

Cogentrix Energy Power Management LLC
Comments on the
FRACMOO Phase 2 Revised Draft Framework Proposal
Posted on January 31, 2018

Cogentrix Energy Power Management LLC (Cogentrix) believes that the California Independent System Operator (CAISO) is making substantial progress in its revised draft proposal for a new flexible Resource Adequacy (RA) framework to address both predictable and forecastable ramping needs as well as unpredictable ramping needs. While Cogentrix directionally supports the CAISO's latest proposal, there are enhancements to this framework that we believe are necessary to maximize the resulting reliability benefits to the grid and to minimize the ongoing risk of early retirement of existing flexible resources.

First, the new framework needs to ensure that there is sufficient capacity economically bid into the day-ahead market to establish a market solution that procures resources in the day-ahead market to meet the forecasted load shape. Second, the new framework needs to ensure that adequate fast ramping and responsive energy resources are procured and available in real-time to address the increasing uncertainty associated with the rapid growth of variable energy resources. This procurement will need CPUC authorization.

Cogentrix agrees with CAISO that the new revised draft flexible RA framework proposal should adequately achieve the following fundamental objectives:

- 1) Identify the ramping needs that flexible RA should be procured to address;
- 2) Quantify the capacity needed to address all identified needs; and
- 3) Establish criteria regarding how resources qualify for meeting these needs.

The eventual FRACMOO2 market structure must include a tightening of the eligibility requirements for fast-start, fast-ramp Flexible Capacity to provide the CAISO with the tools necessary to manage an increasingly volatile grid.

While Cogentrix supports the alignment of Flex RA to the operational requirements of the CAISO, it reiterates its proposal that the 15-minute and the 5-minute markets be combined resulting in only two products, Day-Ahead and Real Time. A 5-minute market is not necessary with a properly designed 15-minute market. The amount of day-ahead load shaping that is dispatched will depend on the anticipated variability and intermittency that is predicted for renewable resources based upon modern forecasting methods. The fast flexible product will be reserved for dispatch to compensate for deviations from expected output and actual load and generation.

Cogentrix also supports the one-hour eligibility for resources to participate in the real time markets as described in the FRACMOO2 Revised Draft Framework Proposal. Accordingly, Cogentrix encourages the timely completion, adoption and implementation of a new flexible RA framework, and looks forward to participating to that end.

However, Cogentrix remains doubtful that the new flexible RA framework will be implemented in a timely manner, which further increases the risk of early retirement of generators necessary to maintain grid reliability. The long history of FRACMOO2 efforts supports Cogentrix's concerns. Therefore, Cogentrix asserts that a Transitional Fast-Flexible RA Program be implemented in the 2019 RA year and remain in place until CAISO's new durable flexible RA program has been fully implemented.

Cogentrix has developed a proposed Transitional Fast-Flex RA Program that was filed in the CPUC RA proceeding (R17-09-020) on February 16, 2018. Cogentrix's proposal is based on a simplified version of CAISO's Revised Draft Flex Capacity RA framework. This proposal establishes a timelier Fast-Flexible Capacity Requirement and eligibility criteria that requires CPUC jurisdictional LSEs to contract with fast-flexible resources as part of their broader flexible RA requirement. This transitional proposal, if adopted, will create a fast-flex resource base that will act as the bridge to a California bulk power system comprised of primarily variable renewable energy resources.

Cogentrix has attached the proposal as Exhibit A to this filing for CAISO's consideration. The attached proposal has minor modifications from the proposal filed at CPUC based on initial feedback from interested stakeholders. We appreciate the opportunity to provide these comments and proposal, and look forward to continued participation in this important stakeholder initiative.

Respectfully Submitted,

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Exhibit A

Transitional Fast-Flexible RA Proposal

February 16, 2018

R. 17-09-020

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I. INTRODUCTION

Cogentrix proposes to augment the Flexible Capacity Framework established in D.13-06-024 that recognized the need for flexible capacity in the Resource Adequacy (RA) fleet. Currently, “Flexible Capacity Need” is defined as the quantity of economically dispatchable resources the California ISO needs to manage grid reliability during the greatest three-hour continuous ramp in each month.¹ Cogentrix proposes to add a transitional “Fast-Flexible Capacity Requirement” to the framework for adoption by the Commission for the 2019 RA year.

A transitional framework is necessary because the CAISO is proposing durable flexible RA requirements that will align with enhancements they are making to their day-ahead market. These enhancements include moving from an hourly day-ahead market to a fifteen-minute day-ahead market, combining the day-ahead market with the Residual Unit Commitment (RUC) process, and creating a new ramping ancillary services product. Cogentrix supports these changes and believes they will enhance reliability; however, Cogentrix notes that they will take significant effort and time to design and implement. It is extremely likely that a durable flexible RA product will not exist until after these changes are implemented and the effects are observed. Given that the implementation date is currently Fall 2019, Cogentrix is concerned that it could be 2020 or even later before a durable flexible RA program is developed by the CAISO.

Cogentrix therefore asserts that a transitional, reliability assurance policy is necessary beginning in the 2019 RA year that extends until the CAISO’s new durable flexible RA program under development has been approved by Regulators and is ready for implementation. The transitional flexible proposal herein is based on a simplified version of the CAISO’s proposed framework in the Flexible Resource Adequacy Capacity and Must Offer Obligation Phase 2 (“FRACMOO2”) initiative.²

The proposal establishes a Fast-Flexible Capacity Requirement and eligibility criteria so that CPUC jurisdictional LSEs are appropriately directed to contract with fast-flexible resources needed for grid stability as part of their existing flexible RA requirement. Without additional requirements in place, Cogentrix believes that the grid will see additional out-of-market procurement in the form of Capacity Procurement Mechanism (“CPM”) designations during the month as well as additional resources seeking and receiving Reliability Must Run (“RMR”) contracts. Cogentrix emphasizes that the normal course for CPM is reactive, and that RMRs

¹ 2018 RA Guide, <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454920>

² <http://www.caiso.com/Documents/RevisedDraftFlexibleCapacityFrameworkProposal-FlexibleResourceAdequacyCriteria-MustOfferObligationPhase2.pdf>

arising out of unplanned market exists are also reactive, which leaves no functional, proactive reliability assurance mechanism in place.

Cogentrix welcomes feedback and looks forward to participating in the February workshops to discuss the proposal.

II. TRANSITIONAL FAST-FLEXIBLE RA PROPOSAL FOR TRACK 1

Cogentrix proposes that the Commission establish a Fast-Flexible Capacity Requirement that captures the operational need for a certain amount of capacity to be able to be committed and dispatched in the CAISO real-time market. The CAISO has demonstrated in numerous presentations and studies³ that while they have abundant flexible capacity in the day-ahead market, they are still experiencing operational challenges due to lack of flexibility in the real-time market. The CAISO has further demonstrated that while the current flexible RA requirement is sufficient to meet day-ahead market flexibility needs, the requirement is not providing incentives for LSEs to procure sufficient capacity and make that capacity available to the real-time market.⁴

As a consequence, Cogentrix proposes a Fast-Flexible Capacity Requirement be established so that LSEs must procure a portion of the current flexible RA requirement from the set of fast-flexible resources defined herein.

- **Requirement:** The Fast-Flexible Capacity Requirement will be set based on the portion of the flexible ramping requirement that may be needed to serve load in real-time. Because there is a great deal of uncertainty surrounding the exact need, Cogentrix proposes that the Fast-Flexible Capacity Requirement should initially be set at 75% of the flexible RA requirement, with solar resource contribution being capped at 25% of this amount.
- **Eligibility:** Resources that can start-up and shut-down as needed in real-time will be eligible to provide fast-flexible capacity. Cogentrix believes that Track 2 should make refinements to this proposal as needed. This includes allowing imports to count as both flexible and fast-flexible RA.
- **Obligations:** Fast-flexible resources will have a 24/7 must-offer obligation similar to system RA resources and be subject to RA Availability Incentive Mechanism (RAAIM) just

³ Working Group Presentations;
<http://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleResourceAdequacyCriteria-MustOfferObligations.aspx>

⁴ Ibid

as flexible RA capacity is today. Eventually, Cogentrix believes both the must-offer and RAAIM hours should be re-evaluated within the broader context of RA reform.

- **Allocations:** LSE and LRA allocation of the requirement and the backstop rules for fast-flexible RA should be established in the same manner as the flexible RA requirement is today.

Figure 1 below summarizes the Transitional Fast-Flexible RA Proposal’s proposed requirements and estimated resources. It uses monthly 2018 data to demonstrate what the proposed Fast-Flexible Capacity Requirements and flexible requirements could look like for the 2019 RA year. In 2018, there was significantly more eligible flexible RA capacity than the Flexible RA requirement. If in place in 2018, the Fast-Flexible Capacity Requirement would have been a maximum of 11,809 MW in December. Cogentrix does not have access to the CAISO MasterFile so cannot perfectly estimate the amount of capacity each month that would be available to meet the fast-flexible requirement.

Figure 1: Illustrative annual fast-flexible and flexible requirements using 2018 requirement and eligibility

	Eligible Resources		Requirements	
	Eligible Flexible RA (MW)	Estimated Eligible Fast-Flexible (MW)	Flexible RA Requirement (MW)	Fast-Flexible Requirement (MW)
Jan-18	35,050	16,000+	13,415	10,061
Feb-18	34,910	16,000+	14,409	10,807
Mar-18	35,024	16,000+	13,435	10,076
Apr-18	35,420	16,000+	12,272	9,204
May-18	35,304	16,000+	13,095	9,821
Jun-18	34,978	16,000+	11,497	8,623
Jul-18	34,886	16,000+	10,908	8,181
Aug-18	34,806	16,000+	11,219	8,414
Sep-18	34,476	16,000+	14,248	10,686
Oct-18	34,554	16,000+	14,271	10,703
Nov-18	34,731	16,000+	14,505	10,879

Dec-18	34,858	16,000+	15,743	11,807
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Using public data and the CAISO’s FRACMOO2 framework published data, Cogentrix estimates there is at least 16,000 MW of capacity available to meet the proposed requirement, as shown above in Figure 1. The CAISO framework stated there was around 15,000 MW each month to meet the difference between the day-ahead and fifteen-minute market and they used a more limiting eligibility criteria to determine this amount than Cogentrix is proposing. The estimated 16,000 MW of eligible fast-flexible capacity also aligns with a review of all CAISO generator data that shows among other resource types, over 8,000 MW of Combustion Turbine capacity, 6,000 MW of Hydro capacity and over 10,000 MW of Combined Cycle capacity is eligible to meet the flexible RA requirement.

Figure 2 describes the new eligibility requirements for both flexible RA and fast-flexible RA. As noted above, Cogentrix believes that imports should be able qualify as both flexible and fast-flexible RA. However, allowing imports to count may unnecessarily delay implementing necessary changes to the flexible RA program. As described in Section IV, the implementation effort to count imports may be lengthy, and therefore should be delayed rather than slowing the implementation of a Transitional Fast-Flexible RA Proposal.

Cogentrix has also included the CAISO’s suggestion to limit solar resources’ contribution to the Fast-Flexible Capacity Requirement to 25% of the total. This is because the CAISO will need real-time resources at times when the sun may not be shining.

Figure 2: Proposed fast-flexible RA compared to current flexible RA eligibility and must-offer obligations

	Flexible RA	Transitional Fast-Flexible RA
Must-offer obligation	17 Hours; 5 AM- 10 PM Daily	24 hours; Daily
Energy limitation	At least 6 Hours	At least 6 hours
Characteristics	N/A	-Start-up time less than 4.5 hours -Cycle time less than or equal to 270 minutes -Minimum down time less than 4 hours
Starts	Minimum of two starts per day	Minimum of two starts per day

Additional resource limitations	N/A	Solar limited to 25% across all LSEs
Percentage of LSE portfolio of flexible resources	100% Minus Fast Flexible RA Percentage	Minimum 75%

Additional details and justification for the Cogentrix transition proposal are described in the Appendix in Section VI.

III. FLEXIBLE RA PROGRAM REFINEMENT PROPOSAL FOR TRACK 1

Cogentrix proposes the additional following changes to the current flexible RA framework for the 2019 RA year.

REMOVAL OR MODIFICATION OF CATEGORIES

Cogentrix proposes to inherently limit the amount of flexible capacity that may be shown in Category 2 or Category 3 through the fast-flexible proposal that would require 75% of all flexible RA to have higher flexibility attributes than Category 1. Cogentrix further proposes eliminate Category 2 or Category 3 as an option or to modify the Category 2 and Category 3 must-offer hours. Currently the CPUC and CAISO's flexible RA approach requires LSEs to procure flexible resources in accordance with flexible categories based on varying must-offer obligations and energy limitations.

LSEs procure and show their flexible resources according to the characteristics defined in Figure 3.

Figure 3: Categories of Must-Offer

	Category 1	Category 2	Category 3
Must-offer obligation	17 Hours	5 Hours	5 Hours
	5 AM- 10 PM Daily For the whole year	3 PM to 8 PM for May – September	3 PM to 8 PM for May – September
	5 AM- 10 PM Daily For the whole year	2 PM- 7 PM for January- April and October-December	2 PM- 7 PM for January- April and October-December
	Daily	Daily	Non-holiday weekdays
Energy limitation	At least 6 Hours	At least 3 Hours	At least 3 Hours
Starts	The minimum of two starts per day or the number of starts feasible with minimum up and down time	At least one start per day	Minimum 5 starts a month
Percentage of LSE portfolio of flexible resources	At least 55 % for May – September	Up to 45% for categories 2 and 3 combined	Up to 5%
	At least 38 % for January- April and October- December	Up to 62% for categories 2 and 3 combined	Up to 5%

In May 2017, the CAISO Department of Market Monitoring put out an assessment of the flexible resource adequacy requirements within their Annual Report.⁵ They concluded in part,

“The flexible resource adequacy requirements and must-offer rules are very dependent on the ability to predict the size of the maximum net load ramp as well as the time of day the ramp occurs. This analysis suggests that the 2016 requirements and must-offer hours were insufficient in reflecting actual ramping needs. Most of the maximum net load ramps occurred at least partially outside of Category 2 and 3 must-offer hours. In eight months of the year, the maximum net load ramp occurred on a holiday or weekend when Category 3 capacity does not have a must-offer obligation. If load-serving entities had

⁵ <http://www.caiso.com/Documents/2016AnnualReportonMarketIssuesandPerformance.pdf>, page 238

procured just the minimum Category 1 and maximum Category 2 and 3 requirements, the ISO may have been short the necessary flexibility to meet ramping needs.”

They further broke down the maximum load ramp by month and noted whether the requirements overlapped with the need. This is shown in Figure 4 below.

Figure 4: Maximum three-hour next load ramp and flexible resource adequacy requirements

Month	Maximum 3-hour net load ramp (MW)	Total flexible RA requirement (MW)	Average requirement during maximum net load ramp (MW)	Date of maximum net load ramp	Ramp start time	Average requirement met ramp? (Y/N)	Why average requirement during max net load ramp was less than the maximum 3-hour net load ramp
Jan	9,621	11,103	10,091	1/26/2016	14:50	Y	Did not overlap with must-offer hours for 50 minutes
Feb	11,010	10,507	10,506	2/1/2016	15:00	N	
Mar	9,756	10,362	9,844	3/6/2016	15:20	Y	Ramp occurred on a weekend
Apr	8,333	9,989	9,489	4/16/2016	17:05	Y	Ramp occurred on a weekend
May	8,340	7,731	6,730	5/15/2016	16:20	N	Ramp occurred on a weekend and did not overlap with must-offer hours for 20 minutes
Jun	7,495	7,244	6,306	6/15/2016	17:15	N	Did not overlap with must-offer hours for 2 hours and 15 minutes
Jul	7,703	7,935	6,908	7/10/2016	16:15	N	Ramp occurred on a weekend and entirely outside of must-offer hours
Aug	8,003	7,998	6,963	8/14/2016	16:00	N	Ramp occurred on a weekend and entirely outside of must-offer hours
Sep	10,340	9,259	8,061	9/25/2016	15:10	N	Ramp occurred on a weekend and did not overlap with must-offer hours for 10 minutes
Oct	9,921	10,331	9,815	10/15/2016	15:45	N	Ramp occurred on a weekend and one hour and 45 minutes did not overlap with must-offer hours
Nov	11,265	12,005	10,910	11/29/2016	14:25	N	Did not overlap with must-offer hours for 25 minutes
Dec	12,898	12,817	11,168	12/18/2016	14:40	N	Ramp occurred on a weekend and one hour and 40 minutes did not overlap with must-offer hours

Cogentrix therefore proposes that the Categories be eliminated or modified.

IV. IMPORT QUALIFICATION FOR FLEXIBLE RA PROPOSAL FOR TRACK 2

Cogentrix asks that the Commission consider the CAISO proposal that allows imports to count toward flexible and fast-flexible RA in Track 2. Imports have the ability to economically offer into the day-ahead and fifteen-minute real-time markets and Energy Imbalance Market (EIM) imports can additionally be dispatched in the five-minute market. Cogentrix does not see the need to artificially constrain the amount imports can count toward flexible RA by breaking the current hourly import/export construct of the real-time market into the fifteen and five-minute intervals. Instead, imports can be naturally limited through the Maximum Import Capacity (MIC) process. In order for imports to provide flexible RA capacity, the CAISO will have to ensure there is sufficient import capability *and* that this import capability is not being used by other self-scheduled resources.

- The way to ensure there is sufficient import capacity is to require imported flexible RA resources to acquire a MIC allocation (or as is more common, have the associated LSE acquire the MIC allocation). Within this process, the CAISO has the ability to naturally limit the amount of import capacity that can qualify as fast-flexible RA. Cogentrix believes this will ultimately be a simpler process than requiring all LSEs to procure two types of fast-flexible capacity, fifteen-minute and five-minute.
- The way to ensure that import capacity is not being used by other resources that may self-schedule and prevent the CAISO from accessing flexible RA imports is to add a constraint to the optimization which reserves capacity on an intertie. This is similar to how the CAISO allows operating reserves to be imported.

While imports would ideally be able to qualify for flexible RA in the 2019 RA year, Cogentrix is concerned that the need for changes to the MIC allocation and the optimization are too significant to be implemented by this fall. Therefore, Cogentrix asks the Commission to postpone adopting this aspect of the Cogentrix proposal until the CAISO can explore the idea through their initiative process.

V. CONCLUSION

Reliability and ratepayers cannot wait for the CAISO to develop a long-term flexible RA proposal. The process to enhance the CAISO day-ahead market, create new ancillary service products, and additionally define durable flexible RA requirements that align with these changes will be lengthy. The Commission has already seen an increase in backstop procurements and the possibility of reliability events. It is therefore in all parties' best interest for the Commission to approve a transitional fast-flexible proposal and small, beneficial changes to the flexible RA program that can be put in place quickly and without extensive studies or processes. Cogentrix strongly believes that its track 1 proposals are a reasonable compromise between ensuring sufficient flexible capacity and holistic reform, and are rooted in solid empirical evidence and analysis. Cogentrix respectfully urges the Commission to adopt both Track 1 proposals.

APPENDIX: TRANSITIONAL FAST-FLEXIBLE PROPOSAL DETAILS

FAST-FLEXIBLE REQUIREMENT

Cogentrix proposes that by April 15 of this year (or as soon as practical), the CAISO will complete and file in the RA proceeding *an additional* component to the flexible capacity requirements study to the one adopted in D.13-06-024. The additional component will list the monthly fast-flexible capacity needs for the following year. Cogentrix proposes that this simply be 75% of the flexible RA requirement each month. Like today, parties to the RA proceeding should have the ability to vet the flexible RA study and submit comments. The annual RA decision will then adopt the flexible obligation and fast-flexible obligation for CPUC LSEs.

Cogentrix arrived at the proposed 75% value by considering the CAISO's framework and assessing the potential for needed flexible capability in the real-time market. The proposed fast-flexible requirement percentage of flexible capacity is based on the mutual consideration of the following components:

1. The difference between the monthly peak net load forecasted three-hour ramping need in the day-ahead market and the five-minute real-time market;
2. The uncertainty between the DA market and the five-minute real-time market, including forecast error between the requirement and peak coincident net load;
3. An adder for the amount of real-time flexible capacity the CAISO depends on in the Residual Unit Commitment (RUC) process; and
4. The need to reserve capacity on resources to provide Regulation services.

Formally, the requirement can be expressed as follows:

$$\begin{aligned} \text{Fast-FlexNeed}(\text{MTHy}) = & \\ & \max\{\text{abs}[\text{DA3RRHRx}(\text{MTHy}) - \text{RT3RRHRx}(\text{MTHy})]\}, \quad \text{and} \\ & \max\{\text{FlexRUCx}(\text{MTHy})\}, \quad \text{and} \\ & \max\{\text{abs}[E[\text{DARRHR}(\text{MTHy}) - \text{RTRRHR}(\text{MTHy})]]\}, \quad \text{and} \\ & E[\text{Reg}(\text{MTHy})], \quad \text{and} \\ & \varepsilon \end{aligned}$$

where,

$\text{DA3RRHRx}(\text{MTHy})$ = forecasted three-hour continuous ramp in hour x for month y in the day-ahead market

$RT3RRHRx(MTHy)$ = forecasted three-hour continuous ramp in the real-time market in hour x for month y in the real-time market

$FlexRUCx(MTHy)$ = flexible capacity the CAISO depends on in RUC in hour x within month y

$E[DARRHR(MTHy) - RTRRHR(MTHy)]$ = the expected value of the difference between the day-ahead market and the five-minute real-time market outcomes in month y

$Reg(y)$ = the expected regulation requirement in the next year

ϵ = expected errors between the requirement and coincident peak net load

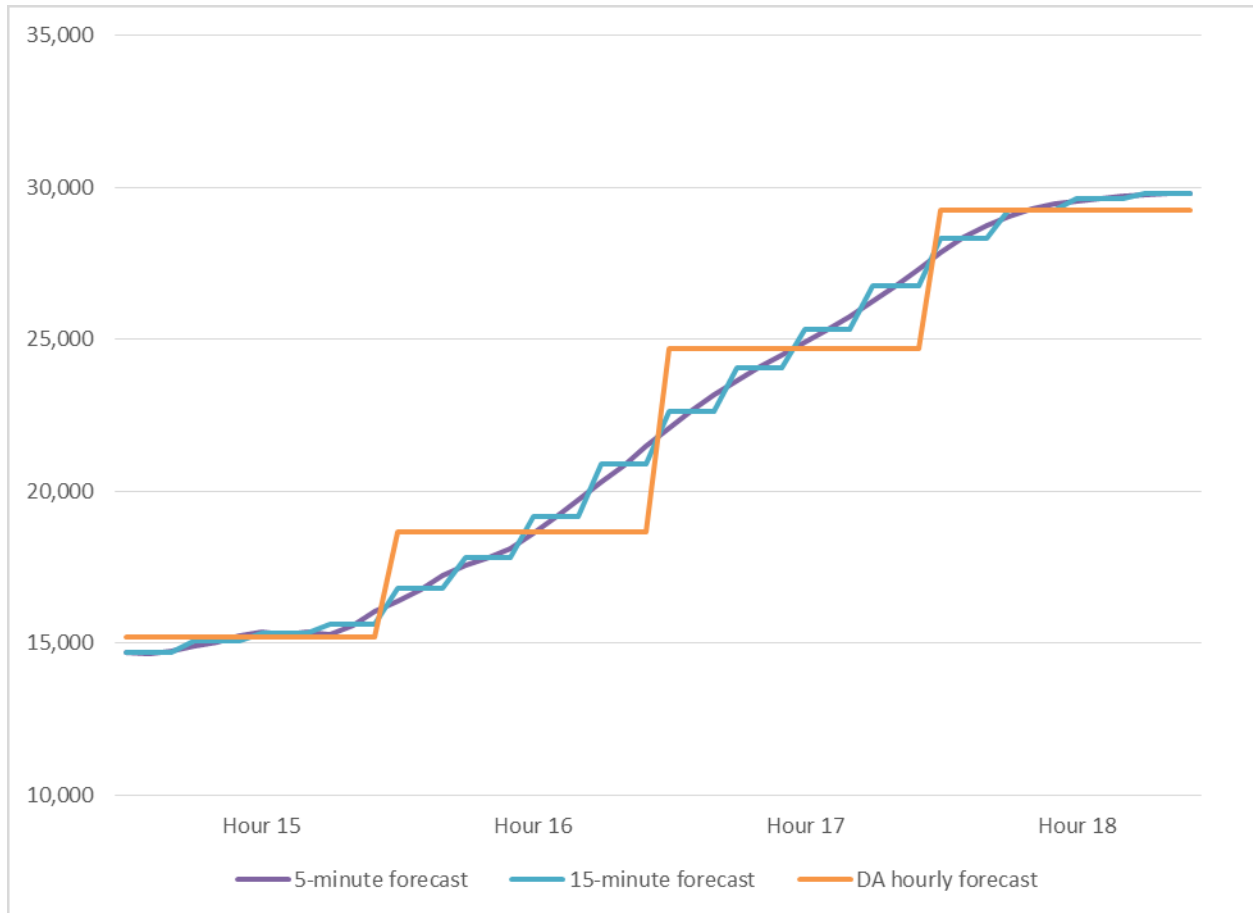
Each of these components is elaborated upon and ultimately quantified in order to arrive at the 75% value.

(1) Ramping interval determination –

The CAISO proposed to use the difference between the hourly day-ahead requirement and the more granular real-time requirement as the basis for the framework of FRACMOO2.⁶ The day-ahead market optimization clears bid-in demand against physical and virtual supply each hour. It ensures that there is sufficient physical or virtual ramping capability to meet an **hourly** three-hour peak net load ramp. By contrast, the five-minute market needs physical supply capable of meeting a five-minute ramping requirement over this same three-hour net load peak. As a result, there are differences in the optimization time period for the hourly ramping and five-minute ramping. This necessitates that sufficient real-time capacity be available to be committed and dispatched to meeting the ramping differences. Figure 5 below demonstrates this difference.

⁶ <http://www.caiso.com/Documents/RevisedDraftFlexibleCapacityFrameworkProposal-FlexibleResourceAdequacyCriteria-MustOfferObligationPhase2.pdf>

Figure 5: Difference between DA and RT optimization ramping solution, Net Load Forecast December 18, 2017 Hours 15 - 18



Cogentrix does not propose to break this into a fifteen-minute ramping requirement and a five-minute requirement. All internal resources that can be committed and dispatched in real-time must bid into the market each hour and so are automatically optimized and dispatched in both markets. There is also not significant difference in resource average five-minute and fifteen-minute ramp rates. Only imports are more limited and primarily (although not entirely) can only provide fifteen-minute ramping services. Therefore, it is likely an unnecessary complication to introduce a specific fifteen-minute and five-minute requirement because imports can be addressed in a different manner as described in Section V.

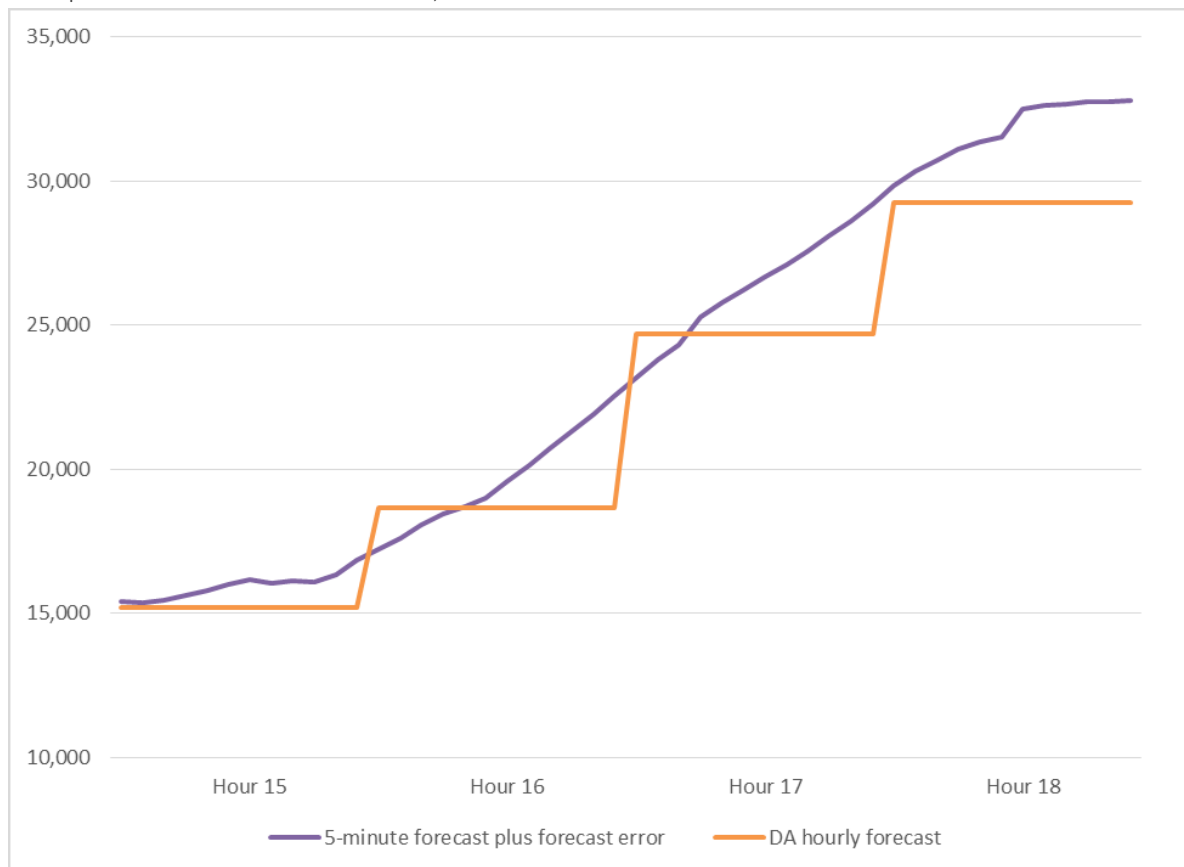
(2) Uncertainty determination –

An uncertainty component is also an aspect of the CAISO's framework. There are two main components of uncertainty between the day-ahead market and real-time market that may need to be covered by fast-flexible resources. There is load forecast error, and net load forecast error, that cause a difference between what the DA market commits to meet ramping needs and what the RT market actually needs. The CAISO has been tracking these errors and the

errors are consistent enough to be predicted with enough certainty to include in a requirement.⁷

The aggregation of components (1) and (2) are very similar to what was proposed in the CAISO’s FRAC MOO Phase 2 framework and are illustrated by Figure 6.

Figure 6: Difference between DA and RT optimization ramping solution, Net Load Forecast December 18, 2017 plus assumed RT forecast error, Hours 15 - 18



The CAISO also did an analysis on the maximum changes between day-ahead and real-time including ramping horizon differences and forecast error. They found that within a month there were large positive and negative deviations, often on the same day, and they could need upwards of 8,000 MW of additional energy in real-time just to account for ramping changes and uncertainty alone. This is illustrated in Figure 7, below, which shows the observed maximum positive and negative differences between the day-ahead and real-time markets.

⁷ http://www.caiso.com/Documents/Agenda-Presentation-MarketPerformance-PlanningForum-Dec18_2017.pdf pages 67-69

Figure 7: CAISO observes changes between the day-ahead and real-time markets

Month and Year	Max positive error DA – FMM	Max negative error DA - FMM	Error range DA to FMM	Error Range FMM to RTD	Total non-coincident error range
October 2016	3,781	-3,826	7,607	2,834	10,441
November 2016	2,673	-2,591	5,264	3,099	8,363
December 2016	4,210	-3,428	7,638	3,636	11,274
January 2017	3,877	-3,912	7,789	3,401	11,190
February 2017	4,276	-4,421	8,697	3,498	12,195
March 2017	3,950	-3,813	7,763	3,540	11,303
April 2017	4,331	-2,610	6,941	3,380	10,321
May 2017	3,033	-3,938	6,971	2,726	9,697
June 2017	2,996	-3,753	6,749	2,857	9,606

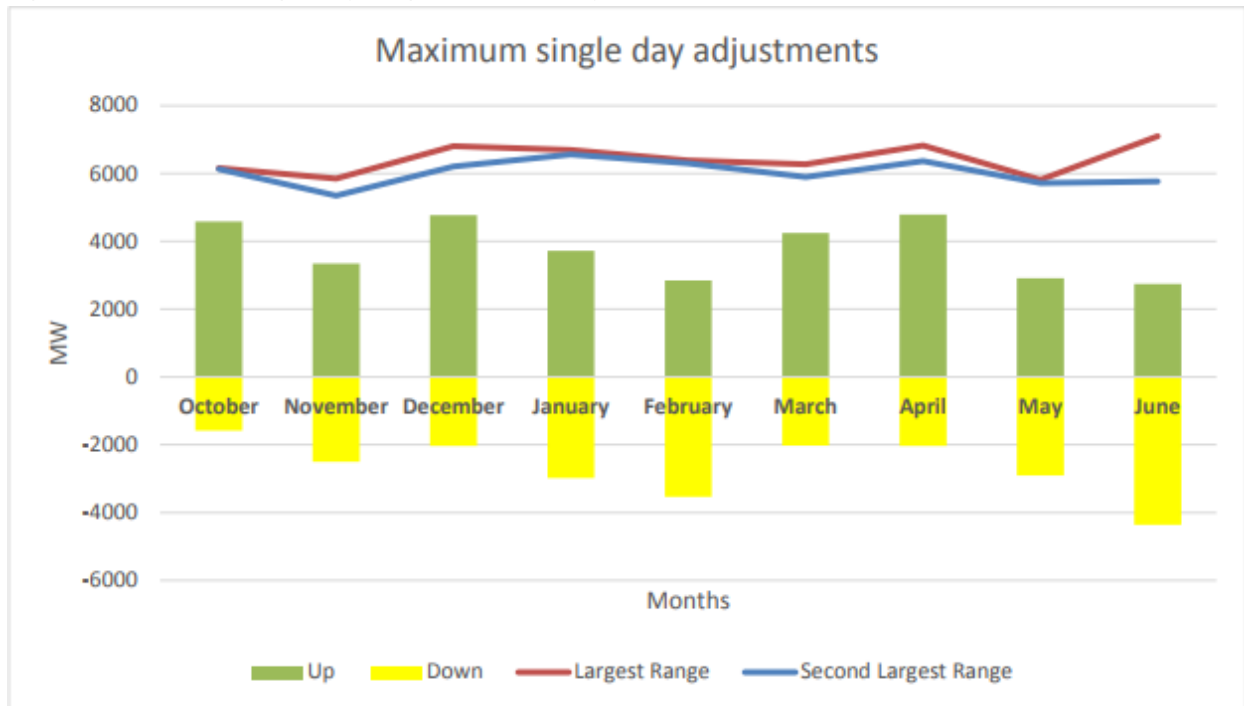
Because the maximum difference between the day-ahead market and the fifteen-minute market, and the maximum difference between the fifteen-minute market and five-minute market did not occur at the same time, the final column in Figure 7 above is an over-estimate of the total fast-flexible capacity needed due to ramping and uncertainty. It reflects an unlikely “worst case” scenario in which both the day-ahead and fifteen-minute under-predict the net load ramping requirement in one interval and have their worst under prediction the interval prior. This is because the total error range in an aggregation of the upwards and downward flexible capability needed. The CAISO would only need both the maximum upwards and downwards fast-flexible capacity in the circumstance where one market interval needed all fast-flexible to be dispatched downward and then in the next needed all fast-flexible capacity to be dispatched back upward- both in the opposite direction than what was predicted by the day-ahead market.

In order to aid in determining the potential amount needed, the CAISO also assessed the maximum adjustments needed from downward to upward dispatch over a single day. This is illustrated in Figure 8, which shows that the individual swings needed in a day could be fairly significant. Figure 8 also shows the maximum and second largest amount of fast-flexible capacity needed in that month; however, the CAISO also noted that the maximum “swing” did

not always occur on the same day or same time as the maximum amount of fast-flexible capacity.

From these data, Cogentrix concludes that the CAISO needs fast-flexible capacity somewhere between the final column in Figure 7 and the error range between day-ahead and the fifteen-minute market. For example, in October, 2016 the CAISO would have needed between 7,607 MW and 10,441 MW of fast-flexible capacity.

Figure 8: Maximum single day ranges between day-ahead and real-time



In formulating the need for fast-flexible capacity, Cogentrix asserts that it is important to recognize and address the possibility that the peak load forecast by the CEC is too low. If the peak load forecast is higher than expected, but the forecast is not uniformly off across the entire day, then the net load forecast could be off and require additional resources that can be committed and dispatched in the real-time. Cogentrix acknowledges that it is unlikely that the CEC would under-forecast peak load on a day when the surrounding hours are above the day-ahead forecast, and therefore considers an adder of one-half the CPUC planning reserve margin - or 7.5% of peak load - or something similar an appropriate estimate for the potential fast-flexible capacity needed.

(3) Residual Unit Commitment (RUC) process implications –

One element missing from the CAISO conceptual proposal was the acknowledgement that the DA market clears both physical *and virtual* supply against *bid-in* demand. This means that even if the DA forecast had no error and the time horizon perfectly aligned between the DA and RT optimizations, there is still a missing set of resources that must be able to be committed and dispatched in real-time. The CAISO's RUC process ensures there is sufficient committed or available *physical* capacity to meet the CAISO forecast of CAISO demand. Included in the RUC process is also an adjustment to solar and wind supply expectations. This adjustment was added due to the large amounts of wind and solar self-scheduling in real-time that impacted the RUC results.

Ultimately, RUC will first count all RA energy as available to meet physical load and then give non-binding commitments to resources that can start in real-time. Only after all RA resources and non-binding commitments are exhausted will RUC commit long-start resources. Eventually the CAISO may combine the DA market and RUC process, which will ensure that day-ahead awards simultaneously meet both constraints.

However, until this enhancement is implemented, the fast-flexible requirement should also include an amount that may be needed due to differences in the bid-in demand as opposed to CAISO forecast of CAISO demand and physical and virtual supply. This amount is more likely to be in the hundreds of MWs rather than the thousands and so Cogentrix views this as a small, but needed adder to the ramping and uncertainty need.

(4) Fast-flexible requirement proposal –

As described above, there is high variability and uncertainty in the amount of real-time capacity the CAISO may need in any given interval. Forecast error for renewables and load will impact the amount of real-time ramping needed to meet peak net load requirements and additional confounding factors like RUC process and regulation requirement will add additional variability. Rather than propose an artificially precise requirement that would require significant amounts of study work and vetting, Cogentrix proposes that the CAISO needs approximately 75% of the flexible RA requirement to be fast-flexible RA. This amount is less than the total non-coincident error range that is definitely an over-estimate, but also high enough to cover potential RUC and needed regulation requirements.

Figure 9 summarizes the data behind the 75% amount. Columns 1 and 2 are taken from the CAISO paper and as described above are likely a moderate over-estimate of the need. Columns 3 and 4 show the estimates of real-time capacity needed to cover RUC and Regulation, and Column 5 is the total of these monthly components. Column 6 shows the total CAISO flexible RA

requirement in each month and finally column 7 shows what the proposed fast-flexible requirement would have been in these months.

Figure 9: Summary of estimated needs and requirement

(1) Month and Year	(2) Ramp & forecast error, DA to RT	(3) RUC	(4) Regulation	(5) Total (Sum of one - three)	(6) Flexible RA Req	(7) Proposed Fast-Flexible Req
October 2016	10,441	200	600	11,241	10,331	7,748
November 2016	8,363	200	600	9,163	12,005	9,004
December 2016	11,274	200	600	12,074	12,817	9,613
January 2017	11,190	200	600	11,990	14,110	10,583
February 2017	12,195	200	600	12,995	12,840	9,630
March 2017	11,303	200	600	12,103	13,456	10,092
April 2017	10,321	200	600	11,121	13,220	9,915
May 2017	9,697	200	600	10,497	12,044	9,033
June 2017	9,606	200	600	10,406	10,939	8,204

Fast-Flexible Eligibility

Cogentrix proposes that fast-flexible RA resources will be distinguished from RA resources by their ability to be committed and dispatched in the real-time market without overly burdening the system with inflexible characteristics. These characteristics include:

- Start-up and cycle time *less than or equal to* 4.5 hours. This is based on resources that are able to be committed by either the Real-time Unit Commitment (RTUC) process or

Short-term Unit Commitment (STUC) process and also be de-committed by the STUC process.

- Minimum down time less than 4 hours. This is based on the approximate average amount of time between the morning and evening ramp as calculated using a subset of CAISO minute-by-minute net load forecast data and should be refined with further analysis.⁸
- The minimum of two starts per day. This requirement is consistent with the flexible RA category 1 requirement.

MUST-OFFER OBLIGATION

Cogentrix proposes that, as suggested by the CAISO, fast-flexible resources have a 24/7 must-offer obligation. This is because resources that can be committed in real-time may be needed due to ramping differences and uncertainty at times unrelated to the net peak load period. Therefore, Cogentrix proposes a 24/7 must-offer obligation to bid in economically when available into the day-ahead and real-time market and no changes to the RA Availability Incentive Mechanism (“RAAIM”) assessment hours at this time.

This is consistent with the offer obligation of system RA resources. While system RA resources are only assessed by the RAAIM during 5 peak hours on non-holiday weekdays, they have a similar tariff obligation to offer into the DA market when available.

ALLOCATION AND BACKSTOP

As noted in the introduction, Cogentrix proposes that the fast-flexible RA requirement be allocated to LRAs and LSEs in the same manner as the current flexible RA requirement.

⁸ http://www.caiso.com/Documents/2018FlexibleCapacityNeedsAssessment_2018NetLoadData.xlsx