Opinion on
Energy Imbalance Market (EIM)
Resource Sufficiency Evaluation Enhancements, Phase 2

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1. Introduction and Summary

The Market Surveillance Committee has been asked to comment on Phase 2 of the proposed enhancements to the EIM resource sufficiency evaluation (RSE) process.[1] This initiative is a continuation of the ISO's refinement of the resource sufficiency evaluation in the EIM that began with the summer 2021 readiness initiative.[2] As part of that initiative, a set of changes to the RSE were approved and adopted for summer 2022 as Phase 1 of this process.[3] Phase 2 addresses several outstanding questions and issues that remained unresolved by Phase 1. In a previous opinion addressing the Phase 1 proposal,[4] we extensively discussed the motivation for the RSE and many of the issues addressed in this current Phase 2 proposal.

As explained at several points in this process,[5] a purpose of the resource sufficiency evaluation is to evaluate whether each balancing area authority (BAA) is capable of meeting its own net load with its own available resources before allowing it to benefit from importing power through EIM transfers from other EIM BAAs.[6] The capacity and flexible ramping evaluations are the tests designed to accomplish this evaluation and have been the primary focus of the enhancement initiatives. The sufficiency evaluation was implemented because the BAAs who initially established the EIM viewed its purpose as the promotion of economic power exchanges in real-time

[1] D. Johnson and B. Cooper, *EIM Resource Sufficiency Evaluation Enhancements: Phase 2. Draft Final Proposal.* CAISO, August 25, 2022. www.caiso.com/InitiativeDocuments/DraftFinalProposal-WEIMResourceSufficiencyEvaluationEnhancementsPhase2.pdf

[2] *Market Enhancements for 2021 Summer Readiness: Final Proposal.* California Independent System Operator. March 19, 2021, www.caiso.com/InitiativeDocuments/FinalProposal-MarketEnhancements-Summer2021Readiness.pdf

[3] D. Johnson and B. Dean, *EIM Resource Sufficiency Evaluation Enhancements, Phase 1: Revised Draft Proposal*, CAISO, Dec. 16, 2021. www.caiso.com/InitiativeDocuments/RevisedDraftFinalProposal-EIMResourceSufficiencyEvaluationEnhancements.pdf

[4] J. Bushnell, S. Harvey, and B.F. Hobbs, *Opinion on EIM Resource Sufficiency Evaluation Enhancements*, Market Surveillance Committee of the CAISO, Feb. 2, 2022, www.caiso.com/Documents/MSCFinalOpinionon EIMResourceSufficiencyEvaluationEnhancements-Phase1.pdf

[5] See Johnson and Cooper, and Johnson and Dean, op. cit., for details.

[6] There is also a downward flexibility evaluation that could result in capping exports but the focus of the changes in this initiative is on imports.

between independent balancing areas who remained responsible, along with their local regulatory authority, for their own balancing area's reliability.

The RSP Phase 1 and Phase 2 initiatives have highlighted the many technical and policy choices to be made in implementing this general vision of the RSE, both with regards to the measurement of resource needs and the appropriate consequences for BAAs failing the RSE. These choices need to balance the trade-offs between the benefits and risks of increased regional integration. On one hand, strict and severe enforcement of an RSE can minimize the risk of EIM being used in a way that causes scarcity to "spill over" from under-resourced BAAs, or undermine the diversity benefit on which other BAAs rely in committing generation and scheduling imports and exports. At the same time, an inaccurate- or overly rigid RSE could also dilute many of the economic and diversity benefits provided by the EIM. The implementation of the RSE therefore needs to balance not only considerations of the reliability implications of various aspects of the test, but also the implications about how the test might expand or limit the benefit of the EIM.

Although several aspects of the RSE were considered during the stakeholder process of Phase 2, there are only two significant changes in the current version of the Phase 2 proposal: (1) the removal from the CAISO's RSE obligation of day-of low priority (LPT) exports that are potentially supported by EIM transfer imports; and (2) the introduction of an emergency energy assistance option as an alternative consequence for failure of the RSE. We support both of these changes on the grounds that they constitute improvements in the RSE relative to current practice. However, it is our belief that these changes still leave the RSE almost certainly in need of further refinement. Several issues remain unresolved or are awaiting further data and developments. We list some of the most important of these issues in Section 5, below.

Other possible changes to features of the RSE were discussed during the stakeholder process, in particular the treatment of load conformance and the inclusion of an uncertainty adder in the capacity test, but ultimately no changes were proposed at this time. We support the decision not to include load conformance adjustments in the load used to apply the resources sufficiency capacity evaluation. Although we support the CAISO's position regarding the uncertainty element at this time, we believe that an uncertainty adder should ultimately be included in the resource sufficiency capacity evaluation (as well as in the flexibility evaluation). We agree with other stakeholders that this inclusion should not be implemented until the new methodology for calculating the uncertainty requirement has been implemented and the CAISO and stakeholders reach the conclusion that it is producing appropriate outcomes. In addition, there are other issues that will deserve more analysis and stakeholder discussion once more information is available.

One concept we will return to below is that the several aspects of the RSE could be designed to better differentiate between violations under severe, regionally stressed conditions, and those violations occurring when either there is plentiful low cost supply available in the region around the failing BAA but the insufficient BAA is suffering scarcity (perhaps as a result of an unexpected variation in net load or other unexpected events), or when the BAA fails as a result of anomalous data flowing into the RSE itself. It is the former situation that the RSE was envisioned for, but treating all violations, including the latter, as if they had similarly serious consequences is both inaccurate and inefficient.

This opinion is structured as follows. In the next section, we summarize our understanding of the goals of the RSE process as context for the subsequent discussion of the proposed RSE enhancements, remaining issues, and our recommendations. Section 3 then addresses issues concerning HASP imports and exports and their effect on the RSE. Particular attention is paid to the role of load conformance and flexible capacity. Section 4 turns to the question of what the consequences should be of failure of the RSE, especially under emergency conditions. In Section 5, we summarize several issues that are unresolved by the proposed RSE enhancements, including load conformance, uncertainty adders, and certain HASP/RSE interactions. Our recommendations are briefly summarized in the conclusions section (Section 6).

2. Resource Sufficiency Evaluation Objectives

From the inception of the EIM, the resource sufficiency evaluation (RSE) was intended to "*ensure each EIM entity is able to meet their demand with their own net supply prior to engaging in transfers … through the EIM in the real-time market*."[7] In this sense the EIM is intended to increase the efficiency of real-time trade, but also isolate scarcity issues within those BAAs with inadequate resources. In addition, the RSE is intended to ensure that all BAAs are incentivized to contribute the balancing capacity needed to provide the EIM diversity benefit across the western EIM footprint.

The intended separation of trade and reliability in the EIM stands in contrast to the shared reliability experienced by customers of different load serving entities (LSEs) operating within a single ISO such as the CAISO. In a fully integrated ISO market, load-shedding is largely random, so the customers of fully resourced LSEs bear the same reliability risks as those of under-resourced ones. This pooled risk is one of the main justifications for the establishment of long-term resource adequacy requirements to prevent undue leaning on the pool.

Since there is no shared long-term resource adequacy policy, or even a common vision for one, across EIM participants, the RSE is effectively intended to serve as an alternative mechanism to avoid undue leaning on the pool by any EIM participant. In principle the RSE allows individual BAAs to pursue their own RA approach, while also isolating the most severe short-term consequences of an inadequate RA approach of an individual BAA from its neighboring BAAs, especially during times of regional stress affecting several BAAs.

One other function of the RSE is to help preserve the diversity benefits assumed to be created by participation in the EIM by requiring that all BAAs contribute balancing capacity. Each BAA is responsible for managing both its expected needs and the short-term variations in net load that arise within its area. Since many of these short-term variations in net load are random, the ability to share resources across a larger geographic footprint should dilute the risks faced by any individual BAA within that footprint. The diversity benefit reflects the reduction in the risk of any individual BAA when these risks are shared across many BAAs. The diversity benefit assumes, however, that each individual BAA preserves enough flexible capacity to meet its share

[7] California ISO, "EIM Resource Efficiency Evaluation Enhancements Issue Paper," May 28, 2021, p. 3.

of the uncertainty shared across the EIM footprint. As we discuss below, if flexible capacity is mismeasured or used to support expected load, rather than made available to balance variations in net load, the assumed diversity benefits will be overstated.

In examining the different elements of the sufficiency evaluation, it is therefore important to recognize that while we want to enable entities with sufficient resources to fully participate in the Western EIM market, it can be counter-productive to severely penalize entities who fail to cover a requirement simply because it is overly volatile, difficult to predict, and calculated in a way prone to producing spurious outcomes. Further, transactions through the EIM should not be penalized relative to comparable transactions that occur on a marginally longer timeframe such as HASP. Avoiding over-penalization in these situations does not appear to be in conflict with the high-level objectives of the RSE.

3. Treatment of Low Priority HASP Imports and Exports

One of the issues in the RSE process which was discussed in Phase 1 but deferred to Phase 2 is the treatment in the RSE of transactions scheduled in the CAISO's Hour Ahead Scheduling Process (HASP). The HASP is a process that is unique in the western U.S. electricity market. It was implemented when CAISO adopted its general LMP-based process in 2010. Its purpose has been to facilitate trade with neighboring BAAs who have traditionally transacted day-of power on an hourly basis. The structure of the CAISO market features the calculation of hourly prices and commitments in the day-ahead market, and (since 2014) fifteen-minute and five-minute prices for settlements in real-time. The HASP provides an opportunity for CAISO participants to also schedule day-of hourly block-interchange transactions with non-EIM BAAs and EIM BAAs who prefer to transact in HASP instead of the EIM fifteen- and five-minute markets. Importantly, the HASP is optimized across the FMM intervals that are nested within a given hour, so the feasibility and benefits of any hourly transaction is influenced by the CAISO market's expectations of FMM conditions, including any advisory EIM imports or exports that are calculated as optimal when HASP schedules are set.

The CAISO HASP creates some challenges for the CAISO BAA in passing the resource sufficiency capacity test. The HASP clears hourly intertie schedules in combination with anticipated (advisory) EIM transfers; the HASP processes will substitute anticipated lower cost EIM transfers for hourly imports if those transfers are projected to be lower cost than the hourly imports. The HASP evaluation uses the same resources, offer prices, and upper limits as those that will be used in the subsequent FMM market processes. The HASP evaluation should therefore be consistent with the subsequent FMM solutions if other conditions are similar. However, FMM prices and schedules may differ materially from those in HASP as a result of changes between the time of execution of HASP and FMM due to transmission or generation outages or deratings or because of differences in net load. In addition, HASP prices would differ from FMM prices if hourly transactions were on the margin in HASP, as those transactions would be price-taking in the FMM.

Under the current RSE policy, however, those anticipated EIM transfers do not count towards the RSE capacity test, while CAISO HASP transactions made possible by EIM transfer imports do count as obligations. This misalignment between the constraints enforced in HASP and the re-

source sufficiency capacity test creates the potential for the CAISO to fail the resource sufficiency capacity test when it could have passed by scheduling additional hourly import transactions, or by reducing hourly export transactions.

The CAISO HASP has always represented a gray area for the RSE, which has been structured to treat hourly transactions as firm supply that counts as capacity for passing the EIM. No other EIM BAA explicitly schedules hourly transactions that are co-optimized with the projected EIM transfers, although several utilize the CAISO's HASP process to schedule hourly interchange.[8] In fact, as described in the CAISO proposal, the CAISO currently could fail the RSE when HASP facilitates optimal exports from the CAISO supported by expected EIM imports, if the imports are based upon advisory EIM transfers and the exports are scheduled hourly.

The likelihood of this outcome is probably materially increased by the very low (usually zero) prices of flexiramp that have been experienced in the EIM region in the FMM, as it appears costless in HASP to deplete flexiramp in the BAAs around the CAISO in order to schedule EIM transfers to support HASP exports. If flexiramp were priced consistent with the supply available to the BAAs around the CAISO, scheduling exports supported by unloaded capacity that instead could be used to provide positively priced flexiramp would be more expensive and less likely to occur to as great an extent in HASP. We also note that CAISO load conformance adjustments in HASP also have the effect of limiting the magnitude of these exports and effectively preserve unloaded capacity in the BAAs around the CAISO for dispatch for balancing in the five-minute real-time dispatch process (RTD).

During this process, it has become clear that the inconsistent treatment of HASP and EIM transactions in the RSE was problematic for both the CAISO and potentially anyone else utilizing HASP. More structural solutions would involve one or more of the following: 1) removing EIM advisory transfers from the HASP process; 2) turning the HASP into a residual unit commitment (RUC)-style process that would treat EIM transfers like virtual supply;[9] and 3) only including DAM schedules with EIM entities in the HASP, and scheduling all intra-day transactions with EIM entities as EIM transfers. All of these options would remove the potential for anticipated EIM transfer imports to impact HASP exports, and thereby avoid the situation in which advisory EIM transfer imports identified in HASP would inadvertently lead to a failure of the RSE capacity test. However, doing so would have other effects that would need to be evaluated.

In our previous opinion,[10] we noted several potential problems with the first option that would also apply to the second and third options.

> *One possible solution to these inconsistencies might be for the CAISO to structure HASP to not consider EIM transfers in its solution, and then enforce the capacity sufficiency*

[8] It is not known to what extent other BAAs take the anticipated availability of EIM transfers into account while trading power in bilateral transactions.

[9] This would entail a RUC pass that would exclude EIM transfer imports from the supply available to support exports, i.e., treating them like virtual supply in the day-ahead RUC, and would also not schedule exports that could not be supported by hourly imports and other CAISO resources.

[10] J. Bushnell, S. Harvey, and B.F. Hobbs (2022), op. cit., p. 23.

test requirements in HASP, enabling the CAISO to pass the resource sufficiency evaluation without the need for load conformance adjustments. However, if the CAISO took this approach, the EIM transfers excluded from HASP would be available in the FMM, causing FMM prices to be systematically lower than HASP prices when CAISO was an importer of EIM transfers. This could discourage the submission of HASP intertie offers because of the risk of high losses.

Instead of these structural changes that would eliminate the inconsistencies between HASP and RSE, the less drastic CAISO proposal will effectively slightly restructure the RSE to "live with" these inconsistencies. Under the proposal, low-priority (LPT) CAISO exports scheduled only in HASP would no longer count as CAISO firm load,[11] and therefore not be part of the CAISO's capacity need in the resource sufficiency test.[12] This will reduce the risk of a HASP-induced failure of the RSE capacity test by the CAISO. Such a treatment strikes us as appropriate given the designation of LPT exports was developed under two premises. First, LPT exports were to be an explicitly non-firm form of export that could be curtailed in the event of a capacity shortfall within the CAISO. Second, the CAISO should not fail the RSE as a result of lower priority exports supported by EIM transfers.[13]

Initially, the CAISO proposed that these LPT exports would also not count as "supply" under the RSE for the region on the importing end of the HASP transaction. This approach would therefore treat most of these hourly HASP transactions as EIM transfers and therefore not eligible to be treated as capacity available to meet the BAA's load and provide balancing capacity. However, this proposal produced concerns from some stakeholders who considered this to be overly burdensome. In particular, several stakeholders commented that a failure to include HASP imports in their RSE supply would leave too little time to procure alternative capacity, particularly given the lack of clarity in the original proposal as to which HASP transactions might be excluded. This lack of time to respond to failure is a consequence of relying on HASP transactions to meet load. The same uncertainty and lack of reaction time will also occur if the export bids failed to clear in HASP. [14] The CAISO faces a similar uncertainty in relying on HASP imports that are not supported by CAISO resource adequacy resources, as there may not be enough supply offered in HASP to meet CAISO's RSE requirements and, if that is the case, the CAISO will have very little time to procure other supply.

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[11] We use the term "LPT" to refer to any export that is not high priority, in the sense that it is an export not specifically backed by an RA resource.

[12] An export from the CAISO is now considered a low-priority transaction if it has not been explicitly linked to non-RA capacity internal to the CAISO area This designation was established to prevent the export of energy produced by resources procured under California's RA process during shortage conditions.

[13] See the CAISO filing in Docket ER21-1790 April 28, 2021, approved by FERC June 25, 2021.

[14] However, the discussion in the October 6 stakeholder meeting indicated to us that some balancing area base schedules currently can include HASP transactions that did not clear HASP. This is not an acceptable situation as the inclusion of HASP schedules that did not clear in the base schedules used to apply the RSE is inconsistent with the purpose of the RSE. The CAISO has included a requirement that only cleared HASP exports should be included in base schedules. However, we understand from the discussion on October 6 that resolving this situation may be difficult but it needs to be resolved soon. The CAISO needs to start discussion of how to resolve this situation promptly so it can be resolved for summer 2024.

However, the draft final proposal simplifies the process by effectively eliminating *all* (non-day ahead) LPT HASP exports from consideration in the CAISOs RSE obligation.[15] If these HASP exports were similarly eliminated from consideration as capacity in the RSE as well, the issue would be more one of market opportunity rather than market timing. Market participants could be aware well ahead of time that their HASP transactions would not help them pass the RSE. This obviously could also make the HASP itself considerably less valuable as a way of meeting RSE requirements, as opposed to as a way of purchasing economy energy.

3.1 HASP, Flexible Capacity, and Load Conformance

One specific concern with a reliance on HASP transactions to provide RSE supply is that it can undermine the diversity benefit of the EIM by converting flexible capacity into hourly HASP transactions. The current HASP and resource sufficiency evaluation design, combined with the lack of a deliverability test for flexiramp for BAAs outside the CAISO, can result in an outcome in which unloaded capacity offered to meet uncertainty requirements in BAAs around the CAISO is scheduled in HASP to support EIM transfer imports into the CAISO. These EIM imports would in turn be used to support hourly export transactions from the CAISO that are cleared in HASP. This exchange converts unloaded flexible capacity into hourly schedules that are needed to meet the load of the importing BAA and are not available to meet variations in net load across the EIM footprint.

Under this scenario, all BAAs in the region around the CAISO could pass the resource sufficiency tests (with the help of the capacity provided by HASP), yet there would be no unloaded capacity available in real-time to provide balancing. Moreover, despite the shortage of unloaded flexible capacity, the price of flexiramp would be zero in the BAAs around the CAISO because of the lack of a deliverability test in the current flexiramp product design. With a zero (or low) flexiramp price, the market engine could fail to commit units that could have otherwise provided the needed balancing. Additional capacity would not be committed to support the CAISO HASP exports and the HASP exports would be supported by expected EIM transfers.

We have discussed above how, under the current RSE policy, this outcome creates the potential for the CAISO to fail the resource sufficiency evaluation because HASP exports are counted as load while the expected EIM transfer imports are not counted as supply. In addition, this outcome could produce a scenario where all BAAs can pass the capacity and flexibility resource sufficiency evaluations, yet there could potentially be no unloaded capacity in the BAAs around the CAISO to provide balancing for real-time transmission system conditions and net loads that differ from those projected in HASP.

[15] The draft final proposal focuses on the low-priority (LPT) status of an export from CAISO rather than attempting to dynamically calculate the amount of HASP exports supported by EIM imports. Any export that is not explicitly tied to a non-RA resource inside the CAISO BAA is considered LPT. Therefore, the only exports scheduled in HASP that would *not* be LPT would need to be linked to such a resource and almost certainly identified in advance of the HASP run.

This outcome does not directly create load shedding risk for BAAs that have procured sufficient supply to meet their projected load and uncertainty requirement, as long as real-time net load is similar to that projected in the HASP. However, it leaves little margin for error, particularly in BAAs dependent upon LPT HASP imports. This scenario--in which no unloaded capacity is available in HASP in the BAAs around the CAISO--would create increased load shedding risk any time real-time net load materially exceeds the HASP forecast across the BAAs in a constrained region around the CAISO. This increased load shedding risk would be greatest for the BAAs dependent on HASP imports from the CAISO to meet their resource sufficiency evaluation requirement, but the risk would also exist for BAAs whose capacity is scheduled in HASP to support EIM transfer exports.

The importing BAAs would be vulnerable if there is surprisingly high net load in the areas expected to support their imports. If the "exporting" BAAs, those with the EIM transfer exports in the HASP, have higher net load in real-time than projected in the HASP, the capacity that HASP expected to support the EIM transfers that would in turn support the HASP imports will be unavailable. The capacity will instead be used to meet the exporting BAA load in real-time and will be unavailable to support CAISO exports to the BAAs that depended on HASP exports from the CAISO to meet their local demand. This situation could require the CAISO to curtail real-time HASP exports that were supported by EIM transfer imports in HASP, and result in load shedding in the BAAs who depended on the CAISO HASP exports.

A shortage of regional flexible capacity could also impact reliability in the BAAs that were exporting EIM transfers in HASP even if they had enough capacity to meet their net load and uncertainty requirement in the RSE. There is still an increased risk of load shedding in this situation because the uncertainty requirement is designed to meet variations in their net load in combination with the diversity benefit. If there is no unloaded capacity across the BAAs inside the constrained region around the CAISO to provide the diversity benefit, the capacity the balancing area procured to meet its load and uncertainty requirement could be insufficient to avoid load shedding within that balancing area if it experiences large deviations between expected and real-time net load.

Fortunately, despite this theoretical possibility of heightened reliability risk from the current HASP and resource sufficiency evaluation design, we have not observed poor reliability performance in the actual operation of the Western EIM. We believe that this apparent lack of adverse reliability outcomes for the current HASP and resource sufficiency evaluation design likely arises because there is one additional factor that we have not considered above. This additional factor is that CAISO operators, who today are actually western EIM operators, are including large load bias adjustments in the CAISO load forecast that is used in HASP and the FMM. We have noted in past opinions that prior to the implementation of the minimum flexiramp requirement for the CAISO, these load conformance adjustments served to ensure that there was unloaded capacity that was deliverable to meet CAISO load, effectively ensuring that the CAISO operators had deliverable flexiramp available to balance net load in real-time. We have also noted in prior opinions that these load conformance adjustments also reduce the likelihood that the CAISO will fail the resource sufficiency test as a result of exports scheduled in HASP, or as a result of the operation of the flexiramp demand curve in HASP.

These load conformance adjustments by CAISO/Western EIM operators have an additional impact in the context of this discussion of HASP exports that we have not discussed in prior opinions. These load conformance adjustments ensure that even when HASP schedules EIM transfer imports to support HASP hourly exports that completely drain the BAAs around the CAISO of unloaded capacity in HASP, there will still be a few thousand megawatts of unloaded capacity in real-time to provide balancing because these load conformance adjustments will cause expected real-time net load to be that much lower than the load modeled in HASP. An example is the load conformance adjustments made by CAISO/Western EIM operators on September 6, 2022. The implication of this is that perhaps the ultimate impact of the ability of EIM BAAs to pass the resource sufficiency evaluation with HASP imports from CAISO that are in turn supported by EIM transfer imports into the CAISO is to motivate CAISO/Western EIM operators to make larger load conformance adjustments than would otherwise be the case.

3.2 Assessment of the HASP Policy Change

As we discuss further below, the issue of the role of HASP load conformance highlights the different implications of the RSE during scarcity conditions as opposed to normal conditions. There may be legitimate concern that reliance upon LPT imports to pass the RSE overstates supply during scarcity conditions. It is not clear to us how significant this concern is. We see no good reason to punish or discourage those transactions during normal conditions.

Therefore, we view the proposed HASP policy change as a positive step from the perspective that it fixes a flaw in the accounting of the CAISO's resources, while essentially making no change to the RSE treatment of other BAAs. In this sense, the issues associated with other BAAs meeting their load with CAISO exports that effectively deplete balancing capacity would be no worse with this proposed change than the existing situation today.

However, assessing the full impacts of this change is wrapped up in other questions, such as the drivers of the CAISO load conformance adjustments. If these adjustments are driven in part by the desire of operators to avoid the risk of CAISO failing the RSE, then the proposed change should reduce the risk of CAISO failures and reduce any associated load conformance adjustments. This would tend to make more capacity available for scheduling as exports from the CAISO and effectively further reduce the unloaded EIM capacity in RTD.

But if, on the other hand, the current level of CAISO load conformance adjustments is instead driven by the intent to preserve unloaded capacity in RTD and prevent these types of transactions from unduly depleting flexibility capacity, then this change to the RSE would have little impact on either load conformance adjustments or the level of unloaded capacity available for balancing in RTD.

While we support this proposed change to the HASP process, the inconsistent treatment of LPT HASP transactions may warrant further attention, particularly after more has been learned about the impact of pending reforms upon flexiramp and any associated changes in the load conformance practices of CAISO operators. As with the energy assistance changes discussed in Section 4 below, any refinement of this policy should be focused on the periods in which regional scarcity--and therefore the curtailment of LPT transactions--is a reasonable possibility.

4. RSE Failure and Energy Assistance

One of the main concerns over EIM supply being accessed by a BAA without sufficient resources is the propagation of its shortfall to neighboring BAAs via the EIM. Unrestricted EIM trade could result in the impacts of shortfalls being distributed across a wider footprint, leading to scarcity prices and potentially reliability issues in areas beyond the under-resourced BAA. While a case could be made that such an outcome could be economically efficient within the individual dispatch interval, it would certainly not be fair to customers in BAAs who were adequately resourced. Moreover, it would undermine the EIM value proposition if BAAs with adequate supply could not benefit from the EIM diversity benefit for balancing because other balancing areas were short or did not contribute unloaded capacity for balancing. Chronic, predictable shortfalls in capacity would instead create an EIM-wide diversity "penalty" for consumers in resource adequate BAAs rather than a benefit, in the sense that they would need to commit additional capacity to compensate for the lack of unloaded capacity across the EIM. We agree that this is a serious, even primary, concern and that the RSE should be deployed in a way that practically prevents such an outcome.

Under the current system, a failure of either the capacity or flexibility evaluation triggers the capping of EIM imports at a level equal to that of the most recent interval in which both tests were passed. During Phase 1 of the RSE enhancement process, almost all stakeholders expressed concern about these EIM consequences of RSE failure. This freezing of intertie capacity can be both too lenient in some cases and inefficiently restrictive in other cases. In our earlier opinion we noted that freezing imports could induce otherwise avoidable economic and reliability losses.

> *We believe that the long run design should not freeze EIM imports for BAs in emergency conditions. It would be inappropriate for a balancing area to shed load because it cannot schedule emergency transfers fast enough at a time when plenty of supply was available and could have been dispatched in the EIM-wide RTD.*[16]

For Phase 2, the CAISO is now proposing to allow transfers into BAAs that fail one of the RSE tests, but at a significant penalty price. As we understand the proposal, a BAA could choose to *either* allow its imports to be frozen as under current practice *or* import any level of feasible energy during the interval subject to either a $1000/MWh or $2000/MWh penalty.[17] The charge would be implemented as a penalty parameter applied to the relaxation of what would otherwise be an import constraint of zero MW. Therefore, the penalty would be additional to the standard nodal prices calculated for the EIM market. It is our understanding that the penalty price would only apply to EIM transfer imports for purposes of calculating the optimal level of imports, but if a BAA that failed the RSE cleared penalty-priced EIM transfer imports, the penalty price would apply to all real-time settlements for the balancing area. The penalty price would also raise the cost of HASP exports settling at FMM prices. The price would only apply to imports, load, gen-

[16] J. Bushnell, S. Harvey, and B.F. Hobbs (2022), op. cit., p. 28.

[17] The penalty value is linked to the concurrent relevant bid-cap price, which is $1000 under normal conditions but can be set at $2000 during periods of high natural gas prices or regional energy scarcity pursuant to the CAISO's Order 831 compliance design.

eration, and exports above (or below) day-ahead market schedules in the case of the CAISO or above (or below) base schedules in the case of other EIM balancing areas, so individual LSEs that had sufficient day-ahead market or base schedules to cover their load would not be adversely impacted by the penalty price.

The charge is proposed to apply to *all* EIM transfer imports of energy, not just EIM transfer imports in excess of the capped level imposed by the current process; and furthermore, they would apply even if the total amount of EIM transfer imports are less than the capped level under the current RSE failure rules.

The CAISO proposes to make this new energy assistance import policy optional. BAAs may elect to continue under the existing system. Our understanding is that this designation would be made in the CAISO's master-file, allowing a BAA to change its status on roughly a weekly basis.

We believe that the proposed penalty approach is a superior alternative to the current approach at least for periods of regional scarcity. It allows for BAAs with available energy to export additional energy to a BAA who failed the RSE without causing scarcity conditions to be triggered in the exporting BAA and without unduly undermining the incentive for BAAs to procure sufficient capacity to meet their expected RSE requirement. These exports would help to prevent scarcity and perhaps load shedding in the importing BAA, particularly when system conditions change too fast for traditional emergency energy procurement to be effective. An informative data point is that the CAISO went from declaring a Stage 2 emergency to having to shed load in the space of 12 minutes on August 15, 2020.[18]

However, we have two concerns. The first is that the current proposal could still result in limiting EIM transfers into BAAs that are critically short, even if increased transfers would not harm reliability in exporting BAAs. This concern applies to BAAs who choose not to adopt the assistance energy option. The fact that LSEs may want to toggle off the option to import power at a high price and potentially risk having to shed load is a clear indicator of inefficient incentives. This can be traced to the differences between penalties for import volumes below the levels that would under the present RSE failure rules be capped at the level in the prior non-failing FMM interval, and the penalties on import volumes above that cap. Under the status quo, the penalty for imports below this import-level cap is zero, but is effectively infinite above this MW level. In contrast, under the energy assistance option, even the first MW of imports would be penalized at least $1000/MW. We suggest that this asymmetry should be eliminated to in turn eliminate the financial incentive to risk load shedding by toggling the option off in order to avoid paying the penalty to buy imports at volumes below the capped level.

There are at least three ways this asymmetry could be eliminated:

[18] California ISO, California Public Utilities Commission, California Energy Commission, "Root Cause Analysis Mid-August 2020 Extreme Heat Wave," January 13, 2021, p. 30.

1. a two-step penalty design where there would be a smaller (or no) penalty on some moderate level of imports. The high penalty price would apply only to EIM transfers above this level;[19]

2. a two-step penalty with no penalty unless EIM transfers exceed the transfer level limit at the time of RSE failure with the penalty price applied to all EIM transfers if the transfer limit is exceeded; and

3. a penalty applied to all EIM transfer imports of failing BAAs (this would correspond to eliminating the option in the Phase 2 proposal to toggle between the current policy and the assistance energy policy).

It appears to us that it would be desirable to eliminate the asymmetry that is leading to inefficient outcomes with one of these approaches or perhaps others we have not thought of. As we discuss below, option 3 would probably be much more palatable to stakeholders if the penalties were not always set to $1000, but were instead set at lower levels during periods with no scarcity. It would therefore be appropriate to consider option 3 as part of a future RSE failure design with tiered failure consequences as discussed below.

Second, we are concerned that this proposal could be counter-productive during periods where there is no regional scarcity. This concern applies to BAAs who do choose to adopt the assistance energy option. The penalty levels are so high that they would effectively shut down trade into failing BAAs during any intervals where prices do not approach scarcity levels. The RSE is only an approximation of future conditions, and random fluctuations in the uncertainty component, in particular, could trigger failures in periods where neighboring regions possess ample excess supply. This is of course the situation with current RSE mechanism, and so the proposal does not make matters any worse, but we believe that the Phase 2 enhancements could provide more benefits if that ample supply could be taken advantage of.[20]

[19] The "low penalty" import level could be set at the same level as the import cap under today's policy (the amount from the most recent interval with no RSE failure). This could greatly distort the multi-interval optimization in HASP and RTPD if those optimization processes set imports in passing intervals in such a way that minimized the cost of the penalty. The CAISO has changed its view on whether this will occur with the current formulation, and we understand that there is no endogeneity that would argue against implementing this option for Summer 2023. This issue is discussed further in Section 5.3 below.

[20] It is noteworthy that several CAISO LSEs prefer that the CAISO opt out of the energy assistance option and other BAAs would like to have the ability to toggle this feature on and off on an hourly basis. We conjecture that these preferences likely are a result of the feature that all EIM imports into a failing BAA would be at the penalty price under the proposed design, while the current implementation would allow EIM transfers to continue without penalty. There are a variety of mechanisms under the current design that can result in the current transfer level being relatively high when a BAA is expected to fail the RSE, thus insulating the BAA's LSEs from the full consequences of failure. Ironically, the impacts may be more serious on LSEs within BAAs that fail because of unexpected spurious uncertainty requirements than for BAAs that are truly short of capacity, because LSEs that expect the balancing areas to fail the RSE can take actions to increase the level of EIM transfers prior to the failure, while LSEs that are blind-sided by an anomalous failure would not have done so.

In fact, based upon data provided to us by CAISO staff, it appears that prices were well below $250/MWh during the vast majority of RSE failures over the last year for non-CAISO BAAs. In fact, the median price during flexibility evaluation failures was $85.54 and the median price during capacity evaluation failures was $79.22. Furthermore, a non-trivial amount of failures of the flexibility test arose when prices were below zero. In fact, the price was negative during almost 4% of flexibility test failures and during just over 3% of capacity test failures. These data provide strong empirical support for the implementation of a tiered penalty design as discussed below and in prior MSC opinions and meetings.

We believe, it would be inefficient to eliminate transactions that could produce hundreds of dollars per MWh in gains from trade if there were no reliability concerns created by those transactions. An extreme case is (somewhat inadvertently) highlighted in Footnote 20 of the Draft Final Proposal,[21] which discusses a situation where the exporting BAA has a negative energy price.

> *All of a BAA's internal supply may not be dispatched if the source of assistance energy is from a BAA with negative prices. In this case a BAA's supply priced greater than $850/MWh may not be dispatched.*

Left unsaid is the fact that when the penalty is applied, the importing BAA would be dispatching internal resources costing up to $850/MWh rather than import energy that has a *negative* cost to the exporting BAA. This strikes us a far from the stated goals of the RSE, and leaves a lot of money on the table that could benefit the consumers and producers of the potentially exporting BAA. Therefore, we recommend a refinement.

The refinement would be to better link the energy assistance penalty to system conditions, which would help to avoid some of these inefficient outcomes outlined above. For example, a more modest penalty (say $100/MWh) could be applied when the system marginal energy cost (SMEC) is below a threshold level (say $100 in the t-55 real-time pre-dispatch (RTPD) run). Furthermore, no penalty could be applied when the price of power for the BAA was negative in the t-55 RTPD run. Another alternative would be to increase the RSE penalty as a function of the severity of the failure in the t-55 RTPD run. There are obviously more sophisticated ways to link the penalty to system conditions based on the outcomes of the t-55 RTPD run, but even a blunt two-level penalty could help resolve some of the extreme inefficiencies that are possible under the current proposal. Because all of these alternatives would be based on the results of the t-55 RTPD run, the information to trigger these rules would be known when the RTPD run for the first binding FMM interval of the hour initialized.

5. Remaining RSE Issues

During Phase 2 of this process, staff and stakeholders considered several technical aspects of the calculation of the RSE that had been deferred from Phase 1. The two main considerations were the treatment of load conformance adjustments and the treatment of uncertainty when performing the capacity test. In both cases the CAISO proposes to make no changes to the current practice,

[21] Johnson and Cooper (2022) , op. cit., pp. 23.

which excludes both load conformance and uncertainty adders from the capacity test, and load conformance from the flexibility test. We support both of these decisions at this time.

In addition, several complications with the current RSE implementation and with the proposed changes have emerged. Many of these concern the complex interaction of the HASP with both the RSE and subsequent EIM pricing. The implementation of an energy assistance option, with its associated large penalty price, further complicates these interactions and could create pricing anomalies. Concern over such anomalies has contributed to resistance from many California LSEs and DMM to the CAISO adopting the assistance option.

5.1 Load Conformance

In our earlier opinion, we supported the exclusion of load conformance from the RSE, and highlighted the fact that high load conformance (e.g., manual adjustments to the load forecast) by CAISO in the FMM was a symptom of underlying problems with the CAISO's flexible ramping product, rather than load forecast errors.

> *While it might seem logical to include any adjustments to the forecast to load in applying the resources sufficiency capacity test, this presumes these adjustments were made in order to reflect a more accurate forecast of the true demand.*
>
> *But within the CAISO, this is usually not the case. It appears that load conformance is instead a tool applied by operators to compensate for the flaws in the flexiramp implementation and for the inconsistencies between the HASP and RTPD solutions and resource sufficiency requirements.*[22]

5.2 Uncertainty Adder

In our previous opinion, we also extensively discussed the challenges associated with calculating an uncertainty adder in the capacity test.[23] One implication is that, while the proposed quantile regression method may be an improvement over the previous histogram method, the choice of the right sample of previous periods upon which to apply either method is critically important, but choices involve a number of tradeoffs. Therefore, it is very difficult to assess how well the choices the CAISO has made in implementing the quantile regression methodology will perform in estimating an uncertainty requirement. Therefore, we agree that it would be prudent to wait until more is known about the performance of the new method for estimating the uncertainty requirement before including it in the capacity test.

That said, under the current implementation there is an inconsistent treatment of uncertainty across the capacity and flexibility tests in the RSE, as well as the flexible ramping product (FRP). While an uncertainty adder remains part of the flexibility test, EIM imports can be used to unload capacity and enable a BAA to pass the flexibility evaluation. Hence the flexibility test

[22] J. Bushnell, S. Harvey, and B.F. Hobbs (2022), op. cit., p. 18

[23] Ibid., Section 3.

is not testing the self-sufficiency of a BAA in the way the capacity test is intended to, and fails to ensure that all BAAs make an appropriate contribution to EIM balancing capacity.[24] For this reason, a long run goal should be to include an accurately estimated uncertainty requirement in the resource sufficiency capacity evaluation.

Given the complex interaction between the flexible ramping product, the flexibility test, and load conformance practices, the design and application of an uncertainty adder for the capacity test will need to be considered after more has been learned about the performance and impacts of the pending changes to flexiramp that will be implemented later this year.

5.3 Remaining Issues with HASP/RSE Interactions

During this process, several details have emerged about the complicated interaction between the HASP and RSE process, both of which are executed in a sequence of partially overlapping advisory and binding calculations. These issues remain unresolved by the current proposal and will need to be addressed, in particular, before LSEs in the CAISO BAA will be comfortable with a pricing-based penalty for RSE failure. We briefly list these below.

1. Following the October 17, 2022 MSC meeting, the CAISO Department of Market Monitoring informed the MSC that the October 14 draft Opinion's description of an endogenous transfer cap (p. 15) was not consistent with the pattern they had observed. After some discussion, we understand that CAISO staff now agree with the Department of Market Monitoring that the transfer cap is not endogenous in the RTPD optimization and is instead always fixed based on a value in a prior run. Since the principal implementation issue CAISO had with Option 1 described in Section 4 of that draft (p. 12) was the impact on an endogenous transfer cap, it appears to us that Option 1 should be a workable interim design for summer 2023.

2. We came to understand during discussions in the last week that an initial RSE is applied prior to clearing the HASP and RSE failures and failure consequences are currently modeled during the subsequent HASP runs. Among other impacts of this design, this means that HASP schedules could be influenced by penalties applied for RSE failure, even if the CAISO passes the final RSE.[25] If CAISO were to opt for a pricing-based penalty for RSE failures (such as the energy assistance penalty in the current proposal), a predicted (advisory) RSE failure would trigger RSE penalty levels for HASP transactions. Therefore, HASP schedules and prices would be calculated as if a $1000 (or $2000) import penalty were in place, even if the CAISO subsequently passes the final, binding RSE test. The CPUC has pointed out that high cost EIM transfers based on these penalties might impact settlements if they caused high offer price hourly transactions to clear in HASP, that would be eligible for higher of HASP offer or FMM price settlements. It is not clear to us that these kind of outcomes can be addressed without significant changes to the RSE and/or HASP.

[24] Ibid., Section 5.2, pp. 24-25.

[25] We do not have a sufficiently clear understanding of how the pre-HASP RSE is carried out to assess how likely or even plausible such an outcome would be.

3. Currently, the first advisory RSE is run at T-75. The results of the RSE and its failure consequences become an input into HASP. While HASP schedules are allowed to count as capacity for BAAs importing from CAISO in HASP, at this point the actual HASP results have not been calculated yet. Our understanding is that the base schedules of some EIM entities can include imports based upon *bids* to buy from HASP, rather than actual cleared bids. These import bids are therefore used for these advisory intervals, and possibly even the binding interval under current practice. The CAISO proposal now makes clear that only schedules that clear HASP should be counted as capacity in the final RSE evaluation for WEIM BAAs,[26] but it is not clear to us how this will be enforced, and even if it is, what values would be used for the advisory evaluations. The results of the advisory tests carry elevated significance as long as failures are modeled in HASP, as discussed above.

This list is not exhaustive; due to the complexity of the interactions of HASP, RTPD, and the RSE process, there will possibly be other issues that will be identified that should also be reckoned with.

6. Conclusions

We support the changes being put forward in this proposal. The change to the treatment of HASP LPT exports should help prevent inappropriate RSE failures by the CAISO. The addition of emergency energy assistance option should allow for more flexibility in serving RSE deficient areas during periods of true scarcity. However, because it is proposed that BAAs will be able to toggle between the existing approach to penalizing RSE failure and the newly proposed energy assistance penalty approach, reliability and efficiency problems can still arise when a BAA has opted for the status quo during a scarcity event, or when a BAA has opted for the new approach but fails the RSE during a period of no scarcity. In addition, there are pricing complications with applying the penalty during advisory runs in HASP.

Even with the above change, we fear that this dual approach will leave many parties unsatisfied. We believe that the ultimate penalty design should adopt a unified approach where there is a graduated penalty that would apply to all EIM transfer imports. This penalty should be based upon system conditions, such as from the prior RTPD run, so that the severity of the RSE failure and the size of the penalty to be applied are determined prior to when the binding FMM interval is cleared. Stakeholders should also consider tiered penalties based on the degree of RSE failure.

Finally, there are several additional pieces of evidence and pending developments that will almost certainly imply that CAISO and stakeholders should take another look at the RSE in the future. The lessons of the September 2022 heatwave are still being analyzed. Potentially important changes to the flexiramp product are pending implementation. The implementation of these flexiramp changes will provide information about the design of an uncertainty adder for the

[26] D. Johnson and B. Cooper, *EIM Resource Sufficiency Evaluation Enhancements: Phase 2. Final Proposal.* CAISO, September 30, 2022, www.caiso.com/InitiativeDocuments/Final%20Proposal%20-%20WEIM%20Resource%20Sufficiency%20Evaluation%20Enhancements%20Phase2.pdf, p. 18.

RSE capacity test. More importantly, an improved flexiramp could help mitigate the concerning outcomes that can potentially be produced by the HASP, RSE, EIM interaction today. Last, it will be important to better understand the role of operator load conformance, both in general, and in particular during the September 2022 heatwave, in response to many of the flexiramp and HASP issues we discuss in this opinion.

Regardless of the lessons from September 2022 and the performance of the flexiramp improvements, there are several remaining aspects of the RSE that will need to be addressed. It is clear that a long-term RSE implementation needs to 1) address the issue of base schedules that include HASP transactions that did not clear; and 2) develop a tiered penalty design.