

Opinion on
Reliability Services Phase 1 and
Commitment Costs Enhancements Phase 2

by

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

Members of the Market Surveillance Committee of the California ISO

Final Opinion
March 23, 2015

1. Introduction and Summary of Recommendations

With a goal of 33% renewable electricity production by 2020, the California power system will face increasing challenges to manage the variable output of wind and solar resources. Since the publication of the ISO’s “20% Study” in 2010, it has been recognized that inadequate investment in flexible resources or a failure of those resources to offer flexibly into the ISO markets will increase the cost of integrating variable renewables and could result in difficulties in matching system supply and demand during periods of steep up- or down-ramps.¹ In response, the ISO has developed a series of initiatives designed to motivate flexible offers and, ultimately, to encourage appropriate investments in flexible resources. Some of these initiatives, such as the flexible ramping product, change the operation of the short-term dispatch and spot markets for energy and ancillary services. Others, in cooperation with the California Public Utilities Commission focus on resource adequacy (RA) mechanisms, including the definition of flexible RA requirements and the must-offer obligations (MOO) imposed upon capacity designated as flexible by RA mechanisms.

The Market Surveillance Committee (MSC) of the California Independent System Operator (CAISO) has been asked to comment on two related proposals that address implementation issues for the flexible RA requirements and rules governing their offers into the ISO day-ahead and real-time markets. These proposals are the Reliability Services Initiative Phase 1 (RSI)² and

¹ CAISO, Operational Requirements and Generation Fleet Capability at 20% RPS, August 31, 2010, www.caiso.com/Documents/Integration-RenewableResources-OperationalRequirementsandGenerationFleetCapabilityAt20PercRPS.pdf

² CAISO, Reliability Services, Draft Final Proposal, Jan. 22, 2015, www.caiso.com/Documents/DraftFinalProposal-ReliabilityServices.pdf; Addendum, Feb. 27, 2015,

the Commitment Costs Enhancements Phase 2 Initiative (CCE2).³ These will be considered by the Governing Board of the California ISO during their March 2015 meeting

The RSI initiative consists of two phases, the first of which we address in this opinion. The overall initiative is to address the ISO's RA rules and processes to ensure that the system's requirements for flexible resources, as well as local and system resources, will be met. As explained in the RSI draft final proposal, the first phase of the initiative focuses on RA rules and processes that must be updated for reliability or regulatory reasons. It is divided into three parts. The first part relates to enhancements to further integrate preferred resources into the grid and rules for integrating flexible RA resources into the energy market. The second part updates the RA availability incentive mechanism, most notably basing the incentive for flexible RA upon whether or not a flexible resource economically offers into the market, not just on whether it is on forced outage or not. The third part revises RA outage management rules, and is intended to serve as a platform to develop flexible RA outage rules in phase two of the RSI.

The second initiative, CCE2 is a continuation of the Commitment Cost Enhancements proposal⁴ adopted by the Governing Board at its September 2014 meeting. The original (phase 1) CCE proposal addressed procedures used to calculate start-up and minimum-load costs for electricity generators. Under the CAISO's current market design, accurate estimation of these commitment costs by the CAISO is important to ensure efficiency of market operations. Caps upon offers for energy and for start-up and minimum run costs should be broadly reflective of actual costs in order to ensure that resources are incented to make offers without having an opportunity to exercise market power. The CCE Phase 1 proposal deferred the consideration of how opportunity costs, which can be a large component of marginal energy costs and of start-up and minimum load expenses for use-limited resources, can be estimated because of the need for further development of calculation procedures. Opportunity costs arise because of limitations upon the amount of energy production, number of starts, or number of operating hours during a time period; as a result, a generating unit should husband its limited energy, starts, or hours of operation for the times when its energy production and ancillary services are most valuable to the system.

The present CCE Phase 2 proposal again defers the opportunity cost calculation rules and procedures further to a later CCE Phase 3 proposal, which will also address some other unresolved issues concerning major maintenance adders, greenhouse gas costs, and accounting for gas transportation costs. CCE Phase 2 addresses two other sets of issues not fully addressed in Phase 1. The first is a clarification of the definition of use-limited resources, whose must-offer rules differ from those for non-use-limited resources. The issue of must-offer rules is where the CCE Phase 2 and RSI Phase 1 proposals intersect, and is the reason we are considering them together. After CCE Phase 3 is implemented, it is anticipated that many use-limited resources will be allowed to

www.caiso.com/Documents/DraftFinalProposalAddendum-ReliabilityServices.pdf

³ CAISO, Commitment Costs Enhancement Phase 2, Draft Final Proposal, Feb. 9, 2015, www.caiso.com/Documents/DraftFinalProposal_CommitmentCostEnhancementsPhase2.pdf

⁴ CAISO, Commitment Costs Enhancement, Revised Draft Final Proposal, Aug. 21, 2014, www.caiso.com/Documents/RevisedDraftFinalProposalCommitmentCostEnhancements.pdf

bid their opportunity costs, but at the present time, most such resources manage their use limitations by withholding their capacity from the market when it is not expected to be needed, and are excused from must-offer obligations if they offer their output in accord with their approved use plans. Resources should not be allowed to claim use-limited status simply to be held to a more lenient performance standard. The second set of issues addressed is relatively minor, and concerns cost accounting and offers, such as the treatment of multistage generators. In this opinion, we comment of the first set of issues.

The MSC has addressed the RSI proposal in recent meetings, including March 11 and May 19, 2014 and Feb. 19, 2015. More generally, the MSC has been considering the design of resource adequacy mechanisms and short-term energy markets to encourage flexibility for several years. Since the publication of the ISO's "20% study" in 2010, the MSC has examined a range of issues and initiatives concerning incentives for provision of flexible resources. These have included our 2012 opinion on flexible capacity procurement and risk of retirement,⁵ a 2014 opinion on must-offer obligations for flexible RA,⁶ and several opinions addressing how the ISO's short-term energy markets should be designed to encourage efficient offers and dispatch of flexible capacity. The latter include opinions on how commitment costs should be estimated, bid, and compensated in the ISO markets;⁷ on payments for capacity used to meet the flexiramp constraint in real-time markets;⁸ and on the Renewable Integration: Market and Product Review, which addressed bid floors, bid cost recovery calculations, and revisions to the Participating Intermittent Resource Program (PIRP) designed to have contracting parties realize more directly the value of their real-time production so as to motivate them to bid more flexibly.⁹

⁵ Market Surveillance Committee of the California ISO, "Final Opinion on Flexible Capacity Procurement - Risk of Retirement," Sept. 2012, www.caiso.com/Documents/MSCFinalOpinion-FlexibleCapacityProcurementRisk-Retirement.pdf

⁶ Market Surveillance Committee of the California ISO, "Final Opinion on Flexible Resource Adequacy Criteria Must Offer Obligation," March 11, 2014 <http://www.caiso.com/Documents/FinalOpinion-FlexibleResourceAdequacyCriteriaMustOfferObligation.pdf>

⁷ Market Surveillance Committee of the California ISO, "Final MSC Opinion on Commitment Cost Enhancements," September 2014, www.caiso.com/Documents/MSC_FinalOpinionCommitmentCostEnhancements-Sept2014.pdf; Market Surveillance Committee of the California ISO, "Opinion on Bid Cost Recovery Mitigation Measures and Commitment Costs Refinement", May 7, 2012, www.caiso.com/Documents/MSCFinalOpinion-BidCostRecoveryMitigationMeasures_CommitmentCostsRefinement.pdf; Market Surveillance Committee of the California ISO, "Opinion on Changes to Bidding and Mitigation of Commitment Costs," June 4, 2010, www.caiso.com/Documents/FinalOpiniononChanges-BiddingandMitigation-CommitmentCosts.pdf; Market Surveillance Committee of the California ISO, "Comments on Changes to Bidding Start-Up and Minimum Load," July 16, 2009, www.caiso.com/Documents/FinalOpiniononStart-UpandMinimumLoadBiddingRules.pdf

⁸ Market Surveillance Committee of the California ISO, "Final Opinion on Payment for Provision of Flexible Ramping," Aug. 16, www.caiso.com/Documents/FinalOpinion_Payment_Provision_FlexibleRamping.pdf

⁹ Market Surveillance Committee of the California ISO, "Opinion on Renewable Integration: Market and Product Review, Phase 1," Dec. 8 2011,

More recently than these opinions, the MSC has considered the issues of flexible ramping product in public meetings of the MSC on August 22, October 15, and December 16, 2014, as well as the definition of future flexible capacity needs at the latter meeting.

Based on our review of the ISO proposal, stakeholder input, and our review of experience with similar problems in the eastern ISOs, we have reached the following conclusions about the elements of the ISO proposals:

- The first part of the RSI addresses the development of eligibility criteria and must-offer obligations for certain resource categories. We support treatment of distributed resources in the same manner as resources interconnected with the transmission system. Defining the default qualifying capacity of non-generator resources based on the output the resource can sustain over a 4 hour period is not unreasonable, but the choice of period is not a precise bright line driven by physics and economics. The need for this and other somewhat arbitrary bright lines is inevitable in resource adequacy markets. Thus, such lines will likely need to be adjusted with experience. We have discussed in prior opinions and meetings the difficulty of defining the default qualifying capacity requirements that will ensure that RA resources that are capable of providing flexible capacity will indeed offer their capacity in a manner that most effectively and efficiently contributes to meeting CAISO resource needs. We have also stressed the consequent importance of energy and ancillary service market mechanisms that will incent resources capable of providing flexible capacity to operate in that manner.
- The RAAIM is designed to split the difference between the view that the RA design needs to provide a strong incentive for RA suppliers to live up to the obligations undertaken when selling RA, and the view that the energy and ancillary service markets will generally provide adequate and efficient incentives. It reduces the per-MWh penalty for non-performance relative to the current design while also eliminating important exemptions to the non-performance penalties. An important example is including planned outages that are triggered in the wake of a forced outage in order to make the necessary repairs. In our opinion both steps are, in general, an improvement upon the previous mechanism as it has been applied to standard capacity resources. However, as we note below, higher, not lower, penalties could be more efficient during high demand periods, but this would entail a much more complex RAAIM design.
- Significantly, the RAAIM also expands the performance metrics to cover the additional obligations undertaken by units selling flexible capacity. This adds financial consequence to the expanded Must-offer Obligation that is applied to flexible capacity resources. We note the potential for the RAAIM penalties to be too high in some periods (when there is more than enough capacity) and, more importantly, to be too low during times of resource scarcity. Too low a penalty could provide an inadequate incentive for making the expenditures needed to reduce forced outage rates.

- The choice of penalty is a difficult balance to achieve in any capacity based RA design and the CAISO will have to monitor how these penalties are affecting the propensity of units to bid their capacity flexibly, and to offer it as flexible capacity in the RA process. With regard to the structure of the proposed penalty, we support the CAISO proposal which opts for simplicity by having a single penalty which is applied whenever a resource fails to meet its Generic RA or Flexible RA must offer obligation rather than a more complex approach with different penalties for Generic and Flexible RA or a tiered structure of the must offer obligation with incremental penalties. While the single penalty approach is a blunt instrument, we are persuaded that in combination with the market based premium for Flexible RA (induced by the Flexible RA capacity requirement) and efficient spot market pricing of energy and ancillary services, it will be sufficient to induce a willingness to provide flexibility and compliance with the must offer obligation in the day-ahead and real time markets. We expect that the finer tuning of incentives will be accomplished through the short term energy and ancillary services markets.
- To better understand how to set the performance incentives we also recommend that the ISO continue to study the reasons apparently flexible resources do not bid flexibly, which we hope would provide guidance as to market rule changes that would incent greater flexibility in offers.
- Regarding the proposed adjustments to exceptions to the RAIM, we support all of them as they, on balance, reduce exemptions and start to normalize the standards of performance across different technology types. However, we note that significant gaps remain. Renewable intermittent resources will continue to be exempt from the performance metrics. Units subject to verified use-limitations that extend beyond the daily scope of the ISO's market runs will continue to be able to use outages to manage these limits and will not be subject to RAIM penalties for these outages. Permitting opportunity cost-based bidding of start-up and minimum load costs, as is intended in the Commitment Cost Enhancements Part 3 initiative, would allow for more efficient utilization of these use limited resources and enable the ISO to apply performance metrics to a broader set of RA resources.
- Although it may be possible over time to tinker with the RAIM penalties to better reflect the capacity contributions of different types of resources at different times, the potential for significant improvements will be limited by the RA mechanism's fundamental inflexibility to reflect rapidly changing system needs and the many attributes of a resource's design, operation and bidding strategy that impact the value of the capacity provided by the resource. For this reason, we reiterate our previous conclusion that a well-functioning spot market will in theory correctly value a resource's availability, flexibility, location, and other attributions, and incent the resource owner to offer and manage the resource in a manner that effectively utilizes the resource's flexibility. The ISO should therefore aim to enhance the efficiency of spot markets so that resource revenues will make up a material portion of the gross margin of resources. As a result, RA mechanisms (and RAIM in particular) would become relatively unimportant in incenting the efficient operation of resources, while continuing to provide for the recovery of a portion of

investment and going forward costs, which means that the consequences of distortions in capacity credit/AIM penalty calculations will matter less. The proposed RAAIM system will, we believe, provide improved performance incentives, but they are not a substitute for a properly functioning set of ISO markets for energy and ancillary services.

- The changes that the RSI proposes in replacement rules are positive steps towards simplifying the process of replacing RA capacity that is not available due to planned or forced outages. They pave the way for expanding this process to accommodate Flexible Capacity in phase 2 of the RSI. The CAISO hopes that these changes would make it easier for unavailable resources to replace their RA obligation with other resources owned by other entities, and thereby avoid penalties under the incentive mechanism and contributing to improved system reliability. We note, however, that shifting the replacement process onto the resource will lead to increased communications among suppliers about outage plans, which might contribute to facilitating of coordinated exercise of market power (either tacit or explicit) if large market players routinely exchange information about capacity outages. This shifting might also make it more difficult for small suppliers to arrange for replacement capacity and avoid penalties at times when there is no actual shortage of capacity. In theory, such coordination would be more difficult if replacement transactions were made through an arms-length central market. Moving slow in implementing such changes is probably a good idea given all the moving parts that need to be coordinated between the ISO, market participants and the CPUC, and the need by participants to evaluate the impact of such changes.
- Regarding the Commitment Cost Enhancements Phase 2, we are disappointed that the opportunity cost calculation procedures are delayed again, although we appreciate the potential complexity of those procedures and the need for careful review. Because of this delay, use-limited resources with true opportunity costs for their energy production, start-up, and running hours will have to continue to use inherently inefficient use plans to manage those limitations. As we have stated in a previous opinion, we believe that the best way to manage these use-limitations is to allow opportunity costs be included in resource offers to the market so that the decision to dispatch or not right now balances the benefits of operation immediately against the benefits of instead using the resource later.
- We understand the need for the restrictions proposed by the CCE2 proposal to restrict use-limited designations to units with genuine physical or regulatory constraints that result in opportunity costs beyond the time horizons of the ISO market software. If contractual provisions rather than regulations or physical limitations were to be allowed to justify a use-limited status, this could conceivably weaken incentives to avoid signing contracts that limit output, starts, or operating hours and perhaps incent the use of contractual provisions to avoid performance penalties when there are no physical or regulatory reasons for those restrictions. However, these changes in use limited designations need to be accompanied by the changes in restrictions in commitment cost offers to be implemented as part of CCE Phase 3 that will allow resources to make offers that are reflective of their actual costs, including opportunity costs.

2. RSI Part I: Enhancements to Resource Adequacy Criteria and Must Offer Obligation

The first part of the Reliability Services Initiative is the development of eligibility criteria, qualifying capacity criteria and must offer obligations for additional categories of resources (distributed generation and non-generator resources¹⁰) and adjustments to the existing rules for proxy demand response.¹¹

The CAISO proposes that distributed generation resources qualifying as a resource adequacy resource must be visible to CAISO, so must be a participating generator or system resource. The resources must either be at least 0.5 megawatts in size or aggregated to 0.5 megawatts or more across resources of the same type, but potentially at different locations.¹² The CAISO proposes to apply the same availability, bidding and must offer obligations to distributed resources as would be applied to a similar resource on the transmission system.¹³ We have not identified any valid reasons for applying different obligations to distributed resources.

The CAISO proposes that the default qualifying capacity of non-generator resources will be based on the output the resource can sustain over a 4 hour period.¹⁴ This approach is reasonable, but it needs to be recognized that it is an approximation. There is no bright line between the value of resources that are available, say, 3.75 hours, 4 hours or 4.25 hours. Resources capable of longer sustained output are potentially more valuable at the margin, but whether this is the case in practice to any material degree will depend on the overall mix of resources available to the CAISO. The need for such bright line distinctions is unavoidable in a capacity-based RA mechanism. The CPUC's maximum cumulative capacity buckets serve to balance the overall resource mix between resources with shorter and longer availability, but again necessarily relies on bright line distinctions when the operational impacts are not that discrete in practice.

The CAISO has determined that the default energy bid, regardless of how it is established, is not appropriate for use with non-generation resources. The CAISO therefore proposes to exempt non-generation resources from the bid insertion provisions of the must offer requirement. Instead, the CAISO proposes to monitor non-generator resource performance and the need for bid insertion rules.¹⁵

¹⁰ NGR is “a resource that operate as either Generation or Load and that can be dispatched to any operating level within their entire capacity range but are also constrained by a MWH limit to (1) generate Energy, (2) curtail the consumption of Energy in the case of demand response, or (3) consume energy.” Footnote 4 p. 17

¹¹ See Reliability Services, Addendum to the Draft Final Proposal, February 27, 2015 Part I, Sections 4 and 5.

¹² *Ibid.*, Section 4.3.1, p. 13.

¹³ *Ibid.*, Section 4.3.1, p. 14.

¹⁴ *Ibid.*, Section 4.3.2, p. 14.

¹⁵ *Ibid.*, Section 5.4, p. 23

Finally, the CAISO proposes to change the qualifying capacity requirements for proxy demand resources to require that they are available to be dispatched at 24 hours a month, for at least 3 consecutive days and for at least 4 hours per dispatch event.¹⁶ These bright line standards are again an approximation of more complex variations in the value of these resources but this is a necessary consequence of the capacity-based resource adequacy design. The proposed minimum dispatch duration is consistent with the requirement for other resources such as non-generator resources and is also consistent with the direction of changes in other ISO RTO markets, which are also tending to require longer and more frequent availability.

We have discussed in prior opinions and meetings the difficulty of defining requirements that will ensure that RA resources that are capable of providing flexible capacity will indeed offer their capacity in a manner that most effectively and efficiently contributes to meeting CAISO resource needs. We have also stressed the consequent importance of energy and ancillary service market mechanisms that will incent resources capable of providing flexible capacity to operate in that manner.¹⁷

3. RSI Part II. Resource Adequacy Availability Incentive Mechanism (RAAIM)

There have been different views about the need for and role of availability incentives as a feature of capacity-based products, such as California's resource adequacy framework. Although capacity and RA frameworks are designed to provide incentives primarily for the advanced procurement (and therefore construction) of generation capacity, such capacity is of no value when it fails to perform.

Of course, the prospect of revenues from sales of energy and ancillary services would be expected, absent market power, to provide incentives for generation owners to make their units available. Most stakeholders agree that the bulk of the performance incentive should and does come through these short-term market incentives.¹⁸ However, a view that the short-term markets will generally provide efficient incentives for unit availability once the capacity is built must recognize that the energy market will not provide efficient incentives when the cost of being remaining available is high relative to real-time shortage prices, if such prices are lower than the actual value of power to the system at such times. Further, if unreliable capacity which suffers more frequent forced or requires more planned outages can claim the same capacity value as more reliable sources, unreliable capacity could crowd-out more reliable sources from the procurement process. This concern is exemplified by the fact that, under the previous resource adequacy availability paradigm, resources could receive capacity credit, go on a planned outage for an extended period of time (multiple months) and be counted as 100% available during the entire period. Because payments are paid from a penalty pool, a resource on an extended planned out-

¹⁶ Ibid., Section 4.4, p. 15.

¹⁷ Market Surveillance Committee of the California ISO, "Final Opinion on Flexible Resource Adequacy Criteria Must Offer Obligation," *op. cit.*

¹⁸ As we argue in *ibid.*

age would take away potential revenues to participating resources and potentially receive more availability payments than a resource adequacy resource that was actually participating in the energy markets.

The proposed resource adequacy availability incentive mechanism (RAAIM) is designed to split the difference between the view that firms need a strong incentive to live up to the obligations undertaken when selling RA, and the view that the energy and ancillary service markets will generally provide adequate and efficient incentives. It reduces the per-MWh penalty for non-performance while also eliminating important exemptions to the non-performance penalties, most notably including all forced outages in the incentive mechanism. In our opinion, both steps are an improvement upon the previous mechanism as it has been applied to standard capacity resources.

Significantly, the RAAIM also expands the performance metrics to cover the increased obligations undertaken by units selling flexible capacity. This adds financial consequence to expanded Must-offer Obligation that is applied to flexible capacity resources.

We address several aspects of the RAAIM design. These include the level of the RAAIM payment, the number of payment categories, and the remaining exemptions for resources in the following subsections.

3.1 RAAIM Incentive Price Level

The challenge in setting performance penalties is establishing a level that is high enough to incent generation units to be available when needed, but not so high that the potential penalties from under performance could exceed the revenues from selling capacity in the first place. Under the expiring Standardized Capacity Product (SCP) framework, availability incentive payments were based upon a price of \$5.91/kW-month. One of the concerns with this level is that we understand that it is higher than some of the prices being paid for capacity in today's bilateral market. The new RAAIM framework would initially set this price to \$3.79/kW-month.¹⁹

There are several potential concerns with the pricing level. Several could be construed as concerns that the price is too high. First, if the level is set considerably above the going bilateral price for RA capacity, the exposure to penalties could exceed the revenues from RA sales. This would put upward pressure on the RA price. This effect would also disproportionately impact units with higher outage rates, even if those units are available during periods of true system-wide scarcity. Last, as we discuss below, generation units owned by small firms may find it more difficult to find substitute capacity than larger firms that can substitute within their own generation portfolios.

Conversely, if the price level were too low, firms may find it preferable to simply under-perform and pay the penalty rather than undertake the expenditures necessary to maintain availability at the desired levels. One concern is that this effect would be strongest during periods when substi-

¹⁹ See Reliability Services, Draft Final Proposal, op. cit., Section 6.8, p. 49.

tute capacity is scarce and expensive, or simply not available. In other words, the gap between the availability penalty and desired incentive level would be largest exactly when the system needs higher availability from units that have sold RA.

As it applies to standard capacity, we believe this reduction in the performance penalty to be a sensible change that appears to better align with the underlying price of capacity in the bilateral capacity market. However, if the bilateral market tightens and bilateral prices increase, there would be a significant lag before the incentive payment would also be increased to reflect the new reality. This is in part because there is not a transparent RA price in California that is generated by a liquid market, so it is difficult to have the incentive mirror conditions in the bilateral market.

As the performance penalty will apply to flexible resources, the issue of an appropriate incentive price is complicated by the lack of clarity as to why flexible resources are not already bidding in ways that would comply with the FRACMOO standards. In a previous opinion on this must-offer requirement,²⁰ we noted that:

(a)bsent 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.

While it makes intuitive sense to link performance penalties for different types of RA to the different requirements faced by RA, the effects are difficult to predict in the case of flexible capacity. Previously we were concerned that the bidding requirements of FRACMOO might raise the cost of participation in RA, and therefore procurement of RA, in unforeseen ways. This concern extends to the impacts of availability penalties that are also applied, as proposed, when flexible RA units fail to bid flexibly as required. The CAISO will have to monitor closely how these penalties are affecting the propensity of units to bid their capacity flexibly, and to offer it as flexible capacity in the RA process. We also recommend that the ISO continue to study the reasons why apparently flexible resources do not bid flexibly, which we hope would provide guidance as to market rule changes that would incent greater flexibility in offers.

3.2 RAIM Single Incentive Price

The compound nature of the FRACMOO obligation, which (1) requires that units not only be available but offer their capacity in a manner that meets rules defining flexibility and (2) co-exists with generic RA, raises some issues regarding the structure of the incentive mechanism. Specifically, generic RA capacity is only required to operate either by bidding into the CAISO markets or through self-scheduling, whereas Flexible RA is required to offer economic bids into the DA and RT markets. Requiring resources to be available in real-time whether or not the CAISO foresees a need for them will raise the cost of capacity. The hours of required performance also differ between the two types of capacity resources.

²⁰ See “Opinion on Flexible Resource Adequacy Criteria and Must-Offer Obligation,” Market Surveillance Committee of the California ISO, op. cit.

One of the questions that has been raised has been whether there should be two different penalties for nonperformance by generic RA and by flexible RA. Another question is whether those penalties should be tiered and compounded so that, for example, Flexible RA that ends up self-scheduling will be deemed as performing as generic RA and be penalized only for not meeting its must offer flexibility. Such a differentiated and tiered penalty scheme can be rationalized on the grounds that providing flexibility constitutes an incremental service relative to generic RA with additional opportunity cost relative to self-scheduling. However, a tiered scheme would also increase the complexity of the incentive mechanism. The CAISO opted for a simple approach consisting for a single penalty that will be imposed on a resource if it does not provide the type of RA it committed to. Thus a flexible RA resource performing as generic RA will be treated as if it did not perform at all, and will pay the same penalty as a generic resource that does not perform at all. The penalty, and incremental payment for flexibility must, of course, be designed so as to not discourage Flexible resources from offering Flexible RA. Likewise the penalty should be high enough relative to the Flexible RA premium so as to discourage non-flexible resources from posing as Flexible RA and then paying the penalty for non-performance.

In theory, if there were transparent prices for both generic and flexible RA from liquid markets that reveal how much load-serving entities pay for each type of RA, then the incentives could be based on those prices. However, such prices do not exist.

We support the single penalty approach for its simplicity if combined with reasonably efficient energy and ancillary service market incentives. Such an approach indeed can achieve the objective of both incentivizing truthful revelation of flexibility in the RA commitment as well as incentivizing performance to the level required by the must offer obligations in the energy markets. To do so we analyze the decision process faced by a resource owner at both stages, the RA contracting stage and the energy markets bidding stage. This is done in form of a decision tree illustrated in the Appendix.

One should recognize that the single penalty approach is a rather blunt mechanism that will not lead to perfect incentives for real-time operation absent adequate compensation for real time energy when needed. For example, consider a flexible unit suffering an operating problem that prevents it from ramping up and down but that can stay on line despite the problem and operate at a fixed output. Such a unit would not have any RA incentive to stay on line since it would lose its entire capacity payment for the period because of its inability to ramp. Hopefully these situations are rare enough so that they are not a critical consideration, and furthermore if the output of such a resource were needed, we also hope that energy market prices would be high enough to provide adequate incentives for the resource operator to incur the costs needed to keep it on line.

In light of the problems with CAISO bidding restrictions, there may be times when there are large benefits to self-scheduling that will swamp the penalty and the self-scheduling may even be beneficial. For example, this can occur when there are large gains from getting a unit on-line when it is needed, but ISO bidding rules are inflating its minimum load and/or start-up costs, so the resource owner self-schedules the resource's minimum load block.

We also need to keep in mind that there is another possible situation in which self-scheduling is efficient. This can occur when the penalty is less the relative inefficiency of self-scheduling the unit or achieving a similar outcome with bids that do not trigger penalties. For example, instead of self-scheduling a unit's minimum load block to get it on line, the penalty could cause a generator to bid in a range above minimum load at an artificially low price to compensate for an inflated minimum load and/or start-up bid and get the unit on line. However, that could result in not only the minimum load block being dispatched, but also the capacity above minimum load that was offered at a very low price below both the actual marginal cost and the market price. So getting energy market prices and bidding rules right is important.

3.3 RAAIM Exemptions

The wide variety and extensive application of exemptions has undercut the impact of previous availability mechanisms.²¹ Exemptions fall under two categories: exempt classes of generation technologies and exempt actions taken by generation plants that reduce availability of those units. One of the positive elements of this initiative is that it reduces exemptions and tries to apply a more consistent standard of compliance to what a diverse set of obligations and unit capabilities.

Given the transition from an outage-based to a bidding-based availability metric, non-standard resources like participating demand resources can now be evaluated on the same basis as other resources.

The category of use-limited resources was a significant and growing concern under the previous SCP framework. Like other unconventional sources, it was difficult under the previous performance framework to measure the value of these resources in terms of availability, as the lack of a forced outage is only one factor determining the availability of a use-limited resource. The shift to a bid-based availability metric allows for some improvement in this regard. To the extent that the ISO's market optimization properly captures use-limitations and to the extent that bidders can reflect opportunity costs in their offers, bidding by these units is both appropriate and should be expected by units who have sold their capacity as RA. As with other generation, it would be a legitimate metric upon which to base performance penalties.

The CAISO proposal points out that while their day-ahead market runs can properly capture intra-day use limitations, any constraints on plant usage that tradeoff usage now against, for example, operation in a subsequent month, are more difficult to capture in the ISO's optimization. The ISO will continue to work to develop methods for incorporating these longer-term opportunity costs into the optimization, but in the meantime the proposal will not apply the bid-based availability metric to outages used to manage resource usage limitations that cannot be modeled in the software. It is crucial for the efficient operation of the ISO markets that, first, resources can reflect opportunity costs in their bids and, second, intraday unit commitments consider opportunity costs within the day since the intraday market runs' multi-hour time horizon does not consider the entire day. The CCE Phase 3 initiative is intended to address the former need, and

²¹ See Reliability Services Issues Paper, January 28, 2014.

we urge its rapid development and implementation.

Another area in which the ISO will limit exemptions is by requiring verification of a real physical use limitation rather than allowing units to unilaterally declare themselves to be use-limited. This is being proposed as part of the CCE2 proposal discussed in Section 5, below. The present use-limitation rules have provided a significant loophole in the enforcement of availability metrics, as a firm could exempt their units from these metrics simply by declaring its capacity to be use-limited.

We support all of these adjustments as they, on balance, reduce exemptions and start to normalize the standards of performance across different technology types. However, we note that significant gaps remain. Renewable intermittent resources will continue to be exempt from the performance metrics, as will units subject to verified use-limitations that extend beyond the daily scope of the ISO's market runs. Allowing opportunity cost-based bidding of start-up and minimum load costs, as is intended in the Commitment Cost Enhancements Part 3 initiative, should allow the ISO to further restrict exemptions in the latter case.

In the future, one possible course is to make further adjustments toward metrics and penalty structures that could be applied fairly to a broad class of units, while still capturing the relative capacity resource values that those units provide. For example, variable resource penalties could be assessed based on average performance over a longer period, such as a month, in a manner similar to the PIRP program. A similar approach could be applied to use-limited resources, but it would require the relative capacity value be downscaled in some way that is proportionate to the use limitation. This would require more analysis and stakeholder consideration of how to value, for example, a reliable but more use-limited resource relative to one that is perhaps less reliable but also a less limited resource. For example, how should a 240 MW resource that is available only for a single hour of a day be compared to a 120 MW resource that is available for 2 hours of the day, or a 10 MW resource that is available 24 hours a day.

We encourage the ISO and stakeholders to continue to explore how the RAAIM framework could be elaborated in a way that could incorporate the broadest set of resources under a single performance framework in way that is consistent with the actual benefits that those resources provide to the system. However, as we concluded in our FRACMOO opinion, the RA construct is an awkward and inherently inaccurate way to value flexible capacity in a market with diverse flexible resources with many different restrictions and capabilities that will be used to backstop the output from an increasing amount of intermittent renewable generation. It is important to give appropriate credit to capacity of different types if market failures in the short term markets mean that capacity revenues turn out to be a significant portion of a resource's gross margin. The wrong credits can give the ISO too little or too much capacity, or the wrong mix. Engineering calculations, based on reliability theory, of the marginal capacity contribution of different resources are difficult and will yield fluctuating values over time as system conditions change, including loads, hydro availability, and the mix of resources.²² Stakeholder processes without

²² In theory, metrics could be based on the expected load carrying capability ELCC method developed by power engineers in which the marginal contribution of a resource to the ability of a system to meet an in-

careful analyses to back them up are unlikely to yield accurate assessments of the capacity value of different resources with dramatically different types of operating constraints and availability.

For this reason, we reiterate our previous conclusion²³ that a well-functioning spot market will in theory correctly value a resource's availability, flexibility, location, and other attributions, and incent the resource owner to offer and manage the resource in a manner that effectively utilizes the resource's flexibility. The ISO should therefore aim to enhance the efficiency of spot markets so that resource revenues will make up a material portion of the gross margin of resources. As a result, RA mechanisms (and RAAIM in particular) would become relatively unimportant in incenting the efficient operation of resources, while continuing to provide for the recovery of a portion of investment and going forward costs, which means that the consequences of distortions in capacity credit/AIM penalty calculations will matter less. The proposed RAAIM system will, we believe, provide improved incentives, but they are not a substitute for a properly functioning set of ISO markets for energy and ancillary services.

4. RSI Part III: Replacement and Substitution Rules

An important component of the CAISO RSI proposal is the set of rules for replacement and substitution of resources in case that resources that have a must-offer obligation as generic RA capacity or are Flexible RA capacity are unavailable due to planned or forced outages. Under current rules, the CAISO uses the term “replacement” for additional capacity provided during planned outages of RA capacity which is not accounted for in the planning reserve margin (PRM). In contrast, “substitution” refers to additional capacity provided during forced outages of the committed RA capacity which is partially accounted for in the PRM. Integration of Flexible RA necessitates significant changes to the current rule that would likely not be implemented until Fall 2016. Hence the CAISO proposes to delay until phase two of the RSI any changes concerning planned outages of flexible RA. It is proposed that such changes will be implemented for the 2017 RA year to allow for gradual adjustment by participants and for proper coordination with the CPUC.

In response to stakeholders' comments, the CAISO opted to delay all aspects related to flexible characteristics for planned outages until phase 2, although this delay leaves a time gap between the implementation of flexible RA requirements and the implementation of rules related to flexible RA planned outages. During this time gap the ISO may need to rely on the CPM to ensure

creased road at a given reliability (e.g., LOLP = 1 day in 10 years) (L.L. Garver, “Effective Load Carrying Capability of Generating Units.” IEEE Trans. on Power Apparatus and Systems, Vol. PAS-85, August 1966, pp. 910–919). But this is a difficult calculation for a system with hydro and other resources with complex constraints. ELCC calculations used to be against system peaks, but now they must account for ramps and possible occurrences of resource deficits off-peak, further increasing their complexity (See S. Madeani, R. Sioshansi, and P. Denholm, Comparison of Capacity Value Methods for Photovoltaics in the Western United States, NREL, July 2012, www.nrel.gov/docs/fy12osti/54704.pdf).

²³ “Opinion on Flexible Resource Adequacy Criteria and Must-Offer Obligation,” Market Surveillance Committee of the California ISO, op. cit.

that the fleet can meet real time net load ramping needs.²⁴

The CAISO proposal describes a variety of problems with the current replacement and substitution rules, some of which result from complexity due to timing and overlapping cure periods for LSE and supplier replacement requirements. The proposed rule changes are designed to address these shortcomings and streamline the cure processes for planned and forced outages of RA resources. The proposed rule changes eliminate the distinction between replacement and substitution, focusing instead on the outage type and whether or not substitute capacity is needed. The proposal also revises the monthly RA timeline so as to fully separate the monthly RA process from the planned outage analysis process.

The changes that the RSI proposes in replacement rules are positive steps towards simplifying the process of replacing RA capacity that is not available due to planned or forced outages. They pave the way for expanding this process to accommodate Flexible Capacity in phase 2 of the RSI. The CAISO hopes that these changes would make it easier for unavailable resources to replace their RA obligation with other resources owned by other entities, and thereby avoid penalties under the incentive mechanism, when there is adequate capacity, and contributing to improved system reliability by reducing outages and improving availability of supply when capacity supply would be tight. We note, however, that shifting the replacement process onto the resource could increase awareness among suppliers about outage plans, which might contribute to facilitating of coordinated exercise of market power (either tacit or explicit) if large market players routinely exchange information about capacity outages. This shift in responsibility might also make it more difficult for small suppliers to arrange for replacement capacity and avoid penalties at times when there is no actual shortage of capacity. In theory, such coordination would be more difficult if replacement transactions were made through an arms-length central market. Moving slow in implementing such changes is probably a good idea given all the moving parts that need to be coordinated between the ISO, market participants and the CPUC, and the need by participants to evaluate the impact of such changes.

5. Commitment Costs Enhancements Phase 2

The feature of the CCE2 proposal that we focus on in this opinion is the clarification of the definition of use-limited resources, whose must-offer rules differ from those for non-use-limited resources. It is important that resources claiming use-limited status be limited to those that actually have physical or regulatory limits in order to maximize the resources available to the market.

In general, a resource may face limitations to the number of hours and starts or the amount of energy it can provide over a given period of time. This limits can restrict when and how much a resource can provide, which means that a decision to dispatch a resource now must consider the benefits that may be foregone later (“opportunity costs”) if the resource runs out of starts, hours, or energy and cannot be dispatched during a time of high energy prices. For instance, a hydro-power plant’s production is limited by the amount of water available, and so its production may

²⁴ See Section 8.3 of the RSI proposal, *op. cit.*

be rationed to peak periods during the day. Emissions limits can similarly restrict the output of a fossil fuel-fired resource, meaning that its owner should consider when its production would be most valuable. Maintenance needs or inherent resource limitations may limit number of starts per month or season or other period. As a result of these limits, there is an opportunity cost that could mean that even though the price of energy now might exceed out-of-pocket expenses for fuel or other short-run costs, the resource should still not be dispatched. The calculation of these opportunity costs and their inclusion in commitment cost calculations was discussed briefly in an earlier opinion of the MSC,²⁵ and is to be considered in the CCE Phase 3 initiative later this year.

As we have stated in that previous opinion, we believe that the best way to manage these use-limitations is to allow the opportunity costs be included in resource offers to the market so that the decision to dispatch or not right now balances the benefits of operation immediately against the benefits of instead using the resource later. However, present market rules for calculating commitment costs and default energy bids do not allow for explicit inclusion of opportunity costs, so instead resources must either submit a use-plan or bid higher commitment costs under the registered cost option. Also, under the RSI proposal, limited use resources will also be able to declare themselves on outage when in case the use limitation is reached; of course, this does not help ration starts, hours, or energy earlier when it might have been more optimal. For reasons we have explained in our previous commitment cost opinions, we believe that these approaches to managing opportunity costs are likely to be significantly less efficient than management based on bids that reflect opportunity costs.

Based on information provided to us by the ISO in August 2014, the following resources had a limited-use designation as of that time:

- Biofuel 638 MW
- Coal 118 MW
- Gas 6476 MW
- Geothermal 258 MW
- Nuclear 2300 MW
- Oil 45 MW
- Other 2700 MW
- Solar 3529 MW
- Waste 103 MW
- Hydro 10,731 MW
- Wind 4198 MW
- Total 31,098 MW

This is compared to the reported 2013 installed capacity of 78 GW in the state.²⁶ Thus the amount of capacity whose flexibility is limited due to declared use-limitations is about 40% of the total. This large percentage implies that it is important to carefully examine whether those

²⁵ “Final MSC Opinion on Commitment Cost Enhancements,” September 2014, op. cit.

²⁶ www.energy.ca.gov/renewables/tracking_progress/documents/installed_capacity.pdf

limitations are due to physical or regulatory restrictions, or are due to economic factors that would be more appropriately reflected in offers and managed by the ISO market software.

The CCE2 proposal aims to remove the use-limited designation from resources that do not need the designation because they do not have a clear use-limitation per the ISO's tariff. The proposed change in the definition of use-limited resources has two parts. First, use limitations must be due to physical or regulatory restrictions, and not economic considerations such as cost of wear and tear or fuel supplies, or the terms of tolling agreements (unless those terms reflect underlying physical or regulatory restrictions). For instance, the ISO has clarified that natural gas unavailability or high costs are not a use limitation, and so under the new availability incentive mechanism, RA resources that do not meet their must-offer requirements for those reasons will be fully exposed to the availability incentive mechanism.

We agree with this part of the changed definition for two reasons. First, it is intended that changes in restrictions in commitment cost offers to be implemented as part of CCE Phase 3 will allow resources to make offers that are more reflective of their actual costs, including opportunity costs, than in the past. It is important for market efficiency that resources bid flexibly, but also in a way that reflects their costs. The past and likely future reforms to commitment cost calculation procedures still need to be worked out and will not be perfect. However, the goal is that they will improve upon past procedures and lessen the need for resources to self-schedule in order to either (1) avoid incurring costs that would not be compensated by the market or (2) bring a resource on line when its operation would be economic, but CAISO bidding rules preclude the submission of appropriate economic bids. Second, if contractual provisions rather than regulations or physical limitations were to be allowed to justify a use-limited status, this could conceivably weaken incentives to avoid signing contracts that limit output, starts, or operating hours and perhaps incent the use of contractual provisions to avoid performance penalties when there are no physical or regulatory reasons for those restrictions. Such contracts would lessen the amount of flexible resources available to the market and, in some circumstances, might abet the exercise of market power by providing an opportunity cost-based excuse to keep resources out of the market or raise bids.

We note, however, that in practice the distinction between contractual and physical or regulatory limitations can be difficult to draw. For instance, a resource may be able to choose to sign higher-cost maintenance contracts that would provide for more starts or operating hours between planned outages for major maintenance.²⁷ To build upon a point we made earlier (Section 3.3), if spot markets appropriately reward flexibility, then the correct incentives would be in place to motivate signing of an efficient contract.

The second part of the changed definition narrows the definition of use-limitation for the day-ahead, and short-term and real-time unit commitment processes, making clear that it must involve an opportunity cost. In particular, the applicability of start-up and hour use limitations

²⁷ However, increased starts would still raise the probability of forced outages later in the season, so increased starts when they are not needed can simultaneously raise contract costs and adversely impact reliability

would be restricted to those limitations whose relevant time horizon is longer than the time horizon considered in the particular unit commitment process. Only such limitations could have an opportunity cost. Thus, for instance, intermittent solar and wind resources do not have opportunity costs, and so will not qualify as use-limited. On the other hand, demand response resources with a limited number of calls per month would be use-limited. We agree with this part of the changed definition as well, and look forward to reviewing the ISO's proposals for opportunity cost calculations in the CCE Phase 3 initiative.

The proposal provides details on how the proposed definition would be applied to various categories of resources. One category of resource that the proposal says that use-limitations are proposed to not apply, but we believe could be applicable in the future is geothermal. It is possible for a given geothermal resource to have an energy limitation over a period of time because of limited heat transfer capability and storage in the tapped source of geothermal energy, which might imply that some husbanding of energy output for use in the highest price hours might be desirable. Such limits might be a contributing reason, for instance, for the Geysers plant and other US geothermal power plants to have a capacity factor of only about 70%.²⁸

Appendix: Incentive Compatibility of Single Incentive Price

Following the decision tree in the figure below, a resource can either be flexible or not and in either case can sell generic RA or Flexible RA (if it can still sell flexible RA with the intention of not performing). Then in the energy market after various uncertainties have materialized, a resource that committed to provide flexible RA can choose to either (i) not be available at all, (ii) self-schedule or (iii) submit flexible economic bids. In contrast, a resource that is not flexible can either not be available or provide generic RA. The rewards resulting from the different combinations of capability and choices for different resources are indicated at the end points of the tree branches in the figure.

The objective of the RAAIM is to induce the decisions designated by the two paths denoted on the decision tree, i.e., to incentivize flexible resources to show Flexible RA and bid flexibly in the energy market while incentivizing nonflexible resources to show generic RA and be available in the energy market. For this choices to be consistent with economic behavior it is necessary that the nonperformance penalty is such that: **Penalty > FlexRAPrem + Max [UnAvailGain, SelfSchGain]**, where

FlexRAPrem = Difference between Flexible RA and Generic RA payment for the period.

UnAvailGain = costs avoided if the unit is not available for the period

²⁸ Geothermal resources used to produce renewable electricity in western states, Today in Energy, USEIA, Sept. 8, 2014 <http://www.eia.gov/todayinenergy/detail.cfm?id=17871>; Capacity factors of geothermal plants, a global analysis by Bloomberg New Energy Finance, <http://thinkgeoenergy.com/archives/9644>

SelfSchGain = costs avoided if the unit self-schedules its output rather than being dispatched in the period

This will deter a nonflexible resource from contracting to provide Flexible RA and will induce a generic RA resource to be available in the energy market.

The above condition also implies that **Penalty > UnAvailGain** so a flexible resource offering generic RA will choose to be available. However, if **FlexRAprem > SelfSchGain** the option to show Flexible RA by a flexible resource dominates the option to show generic RA and realize any savings from self-scheduling. The latter condition will result naturally since the flexible RA premium will adjust to whatever the market will bear until the Flexible RA capacity needs are met. The conditions above on the penalty does not necessarily mean that it should be higher than the self-scheduling benefit or the unavailability benefit under any circumstance. By setting the penalty the CAISO, effectively sets, an upper bound on the level of self-scheduling benefits and unavailability benefits for which it wants to deter noncompliance. Under the penalty scheme if a resource's self-scheduling benefit exceeds the penalty it will choose to self-schedule and if that is a frequent occurrence that resource will be better off not offering its capacity as Flexible RA. Likewise a resource that frequently has unavailability benefits (or avoided cost) that exceed the penalty should not offer its capacity as RA. By selecting the proper penalty level the CAISO can control what resources should be available in real time and what resources offer flexible capacity and ensure that these resources have the incentives to reveal their intended behavior through their RA and Flexible RA commitments.

The above analysis demonstrates that a well calibrated single penalty will suffice to achieve the RAIM goals. Such calibration may not be easy since, as shown above it will depend on estimates of gains and avoided costs that are not well understood. However, calibrating a more complex mechanism with two penalties and tiered compliance will most likely be even harder. If the required flexible RA premium is small because the energy market provides strong incentives for flexible resources to offer in a manner that enables them to be dispatched flexibly, then the required penalty for flexible resources would also be small. As we argue in the body of the opinion, and elsewhere,²⁹ this is the most desirable outcome, and spot market designs should be sought to achieve this outcome.

²⁹ See "Opinion on Flexible Resource Adequacy Criteria and Must-Offer Obligation," Market Surveillance Committee of the California ISO, op. cit.

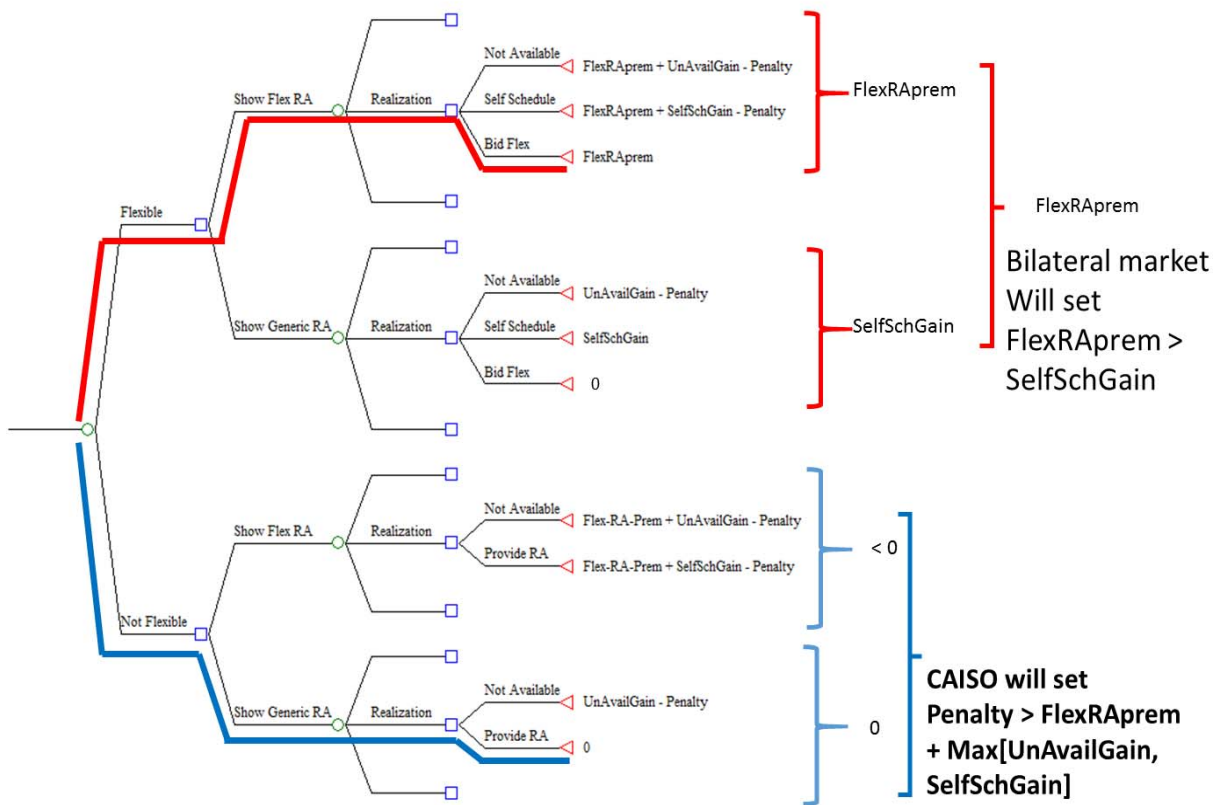


Figure 1: Decision tree for resource self-selection of RA category and performance