Appendix A

Option 1 Introduces A Systemic Difference Between the Day-Ahead and Real-Time Markets

Summary: *The procurement of day-ahead Imbalance Reserves represents a new type of reserve product with a unique attribute. Whereas current reserve products are carried through each actual operating interval, at the same average level, the purpose of day-ahead Imbalance Reserves is to cover day-ahead uncertainty, ensuring sufficient supply is available to be dispatched in real-time. This day-ahead "insurance" means that the actual FMM needs for energy and operating reserves, including FMM Flexible Ramping Up quantities, will be less, on average, than the physical supply committed in the day-ahead market. Under CAISO's proposed Option 1, the systematic divergence between the total demand for physical supply in the day-ahead market and the total demand for physical supply in the FMM can be expected to result in day-ahead energy prices that, on average, exceed energy prices in the FMM, making virtual supply profitable. This will drive an increase in virtual supply awards, which will displace energy awards to physical resources in the day-ahead market, and thus will ultimately result in DAM total physical supply awards being too low to ensure sufficient physical supply is committed ahead of the FMM process. This outcome will, in turn, result in a continued need for additional supply (either higher day-ahead upward Imbalance Reserves or post-DAM operator procurement) to restore the total physical supply to meet FMM needs with a high degree of certainty. The design of Option 1 therefore contains a material and fatal flaw that, if implemented, will be economically harmful, will undermine the reliability objectives of the proposed design, and will not be self-correcting.*

The CAISO's "Option 1" approach described at the August 13 Workshop would require the day-ahead market solutions to satisfy two key requirements:

1. The sum of virtual supply and physical supply must equal the sum of physical load, virtual load, and losses; and
2. The sum of procured "Imbalance Reserves" would equal the "historical uncertainty between IFM cleared net load and FMM net load."[1]

Furthermore, "IFM cleared net load" is defined as cleared demand minus cleared net virtual supply minus cleared VER supply.[2] In other words, Option 1 would procure Imbalance Reserves based on the historical need for additional dispatchable (*i.e.,* non-VER) physical supply in the FMM, beyond the level of dispatchable physical supply scheduled in the day-ahead market.

Notably—and appropriately—Option 1 would not procure merely the *average* quantity of additional physical supply needed in the FMM, but a greater quantity that *ensures* sufficient physical supply is available to meet FMM needs with a high degree of certainty. CAISO presented analysis at the workshop identifying the quantity of upward and downward uncertainty, based on

[1] August 13 Workshop Presentation, at 48-49.

[2] *Id.* at 33.

a confidence level of 97.5%.[3] Powerex understands this analysis to indicate that, in order to be highly confident there will be sufficient physical resources available in the FMM, CAISO anticipates procuring approximately 2,800 MW of day-ahead upward Imbalance Reserves, *in addition to the dispatchable physical energy and traditional operating reserves scheduled in the day-ahead market.*[4]

By definition, Option 1 is intended to be designed to commit a level of physical supply that will exceed the level of physical supply needed in real-time in all but a small number of hours through its procurement of the Imbalance Reserve Up product. Perhaps more importantly, it is also intended to be designed to commit a level of physical supply that will exceed the level of physical supply needed in the FMM, including necessary FMM Flexible Ramping Up quantities, on average. This makes the proposed day-ahead Imbalance Reserve product entirely distinct from the reserve capacity products that are currently procured in the day-ahead market, which the CAISO continues to carry in the real-time markets. For example:

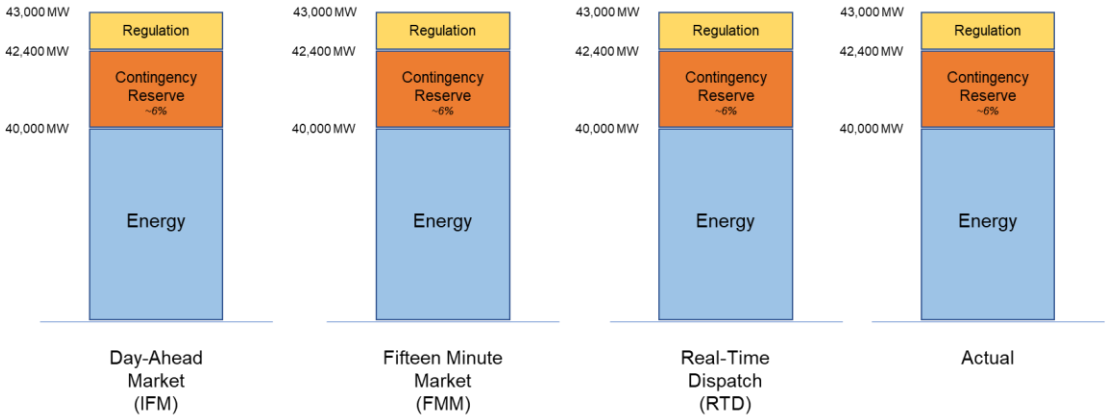
- CAISO currently procures **Spinning Reserve and Non-Spinning Reserve** in the day-ahead market to meet NERC-required contingency reserve standards. None of these reserves are generally "released" in either the FMM or RTD, but must continue to be maintained, at the same level, throughout each operating interval in order to be available to be deployed in the event of a qualifying contingency event. By the time it is known that a contingency did not occur (which is the case in the vast majority of hours), it is too late for that capacity to be "released" (and the underlying resources economically dispatched for energy).
- CAISO also currently procures **Regulation-Up** in the day-ahead market based on its anticipated need for balancing load and supply within each 5-minute RTD interval. Again, this capacity is set aside and carried through real-time operations, and hence it is not "released" (and the underlying resources economically dispatched for energy in either FMM or RTD).

Because contingency reserve and regulation must be maintained throughout each actual operating interval, each of the CAISO sequential markets includes the same reserve requirement,[5] and hence the same total requirement for capacity, as depicted below:

[3] *Id.* at 37-40.

[4] *Id.* at 39. CAISO's analysis for 2018 identified upward uncertainty of between 2,399 MW and 3,268 MW, depending on whether FMM net load was compared to the day-ahead market awards, to the CAISO's day-ahead forecast, or to the CAISO's day-ahead forecast including RUC adjustments. For purposes of this discussion, an approximate mid-point value of 2,800 MW is used.

[5] To the extent the forecast system conditions change between day-ahead and real-time, the requisite level of reserves may also change. However, if the forecasts are unbiased, then the differences in reserve requirements should be random and should not give rise to any systematic divergence on average.



Total Required Capacity:	43,000 MW	43,000 MW	43,000 MW	43,000 MW

The day-ahead Imbalance Reserve product will be fundamentally different, however. In particular, the day-ahead Imbalance Reserve product will not simply reflect the earlier procurement of the anticipated real-time Flexible Ramping Product quantity.

First, it is Powerex's understanding that the day-ahead Imbalance Reserve product is designed to cover the uncertainty surrounding day-ahead forecasts of FMM conditions, which is *in addition to* the Flexible Ramping Up capacity reserved in FMM. The August 23 Workshop presentation included an analysis of uncertainty between day-ahead cleared net load and FMM net load, and concluded that in 2018 the 97.5% confidence level of this uncertainty was 2,400-3,300 MW. Importantly, this is the amount of additional dispatchable capacity necessary to meet "FMM net load," which is equal to the "FMM demand forecast – FMM VER forecast."[6] It is Powerex's understanding that this analysis does not include the quantity of Flexible Ramping Up capacity in FMM. In other words, the day-ahead Imbalance Reserve product needs identified by CAISO are calibrated only to meet the FMM net load, and not the FMM net load plus FMM Flexible Ramping Up needs.

Second, even if the CAISO analysis included not just the FMM net load forecast, but also FMM Flexible Ramping Up needs, it is still clear that the bulk of the day-ahead Imbalance Reserve requirement is not due to anticipated Flexible Ramping Up procurement in FMM. Specifically, CAISO OASIS data shows that the Flexible Ramping Up quantities for the CAISO BAA in RTPD averaged just under 700 MW in 2018, representing approximately one-fourth to one-third of the estimated day-ahead Imbalance Reserve needs.

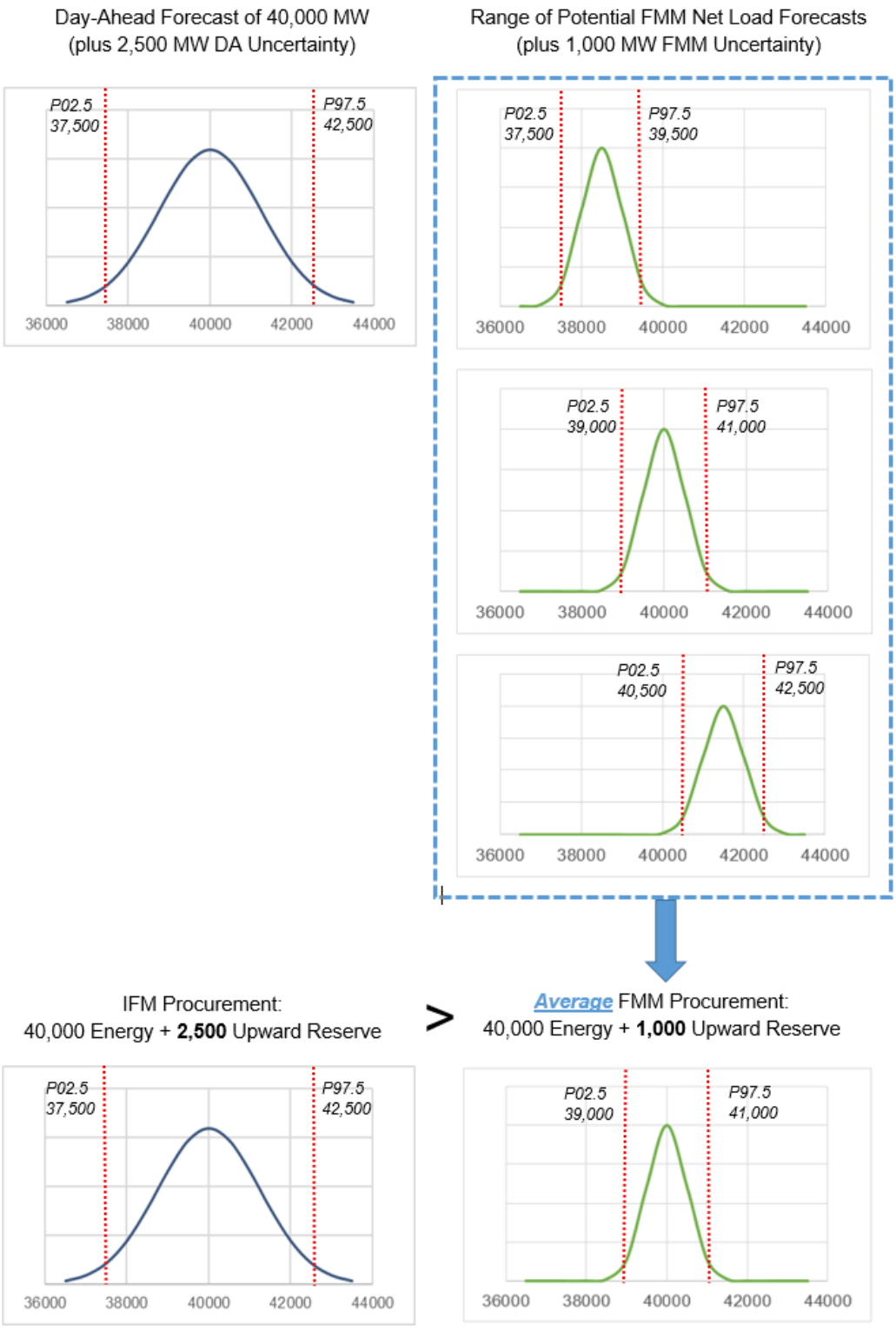
In the majority of hours, then, it can be expected that much of the capacity "set aside" as Imbalance Reserve in the day-ahead market will not be needed in the FMM.[7] There will, of course, be specific individual hours in which some or even all of the day-ahead Imbalance Reserves *are* needed to meet demand in FMM—that is precisely why they were procured—but the nature of

[6] August 13 Workshop Presentation, at 33.

[7] Powerex believes this may be an understatement, as the CAISO's analysis of IFM-to-FMM uncertainty was based on the "FMM Demand Forecast – FMM VER Forecast." FMM Flexible Ramping Product requirements may therefore be in addition to these quantities.

this type of “insurance” product is that a great portion of them will generally *not* be needed, on average.

The illustration below depicts the relationship between the day-ahead procurement of Imbalance Reserve and the need for physical capacity in FMM, both to meet the (real-time) load forecast and to meet real-time uncertainty needs (through Flexible Ramping Up). As shown, the day-ahead uncertainty can be decomposed into (1) changes between the day-ahead load forecast and the FMM load forecast; and (2) remaining uncertainty in the FMM load forecast.



The unique attribute of the day-ahead Imbalance Reserve product, as detailed in CAISO's Option 1 proposal, introduces a systemic and structural difference in the total demand for physical supply

in the day-ahead market and the demand for physical supply in the real-time market, as illustrated below:

Total Required Capacity:	**45,500 MW**	**44,000 MW**	**43,500 MW**	**43,000 MW**

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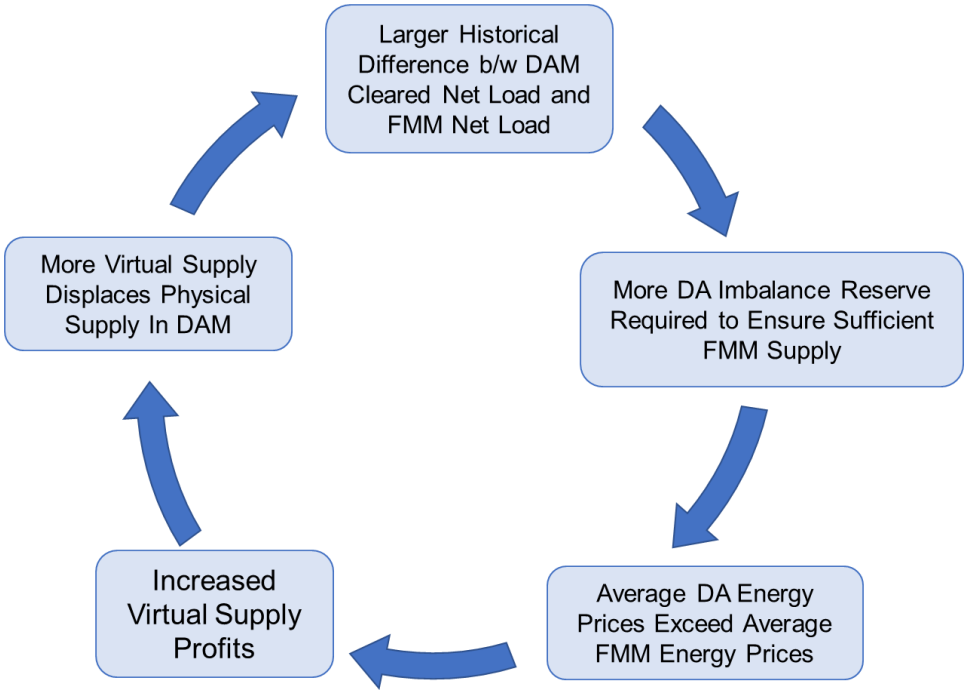
All else being equal, this can be expected to result in day-ahead energy prices exceeding FMM energy prices, on average. It is critical to consider the anticipated response by market participants to this price divergence, and whether these predicted responses will serve to increase, or decrease, the efficiency of the market.

The likely response to day-ahead energy prices that, on average, exceed FMM energy prices is an increase in the quantity of net virtual supply that clears in the day-ahead market.[8] Virtual supply can be expected, in an efficient market, to be offered in at approximately the expected FMM energy price. Where the expected FMM energy price is less than the day-ahead energy price, on average, additional virtual supply offers will clear in the day-ahead market, resulting in a reduction in the amount of physical supply that clears in the day-ahead market. This is highly problematic, however, since it defeats the objective of procuring day-ahead Imbalance Reserve in the first place. Recall that the Imbalance Reserve requirement is based on the historical difference between the need for dispatchable capacity in FMM *beyond what was scheduled day-ahead.* But if the quantity of physical dispatchable capacity scheduled in the day-ahead market is reduced (as will necessarily be the case in order to clear additional virtual supply offers and still converge DAM energy prices to expected FMM energy prices), then the procured level of total physical supply (*i.e.,* physical energy awards, contingency reserves, regulation up, and Imbalance Reserve up) will be "too low" to ensure sufficient total FMM physical supply with the desired level of certainty.

[8] Equivalently, the quantity of load that is bid into the day-ahead market may be reduced.

Powerex believes that Option 1 is fatally flawed, as its design appears to create a vicious circle in which virtual supply earns significant profits while undermining the reliability objectives of the proposed enhancements:



CAISO's experience with the implementation of convergence bidding in 2011 highlights both the critical importance of avoiding market designs that could be used by financial entities speculating through virtual transactions to the detriment of market efficiency and California ratepayers, as well as the difficulty of predicting how virtual transactions will interact with market design changes. Prior to the implementation of convergence bidding, it was believed by many that permitting virtual transactions at the interties would increase market efficiency and converge day-ahead and real-time prices.[9] Following the implementation of convergence bidding in February 2011, however, it became clear that the market design could be used by financial participants to earn profits from activity that did not increase market efficiency and that economically harmed ratepayers. In particular, these opportunities arose from the combined result of CAISO's use of different real-time market timeframes to settle intertie convergence bids as opposed to convergence bids at internal locations, together with hourly (*i.e.,* HASP) prices that were persistently and predictably lower than 5-minute RTM prices. As a result, "market participants were able to profit from submitting large volumes of virtual supply bids at intertie scheduling points and offsetting virtual demand bids at internal nodes," and profiting "from the liquidation of these positions by paying a

[9] *See, e.g.,* Cal. Indep. Sys. Operator Corp., Draft Final Proposal for the Design of Convergence Bidding at 10-11 (Sept. 14, 2009) ("Convergence bidding at the interties will enable Market Participants to arbitrage differences between the Day Ahead and HASP prices thus facilitating price convergence. In addition, by providing a mechanism for market participants to engage in virtual bidding at the interties the proposal will eliminate the incentive for parties to engage in implicit virtual bidding, which can negatively impact reliable operation.").

usually lower HASP price for the virtual import bid, and receiving a higher real-time price for the virtual demand bid."[10] As CAISO explained at the time, the interplay of the dual real-time market and convergence bidding was unexpectedly "inhibiting the intended market efficiencies associated with convergence bidding at the interties and causing adverse impacts on the market through an increase in market uplifts and the distortion of market prices and incentives."[11]

Ultimately, CAISO filed to suspend convergence bidding at the interties in order to prevent further harm to the market, with intertie convergence bidding officially suspended on November 25, 2011. At that point, however, convergence bidding had generated approximately $58.6 million in uplift costs.

Powerex remains concerned that moving forward with Option 1 would represent a repeat of past mistakes, with the potential for significant unintended adverse consequences for the market and for California ratepayers, who are ultimately saddled with the uplift costs associated with inefficient virtual bidding opportunities. Powerex notes that the same fatal flaw would also arise under an approach of merely adding day-ahead procurement of Imbalance Reserves to the existing day-ahead market, as was suggested by certain stakeholders at a recent Market Surveillance Committee meeting. Indeed, Powerex is concerned that *any* approach in which the market clearing price of financially binding (but non-physical) day-ahead energy awards is conflated with the net market-clearing price for physical supply is likely to suffer from the same problem. For this reason, Powerex believes that Option 2 is necessary, as it avoids this flawed approach.[12]

Powerex respectfully requests that the CAISO, the Department of Market Monitoring, the Market Surveillance Committee, and stakeholders carefully consider the potential for Option 1 (and any similar proposals) to create profitable opportunities for activity that defeats the fundamental design objective of the proposed design, and/or creates harmful unintended consequences.

[10] *Cal. Indep. Sys. Operator Corp.,* 143 FERC ¶ 61,087 at P 9 (2013).

[11] *Cal. Indep. Sys. Operator Corp.,* Tariff Amendment Eliminating Convergence Bidding at the Interties, Docket No. ER11-4580-000, Transmittal Letter at 2 (2011).

[12] Option 2 does not enable virtual supply to change the total physical supply committed in the DAM, while continuing to enable virtual supply to satisfy demand for financially binding energy awards. The two power balance constraints under Option 2 appropriately permit the total market compensation for physical supply to diverge from the market compensation to virtual supply in the DAM in circumstances in which the physical constraint is binding. This approach enables virtual supply and virtual demand to support convergence of DAM and FMM energy prices, without improperly distorting the DAM procurement of physical capacity.