

Opinion on
Flexible Resource Adequacy Criteria and
Must-Offer Obligation

by

James Bushnell, Member
Scott M. Harvey, Member
Benjamin F. Hobbs, Chair
Shmuel S. Oren, Member

Members of the Market Surveillance Committee of the California ISO

Final, March 11, 2014

Summary

1. Introduction

The Market Surveillance Committee (MSC) of the California Independent System Operator (CAISO) has been asked to provide an opinion on the ISO's proposal on Flexible Resource Adequacy Criteria and Must-Offer Obligation (FRACMOO).¹ This proposal has been developed by the CAISO staff through a stakeholder process for over a year and has been discussed in MSC open meetings in Folsom on January 17, September 6, and November 15, 2013 and January 16, 2014. MSC members have participated in stakeholder calls, have reviewed stakeholder comments submitted to the ISO, and have participated in a FERC Technical Conference held on July 31, 2013 in Sacramento California concerning the joint CAISO/California Public Utilities Commission (CPUC) Multi-Year Reliability Framework proposal.

The current CAISO proposal addressed by this opinion represents a first step aimed at enabling the implementation of the CPUC Decision 13-06-024, June 27, 2013 which establishes interim flexible capacity procurement obligations as part of the CPUC's resource adequacy (RA) program.² The decision calls for CPUC jurisdictional entities to meet a flexible capacity procurement target for RA compliance year 2014, with these targets becoming procurement obligations in RA compliance year 2015. This ruling and its implementation represent an interim step toward a comprehensive solution, referred to as the joint CAISO/CPUC Multi-Year

¹ California ISO, "Flexible Resource Adequacy Criteria and Must Offer Obligation," Final Proposal, Feb. 7, 2014, www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleResourceAdequacyCriteria-MustOfferObligations.aspx.

² <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M070/K423/70423172.PDF>

Reliability Framework, which was conceived after FERC’s March 29, 2013 decision to reject the CAISO’s “flexible capacity and local reliability retention” (FLRR) proposed mechanism. The proposed FRACMOO framework is aimed at addressing operational challenges involved in integrating the rapidly increasing amount of renewable resources into the California electricity resource mix, the retirement of once-through cooling generation capacity and expected rapid increase in distributed generation. The Joint Reliability Plan will include the establishment of a multi-year resource adequacy forward procurement process by the CPUC, along with a CAISO market-based backstop capacity procurement mechanism. Furthermore, CAISO is in the process of developing a short-term flexible ramping product in its real-time markets. However, while the CAISO current FRACMOO proposal asserts a commitment to a holistic approach that is consistent with the Joint Reliability Plan, the present FRACMOO proposal is narrowly focused on a minimal implementation that will expedite the inclusion of flexibility criteria in the RA process. This narrow focus is the result of a lengthy stakeholder process that resulted in substantially limiting the scope of the proposal, relegating some issues involved in developing a holistic approach to separate stakeholder initiatives.

The MSC recognizes that the CAISO’s proposal is intended to be a pragmatic and narrowly focused approach to expediting procurement of flexible capacity through the RA process as an interim solution to addressing operational challenges in the near term. The experience gained from implementing this approach will likely be useful in the on-going process of fashioning a holistic approach to flexible capacity procurement and offer incentives. Three other elements of the holistic approach being developed through other stakeholder initiatives and CPUC proceedings include: (1) a market-based backstop procurement that will also provide incentives mechanisms and rational performance penalties; (2) a short-term market for flexible ramping products; and (3) a multi-year forward RA mechanism.³ Despite the narrow focus of the present proposal, the CAISO recognizes that close coordination is imperative between the FRACMOO and the other components. In this opinion we will focus primarily on the immediate goals targeted by the CAISO proposal and evaluate how the elements of the proposal serve these goals. We will also provide a general discussion regarding the overall approach pursued by the CAISO/CPUC in addressing flexibility needs and evaluate the FRACMOO proposal from that perspective.

In the remainder of this opinion, we start by summarizing the CAISO’s FRACMOO proposal (Section 2). Then in Section 3, we discuss the two basic problems being addressed by flexible capacity procurement: the need for investment and the need to incent offers to the ISO’s short-run markets. In Sections 4 and 5, we provide general comments on the proposal and a discussion of specific features, respectively. In Section 6, we summarize our recommendations.

³We do not mean to imply that we believe that a holistic approach with these elements will be sufficient or will effectively deal with the flexible capacity problem. Later in this opinion, we note that other elements may well be needed to address the fundamental reasons why existing flexible capacity is offered inflexibly to the market.

2. Summary of the CAISO FRACMOO proposal

There are multiple elements of the integrated reliability framework being developed by the CPUC, CAISO, and other parties. The current FRACMOO proposal narrowly focuses on the essential elements needed for implementing the CPUC interim decision of June 27, 2013. That decision refines the RA procurement process by requiring that any capacity “showing” include a certain fraction of “flexible capacity” capable of supporting a three hour continuous ramp. The CPUC’s decision recognized that the CAISO would determine, through a stakeholder initiative, the operational and availability requirements for utilizing flexible capacity in the CAISO market.

In this FRACMOO proposal, the CAISO has adopted a minimalist approach that will expedite the implementation of the CPUC ruling so as to meet the timeline for compliance with the 2014 RA process and hopefully enable the CAISO to gain information that will inform related stakeholder RA initiatives. The current CAISO proposal⁴ addresses the following elements:

- Requirement Determination
- Allocation Methodology
- Flexible Capacity RA Showing
- Showing Assessment and Resource Counting
- Must Offer Obligations
- Backstop Procurement

Requirements. The proposed timeline for requirement determination mirrors that of the current Local Capacity Requirement, whereas the annual and monthly requirements for flexible capacity will be based on an assessment of the largest 3 hour ramps using the most current information on renewable portfolio standard (RPS) contracts and load forecasts. The requirements will only be system-wide, with no local flexible capacity requirements.

Allocation Methodology. The proposed method for allocating shares of flexible capacity requirements to Local Regulatory Authorities (LRA) in the CAISO balancing area will be based on their jurisdictional load serving entities’ (LSEs’) average contribution to the components of the top five daily maximum three-hour net-load ramps within a given month. The ISO will determine the contribution to all components (the so-called “Deltas”: Δ Load, Δ Wind Output, Δ Solar PV, Δ Solar Thermal) using historical data for Δ Load and forecasts for the other components.

Showing. The CAISO market rules will require two separate RA showings within both month-ahead and year-ahead RA showings: one for system and local capacity, and a separate showing for flexible capacity. Resources that are only included in the flexible capacity showing will be subject to the flexible capacity must-offer obligations. Resources included in the generic system or local capacity showings will be subject to the generic system and local capacity must-offer

⁴Draft Final Proposal, *op. cit.*.

requirements, respectively. Finally, resources included in both generic and flexible showings will be subject to both generic and flexible must offer requirements.

Resource Counting. As a practical matter, we observe that the CAISO's proposed approach to flexible capacity procurement requires that the CAISO develop some sort of resource counting methodology within its tariff that will enable the ISO to assess the adequacy of a Scheduling Coordinator's resources for an LSE's flexible capacity showing. The proposed counting methodology would consider each resource's net qualifying capacity, minimum operating level, start-up time, and average ramp rate.⁵ One of the qualification requirements will be an ability to respond to five minute dispatch instructions, which would exclude all but pseudo-tied or dynamically scheduled import resources from providing flexible capacity in the RA procurement process.⁶

Must Offer Obligations. The CAISO proposes to define the must offer obligation of flexible capacity resources in terms of three distinct technology-agnostic categories. These categories are derived from a needs-based approach that considers the flexibility required to reliably operate the system. The first category, which offers "Base Flexibility," would be a minimum requirement that is set to the level of the largest secondary 3-hour net-load ramp in a month.⁷ The second category, termed "Peak Flexibility" is set to the incremental amount of flexible capacity (above base flexibility) needed to meet at least 95% of the maximum 3-hour net load ramp for a month. The third category, which offers "Super-Peak Flexibility," is set to the additional amount of flexible capacity needed to cover the highest 5% of the maximum 3-hour net load ramp for a month.

While these three categories accommodate certain resource characteristics (*e.g.*, such as the limited energy or limited start characteristics of hydro, storage, combined heat and power, variable energy resources, and demand response), they do not impose explicit restrictions on resource type. The assignment of resources to categories is based on self-selection by resources who are willing to comply with the associated obligation of the chosen category and have the physical capability to be included in a flexible capacity showing in that category. The categories are designed to be hierarchical so that a higher category can substitute for a lower one and is expected to be called more frequently than a lower category. The CAISO will establish maximum percentages for the "Peak Flexibility" and "Super-Peak Flexibility" categories based on analysis of the CAISO's needs.

The categories are subject to modification based on experience. As just one example, under the present proposal, the CAISO would only require that resources offering base flexible capacity be able to provide six hours of energy (instead of the 17 hour suggested earlier). However, this requirement might be modified after implementation of FRACMOO by adding a category requiring more than six hours of energy if experience shows it is needed. Further refinement of the categories to better accommodate preferred resource participation will likely be necessary.

⁵ Draft Final Proposal, *op. cit.*, Section 5.5 and pp. 36-38.

⁶ *Ibid.*

⁷ A secondary 3-hour load ramp is defined as the second largest distinct ramping event in a given day.

Backstop Procurement. Under this proposal, the ISO proposes to initially use the same price for backstop procurement of flexible capacity as it presently uses for the procurement of generic system and local capacity under its capacity procurement authority. Both regular RA and flexible RA acquired under the backstop procurement system will be paid the same price. This pricing scheme will remain in effect until the ISO replaces its capacity procurement mechanism, which is set to expire in February 2016. When there are simultaneous deficiencies in both system/local RA and flexible RA, the required backstop flexible capacity is procured first and is also counted toward the system/local RA backstop. Resources accepting such designation are subject to the must offer obligations of both generic and flexible capacity.

The CAISO intends to eventually replace the initial backstop procedure with a procurement mechanism being developed under the Reliability Service stakeholder initiative. That mechanism will provide a market-based framework for the development of a Standard Flexible Capacity Product, performance incentives, and penalties. The CAISO also believes that it is appropriate to defer a requirement to provide substitute flexible capacity until resources' Scheduling Coordinators have a complete set of tools to effectively manage potential outage risks. These tools will include the opportunity cost calculations for start-up and minimum load costs for use-limited resources and clear rules for providing substitute flexible capacity for resources on outage.

3. Flexible Capacity Investment and Offering: Scope of the Problem

Two features of the California supply environment have contributed to the desire by the CAISO and others for a flexible RA product. First, as has been widely discussed, high ramps of net load have been projected to occur with growing frequency because of the increasing amounts of intermittent renewable resources being added into the grid.⁸ This anticipated need is exacerbated by the looming expected retirement of existing flexible once-through cooling resources. The second element is a long-standing reluctance of generators that are understood to be physically capable of flexible operation to offer their output in a manner that allows their units to be dispatched flexibly. We understand that these two elements are both serious concerns for the sufficiency of flexible supply.

This policy initiative is therefore directed at achieving two closely related but distinct objectives: (1) promoting long-term capital investment in flexible units and (2) incentivizing participation of those units in the CAISO's short-term energy and ancillary service markets. We understand

⁸See, for instance, *Joint NERC/CAISO report on Variable Generation, 2012*, www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC-CAISO_VG_Assessment_Final.pdf or California ISO, *Draft White Paper on Over-supply and Shortage of Downward Ramping Supply in Off Peak Hours*, Jan. 2011, www.caiso.com/Documents/DraftWhitePaperonOver-supplyandShortage-DownwardRampingSupplyin-fPeakHours.pdf. We use the term *net load* to describe the total demand less the amount of generation from inflexible sources, such as non-dispatchable renewable output. However, we note that our use of the term "net load" should not be viewed as accepting that its components are immutable; in order to realize the full economic and environmental benefits of renewable generation, it is imperative that all components of net load become more flexible in the future.

from the CAISO that between 27,000 and 31,000 MW of capacity in California would presently qualify as flexible under this proposal. However, we also understand that even modest assumptions about average resource availability, variations in hydro conditions, and the apparent desire of resources to self-schedule can reduce the effective amount of flexible supply offered into the market to between 10,000 – 14,000 MW in months in which flexible capacity is most needed. The CAISO believes that a substantial portion of the 27,000 to 31,000 MW of existing flexible capacity could operate flexibly but chooses not to. Some of the factors that are believed to contribute to the level of inflexible offers have been discussed or referred to in prior stakeholder initiatives, such as the structure of the bid production cost guarantee and CPUC approved combined heat and power contracts.⁹ We are not aware that any further analysis of these incentives has been undertaken in the course of this initiative. Absent knowing exactly what factors currently discourage resources from offering their output flexibly, it is impossible to assess how successful this must offer requirement will be in overcoming these factors.

We discuss these two objectives, beginning with the incentives for participation in the short-term markets.

3.1 Bid Inflexibility

It is important to note that in order to develop an effective policy for incentivizing the flexible participation of generation units that are capable of doing so, it is necessary to understand the reasons for why participation is not already happening. Although “participation” is somewhat difficult to quantify, our sense is that this problem is more severe in the CAISO than in the eastern ISOs or the Midcontinent ISO. These markets lack any formal requirements for flexibility, yet to date appear to experience fewer problems than the CAISO with the inflexible self-scheduling of units.

Several explanations have been offered for the frequent self-scheduling of at least some categories of generation in the CAISO.¹⁰ For example, generation from CHP units is often provided under the terms of QF contracts that may financially discourage flexible operation or the nature of the host process may hinder flexible operation. Owners of hydro resources may prefer to self-schedule their output to better manage the uncertainty associated with CAISO markets or to take account of inter-relationships not reflected in the CAISO dispatch algorithms. More generally, some aspects of the CAISO market, such as policies for bid-cost recovery (BCR), can discourage participation in the real-time market. Some of these aspects may be addressed soon, such as the soon-to-be-implemented changes to BCR that provide for separate recovery of day-ahead and real-time costs,¹¹ but it is not known at this time what impact those changes may have on the amount of flexible bidding.

⁹See California ISO, “Straw Proposal on Reforms to Energy Market and PRIP Rules and Procedures, Renewable Integration: Market and Product Review Phase 1,” December 22, 2010, pp. 9-11.

¹⁰ *Ibid.*, pp. 10-11.

¹¹ www.caiso.com/informed/Pages/StakeholderProcesses/BidCostRecoveryMitigationMeasures.aspx

If these problems stem from systemic issues related to either physical limitations, contractual constraints, or confounding regulatory requirements, the imposition of a mandate for some fraction of these units to behave flexibly could prove much more costly than engineering cost estimates might imply.

Put another way, in order to efficiently overcome whatever market or regulatory distortions are presently discouraging participation of these flexible units, the must-offer mandates associated with flexibility requirements need to be designed so as to address those issues. It is not obvious to us that the categories and protocols developed in this proposal are shaped with that goal in mind. If part of the problem is CPUC or CAISO rules, and these rules are not changed, then trying to solve the problem through binding requirements such as these could lead to a costly and inefficient solution to the flexibility problem.¹²

3.2 Forward Procurement and Flexibility

As general matter, it is not obvious that a forward requirement such as the Resource Adequacy framework is the most efficient means of procuring flexible capacity. On a theoretical level, RA requirements are frequently justified by some form of regulatory or market failure that is distorting or discouraging investment. By this logic, procuring flexible capacity through a RA process would be needed only if there is evidence of market failure.

Examples of possible market failures include free ridership or a “missing money” problem, such that the remuneration in short-term markets for the supply of flexibility is insufficient to cover the incremental cost of investing in and operating flexible resources or to overcome the opportunity cost of foregoing self-scheduling. Such a market failure can occur due to energy bid caps or the volatility-damping impact of long scheduling intervals (1 hour day-head, shorter in real-time), but scarcity pricing for energy and an appropriately designed short-term market for flexiramp might effectively address this problem. The missing money rationale for resources needed to meet peak demands (when prices are likely to be more extreme) is more compelling than for flexibility, where we have not seen evidence that bid caps or 5 minute real-time price intervals are significantly distorting payments to flexible resources during ramp-constrained periods. Another possibility might be that for some reason, the performance of flexible resources across a range of possible ramp periods cannot be properly remunerated through revenues from real-time energy price spikes and 5 minute flexiramp market.¹³ However, we are not aware of any explanation of why this might be the case.

¹² We are hopeful that other impending changes in market rules (namely separation of day-ahead and real-time bid cost recovery) will lessen the amount of flexible capacity that self-schedules. However, if large amounts of potentially flexible capacity still chooses to bid inflexibly, further investigation of the institutional and economic reasons for this is needed to identify how such barriers can be removed.

¹³ Overall energy prices might be depressed by entry of new capacity because of renewable energy mandates, which means that thermal capacity in general might not recover all of its fixed costs. If there is an excess of capacity generally, this is how the market should behave. However, if there is at the same time a need for more of that capacity to be flexible on a 5 minute time frame, then real-time markets (through flexiramp payments and energy price spikes associated with shortages of ramping capability during ramping periods) should differentially reward flexible capacity, providing incentives to offer

On a practical level, it is very difficult to properly value flexibility in a forward procurement context, given that flexibility (unlike capacity) has *many* attributes to it. Consequently the conventional RA policies may not be generalizable to ensure that adequate flexibility is provided efficiently. Many factors combine to determine the actual market and reliability value of a specific flexible resource. Some of these factors are the incremental offer price of capacity, its minimum load and start-up costs, its ramp rate, its daily, weekly, monthly and annual energy limits, its minimum up and down times, and its start-up or notification time. Last, the specific manner in which a unit chooses to participate (through its offer prices) in the market determines to a large extent the exact value it is contributing in terms of flexibility. While the CAISO has attempted to approximately account for some of these factors in its groupings of flexible capacity, and their proposal is a workable partial solution, it is in general impractical to fully account for all of these factors in forward procurement processes.

While an RA contract can be interpreted as a call option with a strike price set to the energy price cap, such an interpretation does not carry over to flexible RA, particularly when it is fragmented into categories with implicit assumptions about frequency of use which can be circumvented through resources bidding behavior in the energy market. Some of the practical complications involved in cost effectively contracting for flexible capacity without taking account of these factors can be illustrated by the following five examples.

- A resource that offers supply at the price floor is not providing much additional flexibility relative to a resource that self-schedules its output.
- A resource that offers supply, perhaps in the form of demand reduction, at a high price might not be providing much economic benefit relative to the cost assigned to a power balance violation.
- The economic and environmental value of capacity able to start up in order to meet peak ramps depends on the resource's start-up costs and emissions.
- The economic and environmental value of capacity that is able to stay on line to meet multiple ramps over the operating day depends on the resource's minimum load output, costs, and emissions.
- The economic value of capacity able to stay on line to meet variations in intermittent resource output over the operating day depends on the resource's ramp rate as well as its minimum load output and costs.
- The economic value of ramping capability depends on the frequency with which transmission congestion makes that capability unavailable to be dispatched up or down to manage variations in net system load.

These examples illustrate the difficulty in distilling the full value of flexibility with one or two parameters. The actual value of the flexibility depends upon a wide range of attributes, and is highly case specific. Some attributes may be very valuable in some circumstances, but of little

flexibly and to make incremental investments to increase the flexibility of capacity. See Footnotes 14 and 15, *infra*, for more explanation of how real-time price fluctuations associated with ramping events benefit flexible capacity.

help in others. In advance, it is impossible to fully anticipate which of these attributes will be most valuable and at what locations.

We believe that these attributes are most appropriately valued in competitive spot markets that reward flexibility through energy, ancillary service, and perhaps flexiramp markets whose prices reflect changing market conditions and resource requirements, and whose volatility is not artificially suppressed.¹⁴ Well designed short-run markets result in least-cost scheduling of energy and account for flexibility needs. Such short-term markets will respond much more rapidly to changes in market conditions and requirements than would be possible through a resource adequacy design requiring a multi-year stakeholder and regulatory approval process to implement changes. Further, when generator attributes or bidding behavior limit flexibility (as in the examples above), profitability in such markets will decrease, providing incentives to enhance flexibility.¹⁵ The energy market, on the other hand, rewards whatever flexibility resource are able to provide at times when it is needed, even if the resource cannot commit to bid that way over all the hours required by the CAISO FRACMOO design. The energy market also better accommodates differences in the proportion of the various categories provided by individual LSEs, which could reflect historical differences in their resource mix, and differences in how they meet local capacity requirements.

Appropriate energy and ancillary service market prices will make it profitable for suppliers to offer as RA resources and efficiently operate a mix of resources that will be able to cost-effectively meet variations in net load. If energy and ancillary service market prices are efficient, and result in cost-minimizing mixes of resource investment and offers, then adding resource adequacy procurement constraints to the market may only serve to raise consumer costs

¹⁴ Ramps can be accompanied by both downward energy price spikes (in an interval in which a higher load would make it easier to meet the ramp in a subsequent interval) and upward spikes (in the interval when more supply is needed to meet the rising net load). A flexible resource will be dispatched down during downward spikes and dispatched up during upward ones, earning more net revenue than an inflexible resource with the same variable cost. The larger the variations in real-time prices, the larger the profit advantage of a flexible resource over an inflexible resource. Furthermore, because of the co-optimization, the energy price spikes would then affect the opportunity costs and therefore prices of ancillary services and flexiramp, particularly once Order 764 is implemented resulting in 15 minute pricing of all commodities.

¹⁵ Another advantage of rewarding resource flexibility in short-term rather than forward markets is that efficient short-term pricing of energy and ancillary services will value, on a comparable basis, the ability of both internal and external resources to meet ramp events of both short and long durations. This avoids the difficult issue of determining whether or how to reward external resources that provide ramp to the CAISO system. This comparability arises because, subject to transmission congestion and the limitations of 15 minute pricing at the interfaces, the price spikes that occur because of ramp events (whether fifteen minutes or over, say, three day-ahead hourly intervals) will equally reward adjustable resources and schedules that can provide the needed supply and ramp at those times no matter where the supply originates. Furthermore, inflexible internal loads and external schedules will bear the same penalty if they exacerbate a ramp event. Internal loads that have high consumption when the CAISO system is ramp constrained up will pay the high prices that occur during an upward ramp. Net imports that are low when the when the system needs up ramping supply will similarly not benefit from the high price.

when the RA requirements bind. However, absent such efficient short-run prices, the resource adequacy framework is needed to help select the appropriate mix of resources. This is likely to require a much more complex procurement process than envisioned by the ISO's draft final FRACMOO proposal.

However, we do not believe that an even more complex RA requirement than the ISO is currently proposing would be advisable at this time. As discussed above, the CAISO market is rapidly changing, in terms of the mix of generation, the projected need for flexibility, and finally short-term market rules such as for flexiramp procurement and the structure of bid production cost guarantees. As a result, the full value of any of the flexibility attributes, even if they could be measured accurately in the current environment, will likely change by the time the changes to the CAISO short-term markets are adopted. Furthermore, additional fragmentation of RA by introducing multiple categories of capacity with rigid obligations and limited trading opportunities could reduce liquidity in over-the-counter capacity markets, with potentially negative consequences for efficiency.

4. General Discussion of the CAISO Proposal

We have described the significant challenges involved in procuring and deploying an efficient mix of flexible resources through an RA mechanism. In our opinion, a generic RA process combined with a well-designed market for a short-term flexible ramping product and a residual market for backstop capacity is more likely to produce the desired results of investment in flexible resources for the long run as well as efficient participation by existing flexible resources in the CAISO markets. We believe that short-term market revenues are more effective in rewarding availability and performance at precisely the times that such capacity, and performance, is needed.

Nonetheless, the current proposal may provide a short-term backstop that addresses concerns that the CAISO overall market design will not keep needed flexible capacity in operation. The proposal also has the potential to produce information about these challenges. We believe that the CPUC decision that establishes the interim flexible capacity procurement obligation is properly framed as an *interim* measure addressing an immediate concern of the CAISO. This is particularly true given that a short-term market for flexible ramping product has yet to be fully implemented, and other important changes with regards to renewables integration and improved interactions with neighboring control areas are due to be implemented in coming years.

The needs definitions and must-offer requirements in the CAISO proposal can also be viewed in this light. They are a first step down the path of a better understanding of both (1) the needs for flexible capacity, and (2) the incentives necessary to promote participation of that capacity in the CAISO short-term energy markets.

Once the upcoming changes to CAISO's short-term market designs are implemented and the CAISO establishes its market based procurement of backstop capacity, the procurement of flexible capacity through the RA process should be revisited. Providing flexibility through short-term markets with properly designed incentives has the potential to solve many of the thorny issues (such as the relative merits of a 5 minute vs. three hour ramping standards) and LSE by

LSE procurement mix requirements that were encountered in the process of developing this proposal. Also the difficulty of defining must offer obligations that can accommodate the diversity of resources available to provide flexibility will be solved by procuring energy and the flexible ramping product from whoever can most economically provide it in short-term markets.

It is possible, and indeed desirable, that sufficient energy and flexiramp revenues will be earned by flexible resources such that the price premium for flexible capacity in the RA market will go to zero.¹⁶ In other words, if firms would find it desirable even in the absence of a requirement, to invest in flexible resources to such an extent that their capacity reaches or exceeds levels specified by the flexible RA requirement, flexible RA might cost no more than other types of RA. Under this scenario, the RA requirement for flexibility could be irrelevant and add no additional costs. However, with multiple categories of flexible RA, there is a possibility that the requirements for the base category might bind, despite sufficient flexibility being available to meet reliability needs.¹⁷ In this circumstance, the procurement of some types of flexible capacity may be quite expensive if the RA process requires more of these resources than is necessary from an economic or reliability perspective. Given the difficulties in forecasting in advance exactly how valuable each category might be, and how much will be needed, these capacity prices may not accurately reflect the underlying value such capacity would add to the system.

Given the above considerations, we support the current minimalist approach of this proposal. It addresses the immediate challenge of operationalizing the interim CPUC decision, while deferring some of the thornier issues. Deferral allows the CAISO to take advantage of additional data regarding potential shortfalls in flexible resources, and to better coordinate with other related initiatives pertaining to flexiramp markets, a market-based backstop and the multi-year RA are resolved.

In the remainder of this opinion we will address several specific issues regarding the elements of the CAISO proposal.

5. Comments on Specific Issues

5.1 Requirement Determination

The determination of yearly and monthly requirements for flexible RA in each category will be based on the largest net load ramps over a predefined (three hour) interval. In general, the ISO

¹⁶Such a market development would also likely depress RA payments for inflexible resources because of the greater energy and ancillary service margins earned by flexible resources. This would be consistent with projections of future market conditions in which there is no need for additional inflexible capacity and, as a result, the equilibrium RA payment will be less than the full cost of new inflexible resources. Footnotes 14 and 15, *supra*, explain how flexible capacity differentially benefits from real-time price variations resulting from ramp events by being able to ramp upwards during high price events and avoid intervals with downward price spikes..

¹⁷ The constraint for the base category is a lower bound, while for the other, less premium categories, they are upper bounds. If the upper bounds are defined too tightly for less premium categories, so that more of the base category needs to be acquired, costs could increase unnecessarily.

requires flexibility in its resource mix to meet ramps that can occur over intervals ranging from seconds (met by regulation) to minutes (addressed by resources that contribute to meeting the flexiramp constraint in the real-time market) to three hours (addressed by flexible RA resources). The resources that would optimally meet each are likely to be somewhat but not completely overlapping. The ISO's proposal implicitly assumes either that resources are sufficient to meet ramps whose durations exceed 5 minutes but are shorter than 3 hours, or that resources acquired for those bookend cases would also economically meet intermediate ramps. This conclusion could be better justified by explicitly quantifying the likelihood of extreme ramps of each duration, and comparing them to the flexibility of the resource mix likely to be provided if the flexiramp and 3 hour flexible RA requirements are met.¹⁸ There is a potential that if only the requirements for 3 hour flexible RA and 5 minute flexiramp are met, then the CAISO might not acquire mix of ramping characteristics that would most efficiently meet the full range of flexibility requirements.

Some comments by stakeholders claim that the proposed determination of the three hour ramp need may overestimate the need for flexible RA procurement since it does not account for flexibility that is provided implicitly through the energy markets. In particular it was pointed out that the CAISO's ability to control imports and export through its 15 minute dispatch under FERC Order 764 will provide ramping capability which is not accounted for in the requirement determination since imports are not eligible under the CAISO proposal to be counted toward meeting flexible RA. For instance, the day-ahead market could schedule an increasing amount of imports over a two or three hour morning or evening ramp. In our opinion, this is an example where the resources that could be scheduled day-ahead to meet a three hour ramp do not overlap completely with resources needed for short-term ramps on the order of minutes. Since three hour ramps are forecast day-ahead when imports and exports can be scheduled, we anticipate that the cost-effective mix of resources to meet the highest such ramps over the month will include adjustments to imports. Setting procurement targets of flexible RA provided by physical CAISO resources without regard to the flexibility available from external sources (such as adjustments in interchange schedules) poses a risk of over-procurement and higher costs than necessary to meet the actual system need for flexibility. We recognize that there are complications in accounting for the flexibility provided by adjustments in net interchange, but not accounting for this flexibility at all likely misstates actual system needs. The historical role of adjustments in net interchange in meeting the predictable morning and evening ramp requirements could be analyzed using historical data, and the CAISO could make further adjustments in the future as it gains experience with interchange scheduling on a 15 minute basis and as a better price signal is provided for short-term adjustments in interchange schedules..

We suggest that the CAISO use data from the 2014 RA compliance year in which flexible RA provision is voluntary to reevaluate its methodology for determining the flexible RA requirement. This should include an assessment of whether the targeted procurement reflects the actual need, accounting for the ability to adjust ramp capability by adjusting net interchange, and the offering behavior of the procured capacity under the proposed MOO. We understand that it

¹⁸ We understand that there have been non-public studies of this issue by entities outside the CAISO, but because those studies cannot be reviewed, we are unable to assess the analytical support for such a conclusion.

may be several years before the flexible RA obligation begins to bind, and the ability to collect such data before the CPUC flexible RA obligation becomes binding is a reason to expedite the implementation of the CPUC flexible RA decision so as to begin observing the operation of the design. The time schedule of the CAISO FRACMOO proposal is useful from this perspective.

5.2 Showing Assessment and Resource Counting

Some stakeholder comments suggested that the determination of the requirement for flexible RA capacity resources should account for flexibility that is provided implicitly in the short-term energy market by resources that are not flexible RA, in particular to account for the flexibility provided by imports and export 15 minute dispatch. We suggest that the CAISO use the 2014 and subsequent compliance years to collect data for evaluating how resources that are dispatchable at different time frames (*e.g.*, 5 vs 15 minute vs hourly) may contribute to meeting ramping needs, even if they don't qualify to provide flexible RA. We hope that, with the implementation of FERC Order 764, the CAISO will gain some insight into the ramp available from 15 minute interchange. The CAISO should also assess the extent to which hourly interchange reduces the need for ramp compared to the targets that result from considering only CAISO net load. If the expectation that the flexible capacity procurement constraint will not bind or not bind materially for several years is correct, the CAISO will have time to refine how it sets the target before the constraint begins to bind.

5.3 Allocation Methodology

The proposed allocation methodology assigns shares of the total flexible capacity requirements to LRA areas based on the average contributions of their jurisdictional LSEs to the various components (the "Deltas" referred to in Section 2, above) of the five highest monthly net load ramps. PG&E has argued that the proposed allocation methodology is unfair since it favors LSEs whose individual peak ramps do not coincide with the system highest net load ramps. Consequently PG&E has proposed an alternative allocation methodology that accounts for each LSE's individual peak ramping contribution in determining their obligation, without regard to whether the individual ramp requirement coincided with the overall CAISO ramp requirement.

We do not support the PG&E fairness argument since it stands in contradiction to established economic principles of marginal cost pricing and peak load pricing theory. Their argument asserts that procured flexible RA based on peak ramping needs also supports ramps that do not coincide with the system peak ramps so LSEs whose main contribution to ramping occurs at times other than the peak ramps upon which the CAISO allocation is based are "free-riding" on the flexible capacity provided by those contributing to the coincident peak ramps.

However, a similar argument could be made with regard to marginal cost pricing for energy. High marginal prices paid by users of electricity during peak load periods provide infra-marginal payments that support the capacity costs of base-load generation units. Hence, the PG&E logic would imply that a wholesale buyer of electricity whose consumption occurs off-peak and hence pays low off-peak energy prices is being subsidized or is "free-riding" on the peak load energy users who pay the capacity cost for the plants supplying the off-peak energy users.

It may be possible to develop a methodology that distributes the procurement costs or allocates the obligation of flexible RA based on the contribution to reliability in each hour and subsequently distribute it to the LSEs based on their hourly contribution to ramping need.¹⁹ Such a methodology may better address the equity concern raised by PG&E but will reduce incentives to shift ramps away from the system peak ramps and add unwarranted complexity to the allocation processes.

Therefore, given the CAISO's current proposed methodology for determining flexible RA requirements, we support the CAISO proposed allocation methodology as a reasonable and simple approach that provides incentives to LSEs to diminish their contribution to the peak system net-load ramps that the CAISO is concerned about. We cannot think of any efficiency gains that would result from an allocation that would put more weight on individual LSE peak ramps, given the way the CAISO proposes to establish the overall requirement. However, as the CAISO gains more experience with the factors driving the need for flexible RA capacity, it may become apparent that the 3 hour ramp is not the actual or sole driver. If that occurs, then other factors may be appropriately taken into account in allocating procurement costs.

5.4 *Must-Offer Obligation*

The CAISO proposal addresses the must offer obligation of a diverse resource portfolio by introducing three technology-agnostic categories of flexible capacity with associated must offer obligations. The categories have been designed to accommodate in an approximate way the diverse operating characteristics of the various resource types that serve the California market, while attempting to avoid excluding any technology from any category whose attributes that the technology can provide. The proposed design allows the resource owners to self-select the category of flexible capacity they provide. Resource operating restrictions will result in *de facto* limitations on which resources can provide which category of flexibility. The CAISO has been responsive to stakeholder comments by removing some of the initial limitations on the participation of certain resources in certain categories and by adding clarity to the MOO description.

One stakeholder comment raised the concern that demand response may be crowded out by gas-fired resources, asking that limits be imposed or other mechanisms be implemented to give priority to demand response resources in providing the lowest category. However, until the CAISO has experience with whether any or how much demand response will be offered in any of these categories at a cost competitive price, as well as experience with the use of demand response to manage variability in net load, we believe that setting such a quota risks requiring consumers to procure demand response at a high price to meet a role it is not suited for. It would be better to define classes with technology-agnostic characteristics and allow consumers or

¹⁹ Such a methodology has been proposed in the peak load pricing literature for allocating the cost of capacity across all hours based on the contribution of that capacity to reducing the loss of load probability in each hour and subsequently allocating the hourly capacity cost to load in each hour on a load share basis (see J. Vardi, J. Zahavi and B. Avi-Itzhak "Variable Load Pricing in the Face of Loss of Load Probability, *The Bell Journal of Economics*, Vol. 8, No. 1, Spring, 1977, pp. 270-288).

demand response providers develop their ability to meet those requirements over time, if they are able to do so cost effectively.

Overall, however, there seems to be overwhelming stakeholder support for the technology-agnostic category approach. This also provides opportunities for particular resources to modify their characteristics so as to provide more valuable flexibility. The simplicity of this approach is compelling but it remains to be seen if this approach will cost-effectively meet the CAISO needs for flexible resources. We understand the view that the categories should be defined based on CAISO needs with as few as possible restrictions on participation by different resource types in order to maximize the flexibility and competitiveness of these markets while ensuring that the flexibility needs are met. We also understand the concern that this will result in categories that in practice do not procure the mix of resource characteristics that is needed or do not procure it on a cost-effective basis. Given the interim nature of the proposed flexible RA mechanism and the uncertainties regarding actual CAISO flexibility needs and whether energy and ancillary service market prices will elicit the needed supply, we support the postponement of a more elaborate framework until the RSA and standard capacity products are developed and the Flexiramp product markets is finalized. These other components may provide the additional tools needed for a more holistic solution.

As indicated earlier, the three categories have been designed so that they reflect a hierarchy of availability and response capability similar to the hierarchical relationship of the different reserve types procured in the ancillary service markets. There is an implication in the CAISO proposal that resources in the base flexibility category in the hierarchy entail higher availability which will likely lead to more frequent use. However, more frequent dispatch will not necessarily occur because the use of the different resources will depend on their bidding behavior in the energy markets. Consequently, it is possible for a high-cost but flexible resource to be used relatively infrequently, which would be appropriate.²⁰

The proposal includes no provisions for market power mitigation. In theory, an owner of relatively large amounts of flexible capacity might be pivotal with respect to, for instance, class 1 requirements. Then that producer might exploit the flexibility in choosing the class of capacity by offering some of the potential class 1 capacity instead as class 2, in order to create a shortage of class 1 capacity. As a result, the price paid to flexible RA might be significantly increased, although under the present backstop procurement proposal, it would not increase to more than the price paid for backstop capacity. If that proposal was to be changed to allow higher payments, then potential price increases would be higher. We have no information as to whether any producers are potentially pivotal in the flexible RA market, so we urge the ISO to monitor the concentration of ownership of flexible capacity and assess whether providers are potentially pivotal in the flexible RA market.

²⁰ As observed above, one of the limitations of a RA procurement process relative to energy and ancillary service prices in incenting the supply of flexible capacity is that energy and ancillary service markets provide a more complete set of incentives for the supply of an efficient mix of resources. We do not recommend trying to account for all of these tradeoffs in the RA procurement process but rather recommend trying to ensure that the needed supply of flexible capacity is elicited by the incentives provided by the energy and ancillary service markets.

5.5 Backstop Procurement

We support the proposal to use the Capacity Procurement Mechanism (CPM) framework as an interim mechanism for procuring backstop flexible capacity until the sunset date of CPM when it will be replaced with the RSA under development. We are told that at this point all the stakeholders agree to use the same CPM price for backstop procurement of generic RA and flexible RA.

6. Summary and Recommendations

Implementing a target for flexible RA procurement and imposing a must offer obligation on flexible RA capacity will provide extra assurance that load serving entities will contract for the amount of flexible capacity the CAISO expects to be needed, if the energy and ancillary service markets do not properly value and compensate such resources. The initial years when the flexible capacity requirement is expected to be non-binding have the potential to provide helpful insights regarding the ability of the LSEs to meet the flexible RA targets set by the CPUC and the adequacy of these targets to provide the CAISO with the flexibility it needs. Such data will also inform the CAISO on how generators may respond to incentives, and shed light on the factors that limit the amount of flexible capacity available for procurement in the RA process. At the same time, the voluntary nature of the 2014 flexible RA targets limits the risks of overpayment for flexible RA that could occur if more capacity is required than is actually needed.

However, in 2015, under the CPUC rule, the flexible RA showing requirement becomes an obligation, and such overpayment will become more of a risk if and when the flexible capacity procurement requirement begins to bind. Hence, what is learned in 2014 and subsequent years could lower this risk. In particular, in establishing procurement obligations that will be enforced as a mandatory requirement, it will be important that the CAISO draw upon the lessons of the early years to fine tune the monthly and annual flexible RA requirements in the various categories. This is needed to ensure that the 2015 and subsequent flexible capacity requirements take into account of the flexibility available from other sources in meeting the ramps used to define the procurement targets so that the mandatory targets are in line with actual system needs for flexibility from RA resources.

Benchmarking flexible capacity requirements based on peak net-load ramps against the amount and mix of flexible capacity actually used to meet historical peak ramps would be one check on the requirements.

In order for the flexible RA requirement and must offer obligation to provide assurance that load serving entities will contract for the amount of flexible capacity needed to meet these projected ramp requirements, the CAISO will need to gross up the amount of flexible capacity actually needed to meet the projected ramps to at least account for capacity likely to not be available due to short-term outages and deratings, and will likely also need to account for the amount that would be uneconomic to commit. In addition, the CAISO will need to account for the amount of flexible capacity that was on line, but because of dispatch practices, was not actually available to

meet the peak ramps. This will be complex, and understating the gross up will mean that the requirement provides little if any extra assurance that adequate flexible capacity will be available, while overstating the gross up could lead to inflated requirements and procurement costs. The experience during the initial years of flexible capacity procurement should be helpful in understanding how these considerations should be taken into account in defining mandatory requirements before the requirements begin to bind. Furthermore it is our understanding that the CAISO committed to an annual study process with stakeholder meetings to address the fine tuning of these requirements.

In order to avoid higher than anticipated costs for meeting the requirement, should the data on flexible RA procurement begin to suggest potential shortages of flexible RA, the CAISO needs to work with stakeholders to understand the reasons, if any, that the energy market is not eliciting the needed supply and that potentially flexible capacity is not available for procurement as flexible capacity or is only available at a substantial premium. This is necessary so that the CAISO or the CPUC can address those causes so that flexible RA procurement costs are not inflated by unnecessary barriers or costs to supplying flexible capacity in the RA process. Similarly, it is important to understand why potentially flexible resources are not bidding in a flexible manner in the market; are there features of the market, contracts, or regulations that encourage self-scheduling or inflexible bidding? Understanding these causes will help in designing must offer obligations that are effective and do not impose substantial costs on resource owners or power consumers.

Finally, we conclude that short-term markets should be the primary source of economic incentives for providing flexibility to the CAISO system. There are two reasons for this conclusion. First, short-term energy, reserves, and flexiramp markets respond by providing energy precisely when needed during ramp periods, and thereby avoid the very serious conceptual and practical problems of trying to accurately evaluate the contribution of imports, storage, start-limits, energy-limits, and other attributes in resource adequacy markets. Second, whether there is a market failure in those short-term markets that would yield too little flexibility is not well understood. There are several changes that are being made or could be made to the CAISO markets to ensure that flexible resources are appropriately incented. These include creation of a flexiramp product; separation of day-ahead and real-time bid cost recovery; moving to 15 minute markets for interchanges under FERC Order 764; geographic expansion of the energy imbalance market; decreasing the use of out-of-market dispatch; and expanding scarcity pricing through appropriate reflection of energy imbalance and other constraint violation penalties in locational marginal prices. If these changes are successful and if flexible RA requirements are not overstated relative to actual system need, we anticipate in the long run that flexible RA capacity will receive little or no premium in the RA markets.