramp occurred in the evening, it was fairly close to the morning ramp. Additionally, while August ramps occurred later in the day than most summer months, this ramp is still considered a morning ramp.

assess the modeling approach used for distributed solar resources, further review methods to address year-to-year volatility, account for potential controllability of some variable energy resources, and determine if there is a need for a non-zero error term.