Comments of Powerex Corp. on System Market Power Analysis

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Powerex appreciates the opportunity to submit comments respecting the CAISO's Analysis of System Market Power in the CAISO Balancing Authority Area ("BAA") ("White Paper") and related working group meeting.

In the White Paper, CAISO explains that it recently conducted an analysis of the structural competitiveness of the CAISO market after the CAISO Department of Market Monitoring ("DMM") expressed concern that tighter supply conditions in the CAISO markets may be increasing the ability of energy suppliers to exert market power in the day-ahead market at the system level. More specifically, DMM estimates that the day-ahead market was structurally uncompetitive during approximately 325 hours in 2017 and likely to become increasingly uncompetitive going forward.[1] CAISO's analysis indicates that the CAISO markets were structurally uncompetitive in only 55 hours in 2018; however, CAISO suggests that the increasing potential for the exercise of market power at the system level may warrant changes to CAISO market rules, including the potential implementation of system market power mitigation measures and/or requiring suppliers to cost-justify import offers.[2]

Powerex recognizes the importance of ensuring that organized market rules are sufficiently robust to protect against the exercise of market power when uncompetitive conditions exist in order to ensure that prices remain just and reasonable. In evaluating whether additional market mitigation measures are needed, however, it is critically important to recognize that metrics such as the residual supply index ("RSI") have significant limitations, as they fail to distinguish between different underlying causes for RSI statistical outcomes. In particular, a low RSI value can be due either to high levels of concentration of resource ownership or control (*i.e.,* market power concerns) or it can be due to a general lack of adequate supply in the market as a whole (*i.e.*, resource adequacy and/or scarcity conditions).

This distinction is critical and can be illustrated by comparing the following examples.

[1] White Paper at 3.

[2] *Id.*

- **Example 1: High supplier concentration, with sufficient total supply.** Take an example where the CAISO demand forecast is 40,000 MW and there is 50,000 MW of supply available, 15,000 MW (or 30%) of which is controlled by a single market participant. In this situation, there is adequate supply available in the market, but the large supplier may have the ability and incentive to raise the market-clearing price. This is an example of a situation where the market is resource adequate with a substantive reserve margin, but there is a system market power concern due to high supplier concentration. Stated differently, the market would be viewed as structurally competitive if it were not for the large fraction of supply controlled by a single entity. In these types of situations, it may be appropriate to take steps to prevent such suppliers from using or benefiting from their control over a significant share of the market supply to increase prices above competitive levels.

- **Example 2: Low supplier concentration, but inadequate overall supply.** In this example the CAISO demand forecast is still 40,000 MW, but there is only 40,500 MW of supply available—only 1,000 MW of which is controlled by the largest market participant. In this example, the quantity of supply offered into the market by all suppliers is just sufficient to meet demand, but with very little reserve margin. Importantly, in this example, even the single largest supplier controls only a modest share of that supply (*i.e.*, less than 3%). ***It would be inappropriate to characterize this scenario as presenting a system market power concern, because ownership concentration is not the root of the problem.*** Rather, the key issue in this situation is that the total quantity of offers submitted into the market is not sufficient to ensure that the market operator is able to serve demand with a high degree of confidence. ***That is, such a situation reflects resource adequacy challenges and short-term supply scarcity.***

Powerex believes that clearly distinguishing between a system market power issue due to high supplier concentration and a resource adequacy issue that results from short-term supply scarcity (regardless of ownership concentration) is a critically important first step in this stakeholder process. An accurate diagnosis is vital to informing the discussion of what measures, if any, should be taken to mitigate potential market power at the system level. When the issue is one of resource adequacy, then the focus should be on securing additional resources (either by investing in new resources or forward contracting with existing resources), rather than applying new mitigation measures to combat system-level market power that is not, in fact, the challenge.

If the problem is inadequate supply and resource adequacy, the right response is to efficiently ensure that sufficient resources are available to maintain reliability (thereby reducing the frequency of short-term supply scarcity). This in turn requires improvements to resource adequacy programs and more robust short-term price signals to encourage market entry, participation and performance. In contrast, responding to a resource adequacy problem by imposing new administrative bid mitigation measures will not only

fail to increase the supply available to the market, but may actually serve to exacerbate the problem by creating a disincentive for voluntary suppliers to participate in short-term markets with excessive mitigation practices.

If, on the other hand, there is a fundamental supplier concentration issue that is resulting in market power concerns—meaning there is adequate supply overall, but high levels of ownership concentration lead to uncompetitive outcomes—then it is appropriate to focus on ways to address supplier concentration and resulting market power concerns.

Powerex believes that the analytical outcomes presented in CAISO's White Paper are symptomatic of underlying problems with the California Resource Adequacy program, which are creating more frequent short-term supply scarcity, and are creating a growing risk that CAISO will regularly have insufficient capacity and flexibility available to allow it to reliably operate its system under a full range of market conditions.

As discussed further below, the existing Resource Adequacy program contains critical gaps that have been impairing the ability of the program to ensure that sufficient resources with the right types of attributes are committed on a forward basis to meet reliability needs. Indeed, the data presented in CAISO's recent 2019 Summer Loads and Resources Assessment indicates a dramatic increase in the likelihood of emergency conditions once the assumed level of available imports to the CAISO BAA is appropriately modified to reflect the level of imports actually committed under forward Resource Adequacy contracts and/or to reflect the actual level of imports that were delivered to the CAISO BAA during peak demand hours in the summer of 2017 and 2018. The CAISO has correctly emphasized that "[a]vailability of sufficient imports during high peak load conditions is critical to ensuring system reliability."[3] Powerex believes the substantive shortcomings in the California Resource Adequacy program leave the CAISO unable to ensure reliable service under the full range of potential summer grid conditions, absent sufficiently high levels of voluntary imports.

The CAISO's short-term energy market design is also unable to compensate for the shortcomings of the California Resource Adequacy program. This is largely due to market design issues in the CAISO's short-term energy markets that systematically suppress prices, particularly during periods of relative scarcity, muting the price signals for external suppliers to voluntarily make their resources available in the CAISO's short-term markets. These market design issues include:

- Routine reliance on out-of-market dispatch during periods of relative scarcity to compensate for the failure of the Resource Adequacy program to commit sufficient capacity and flexibility to meet system needs;

[3] CAISO 2019 Summer Loads & Resources Assessment at 41 (May 8, 2019), *available at:* http://www.caiso.com/Documents/2019SummerLoadsandResourcesAssessment.pdf.

- Routine reliance on upward load-biasing, particularly during peak hours of the day, to increase imports in order to compensate for the failure of the Resource Adequacy program to commit sufficient capacity and flexibility to meet system needs;
- The lack of a robust shortage pricing mechanism that ensures scarcity is accurately reflected in market prices and encourages robust voluntary participation by resources during periods when they are most needed; and
- "Energy only" dispatch, pricing and settlement practices that fail to take into account the capacity and flexibility attributes of different types of resources, and compensate them for the services they provide.

Against this backdrop of chronically insufficient forward procurement of capacity and flexibility under California's Resource Adequacy program, together with systematically suppressed short-term energy prices during periods of relative scarcity, CAISO is now considering an initiative that would impose new administrative pricing measures that would undoubtedly further suppress prices and further interfere with the operation of the market. Powerex believes the underlying premise—that the issues affecting the CAISO markets are principally due to system market power, rather than a lack of resource adequacy—is wrong, and the measures being considered would send CAISO further down the road towards ever greater reliance on out-of-market dispatch and operator interventions.

In evaluating the potential implications of such measures, it is important to keep in mind that the participation of external resources in the CAISO markets – whether through the intertie bidding framework or through the Energy Imbalance Market ("EIM") – is entirely voluntary.[4] Unlike internal resources, which have few alternatives to selling their output into the CAISO markets, external suppliers have a choice of selling the energy, capacity, and flexibility of their resources to CAISO, selling it to other purchasers outside of California, using it to meet their own needs, or—in the case of storage hydro resources—conserving the resource for use at another time. To the extent that the CAISO imposes new administrative pricing measures that have the effect of further suppressing prices during periods of scarcity, thereby preventing suppliers from being appropriately compensated for the services that they supply to the CAISO grid, it is reasonable to expect that external suppliers will increasingly choose to make their supply available to purchasers outside of California.

Suppressing short-term energy prices during periods of scarcity will also likely serve to continue to drive the premature retirement of additional capacity resources within the

[4] External resources may elect to voluntarily enter into Resource Adequacy arrangements with California load-serving entities, in which case they accept the associated must-offer requirements. External resources that are not used to support a Resource Adequacy commitment may freely elect whether or not to submit offers or self-schedules into the CAISO day-ahead or real-time markets for any particular delivery hour.

CAISO. It is widely acknowledged that one of the key challenges facing the CAISO market is the retirement of conventional resources that have long contributed to supplying the capacity and flexibility necessary to meet grid needs. For instance, the CAISO DMM's 2018 Annual Report of Market Issues and Performance notes that approximately 6,000 MW of generation withdrew from participation in the CAISO markets between June 2015 to June 2018, noting that "[t]he majority of this retired capacity was from natural gas resources in local capacity areas."[5] The report further observes that, "[g]oing forward significant reductions in total gas-fired capacity may continue beyond 2018 because of the state's restrictions on once-through cooling technology as well as other retirement risks."[6] Powerex believes that imposing new administrative price mitigation measures is likely to exacerbate the issues that CAISO is experiencing with the retirement of conventional generation resources by further reducing the annual market revenues received by internal resources that currently play a role in meeting system needs during critical demand periods.

Rather than going down the road of imposing additional administrative pricing measures, Powerex believes CAISO should refocus its current efforts on (i) working with the California Public Utilities Commission ("CPUC") to address issues with the underlying California Resource Adequacy program, and (ii) exploring short-term market design improvements and enhanced price formation practices that support the goal of increasing voluntary participation in its markets, thereby promoting durable, competitive markets for energy, capacity, and flexibility. Powerex believes that taking steps to encourage suppliers to voluntarily make their energy, capacity, and flexibility available in the CAISO's short-term markets is far more likely to ensure that CAISO has the resources necessary to maintain reliability while cost-effectively integrating increasing amounts of renewables to meet California's ambitious environmental goals.

In this regard, Powerex believes that CAISO's short-term market design and price formation practices increasingly lag behind those of other organized markets. For instance, PJM recently submitted tariff amendments to modify its reserve market and shortage pricing mechanisms to ensure that the PJM markets send efficient price signals for the development and deployment of flexible resources that PJM expects will be necessary to integrate a growing portfolio of renewable resources on its system. While PJM explains that PJM market operators (like CAISO market operators) have been relying on out-of-market actions and operator interventions, such as load biasing, to procure the flexibility necessary to meet system needs, PJM has recognized that such an approach is not sustainable in the long term and that such interventions "suppress

[5] CAISO DMM, 2018 Annual Report on Market Issues and Performance, at 15, *available at:* http://www.caiso.com/Documents/2018AnnualReportonMarketIssuesandPerformance.pdf.

[6] *Id.* at 16.

clearing prices, fail to correctly recognize the essential value of reserves in managing uncertainty, and increase out-of-market uplift."[7]

Powerex believes that the manner in which CAISO deals with these challenges will have profound consequences for the continued health and development of the CAISO markets, as well as for the prospects of any potential regional day-ahead organized market in the west. For example, the surplus capacity and flexibility of resources located outside of the CAISO BAA—particularly the large hydroelectric storage systems that comprise the Pacific Northwest—have the potential to play a significantly expanded role in enabling California to efficiently and cost-effectively meet its renewable goals while maintaining reliability. However, these resources are unlikely to be willing to provide their capacity and flexibility attributes to CAISO's short-term markets—whether through intertie bidding or participation in the EIM or an expanded day-ahead market—unless these products and services are efficiently and equitably compensated in the market through an efficient market design. Such external suppliers are likely to increasingly find that market opportunities for their products and services outside of California are more attractive, particularly as the rest of the west also experiences significant retirements of conventional fossil fuel resources.

To the extent California's short-term market design impairs its ability to compete for the participation of capacity and flexibility rich resources, California may need to turn to less attractive options, such as continued reliance on the capacity and flexibility from external fossil fuel resources or an aggressive and costly build out of in-state storage resources, to maintain reliability. Moreover, a short-term market design that does not promote efficient, equitable price formation cannot be expected to be a workable market design for a regional day-ahead organized market with participation by entities and regions facing very different circumstances, and ratepayer interests, than California.

I. CAISO Should Refocus Its Efforts On Addressing Market Design And Price Formation Issues

A. The Problem Is Resource Adequacy; Not Market Power

In the White Paper, CAISO explains that it evaluated whether the CAISO markets were structurally uncompetitive during 2018 using the RSI. In effect, the RSI evaluates whether demand can be met without the contribution of supply from particular "pivotal suppliers" during a given period. Where demand cannot be met without the supply of these suppliers, then the market is considered to be uncompetitive. According to CAISO, using this measure, the CAISO markets were structurally uncompetitive in 55 hours during 2018.

[7] *PJM Interconnection, L.L.C.*, Enhanced Price Formation In Reserve Markets of PJM Interconnection, L.L.C., Docket No. ER19-1486-000 (Mar. 29, 2019).

Powerex acknowledges the importance of protecting against the potential exercise of market power and recognizes that market power mitigation measures are one way to achieving that objective. However, Powerex believes that it would be incorrect to conclude that there is any system market power issue in the CAISO BAA, based merely on the observations that the supply of all sellers participating in the market was necessary to meet demand during certain hours in 2018. ***To the contrary, the fact that there were numerous periods in which there was limited excess capacity available to meet system needs reflects scarcity conditions, not a supplier concentration or system market power issue***.

Notably, gaps in California's System Resource Adequacy program have seriously impaired the ability of the program to ensure that sufficient resources are committed on a forward basis to meet peak demand plus required contingency reserves. In particular, over the past several years, it has become increasingly clear that the existing Resource Adequacy framework is not sufficient to maintain the reliability of the CAISO grid in the face of a rapidly evolving resource mix, both in California and across the west. More specifically, there is growing evidence that the California Resource Adequacy program:

- Substantially underestimates Resource Adequacy requirements by setting System Resource Adequacy procurement requirements in a manner that does not accurately reflect system needs; and
- Substantially overestimates the ability of committed capacity to actually meet Resource Adequacy requirements by failing to take into account resource availability in evaluating the quantity of capacity that a resource can provide and by allowing resources to obtain Resource Adequacy commitments that have little ability to actually supply capacity to the CAISO BAA.

Collectively, the result of these gaps has been that the quantity of resources with Resource Adequacy commitments that have actually been available to the CAISO has regularly fallen below actual system needs. This is reflected in historical public data for the summer months of 2016 through 2018, compiled by Powerex and included in the table below, which shows that the System Resource Adequacy Requirement set by the CPUC has been, at best, just enough to cover CAISO actual peak hourly demand plus required contingency reserves in several months, but appears well short of the amount needed to also cover unit outages.

		CEC 1-in-2 Forecast Peak[1] (MW)	*plus* 15% PRM (MW)	**RA Target[2] (MW)**	Actual Peak Hourly Load[3] (MW)	Required Contingency Reserve[4] (MW)	**Total Capacity Required (MW)**	RA Surplus (Deficiency) (MW)	Unit Outages[5] (MW)	**Resource Adequate?**
2016	June	39,625	5,944	**45,568**	44,454	2,590	**47,044**	(1,476)	(7,152)	***No***
	July	44,364	6,655	**51,018**	45,981	2,716	**48,697**	2,322	(6,222)	***No***
	August	46,848	7,027	**53,875**	43,812	2,548	**46,360**	7,515	(5,944)	***Yes***
	September	42,388	6,358	**48,747**	42,810	2,460	**45,270**	3,477	(7,309)	***No***
2017	June	41,834	6,275	**48,109**	44,184	2,659	**46,843**	1,266	(9,454)	***No***
	July	45,259	6,789	**52,048**	45,374	2,627	**48,001**	4,047	(7,088)	***No***
	August	45,967	6,895	**52,862**	47,297	2,778	**50,075**	2,787	(6,151)	***No***
	September	45,489	6,823	**52,312**	49,909	2,871	**52,780**	(468)	(5,885)	***No***
2018	June	37,596	5,639	**43,235**	37,803	2,594	**40,397**	2,838	(7,228)	***No***
	July	43,080	6,462	**49,542**	46,487	3,026	**49,513**	29	(4,780)	***No***
	August	44,923	6,738	**51,661**	45,021	2,734	**47,755**	3,907	(6,181)	***No***
	September	42,579	6,387	**48,966**	38,536	2,374	**40,910**	8,056	(5,275)	***Yes***

1 2016 monthly values are from CPUC 2016 RA Report, Tbl. 3 (for CPUC-jurisdictional LSEs only) scaled to "Total CAISO Coincident Peak" for 2016 from final CEC Mid-Baseline Mid AAEE Savings forecast in 14-IEP-1
2017 values from https://www.caiso.com/Documents/AgendaandPresentation_2018AnnualReviewofAvailabilityAssessmentHoursJun6-2017.pdf (at 32);
2018 values from http://www.caiso.com/Documents/Presentation-CapacityProcurementMechanismSignificantEvent.pdf (at 4, "CAISO-RA")

2 Equal to CEC 1-in-2 peak forecast plus PRM; does not reflect reductions due to demand response or other factors, and hence may exceed the System RA that LSEs are required to show.

3 From CAISO OASIS, "CAISO Demand Forecast" for "Actual" process and "CAISO-Total" region.

4 From CAISO OASIS, "AS Requirements" of Spin and Non-Spin for "AS_CAISO_EXP" region during hour of peak load for respective month. Does not include Reg-Up, which is approximately 350 MW during peak hours.

5 From CAISO report "Curtailed and Non-Operational Generators in California" on day of peak load in respective month. http://www.caiso.com/market/Pages/OutageManagement/UnitStatus.aspx.

This data shows that, even in those months where the System Resource Adequacy requirement has covered actual system needs, virtually every resource committed to meet Resource Adequacy requirements would be required to be available and perform in order to allow CAISO to meet reliability needs. In practice, however, a significant portion of the resources contracted to provide Resource Adequacy capacity have not performed during this period. For instance, the data above suggests that the quantity of resources contracted to provide Resource Adequacy that have actually been available to the CAISO has regularly fallen below actual system needs during these periods when resource outages have been taken into account. ***The net result appears to be an actual shortfall of several thousand MWs of available Resource Adequacy capacity to meet actual peak load plus contingency reserves in most summer months***.

These conclusions were recently corroborated in CAISO's 2019 Summer Loads and Resources Assessment, which concluded that the "[a]vailability of sufficient imports during high peak load conditions is critical to ensuring system reliability."[8] This conclusion appears based on the results of CAISO's "sensitivity case," which among other things assumed a lower level of imports. However, even under the "sensitivity case," CAISO's assessment appears less-than-conservative, assuming imports equal to the *maximum level* of imports (9,309 MW) observed during high demand hours of Summer 2018.[9] If the assumptions were revised—and assumed imports were simply at the median level observed during such hours in 2018—or were more conservatively estimated at the lowest quartile of such hours—it would imply a further reduction of *several thousand megawatts* in supply available to meet CAISO demand.[10] Simply stated, the CAISO BAA

[8] CAISO 2019 Summer Loads and Resources Assessment at 41.

[9] *Id.* at 9 and n. 5.

[10] *Id.,* Tbl. 3.

is unambiguously incapable of maintaining reliability with the supply it has contracted under the existing Resource Adequacy program. Under such conditions, the results of a residual supply index type of analysis are neither surprising nor particularly informative.

Similarly, it has become increasingly clear that the current Flexible Resource Adequacy framework is not capable of ensuring that sufficient flexible capacity is committed on a forward basis to meet CAISO's operational needs or of providing forward market price signals for the development of resources necessary to meet CAISO's growing flexibility needs in the long-term. While the development of the existing Flexible Resource Adequacy program represented an important first step toward ensuring the reliability of the CAISO grid, the program was intended as an interim measure to address emerging flexible capacity needs while CAISO worked with the CPUC and stakeholders to develop a durable Flexible Resource Adequacy framework. The current Flexible Resource Adequacy program was never intended to address CAISO's flexibility needs in the long term.

Notably, the existing Flexible Resource Adequacy program was designed around a three-hour net ramping period that was selected because it represented a "reasonable ramping period" that many internal generation resources could satisfy, rather than approximating the full range of flexibility needs experienced by the CAISO. The result is a program that allows existing in-state generation resources to qualify to provide flexible capacity – even when they have limited ability to actually meet CAISO's ramping needs – and fails to send price signals that encourage changes in the CAISO's resource mix to more effectively meet CAISO's future needs. It is therefore unsurprising that CAISO has continued to experience significant challenges in meeting hourly and intra-hourly flexibility needs even though the total Flexible Resource Adequacy capacity included in load-serving entity ("LSE") resource showings has consistently met or exceeded the CAISO's predetermined flexible capacity requirements since the program was implemented.

The lack of an effective framework for the forward procurement of capacity and flexibility would not be as problematic if short-term market price formation practices were sufficiently robust to induce the voluntary participation of the quantity and types of resources necessary to meet CAISO's reliability needs. Unfortunately, the existing price formation practices within the CAISO's short-term markets serve to exacerbate the shortcomings of the existing forward procurement frameworks by resulting in the systematic suppression of day-ahead and real-time prices, particularly during periods of scarcity. In recent years, the CAISO markets have become characterized by increasing reliance on out-of-market dispatch and operator interventions to maintain reliability and meet uncertainty associated with variations in load and demand. For instance, CAISO has repeatedly had to rely on the procurement of backstop and/or residual capacity on an hourly and multi-hour basis after the day-ahead energy market to firm up day-ahead energy awards that cannot be counted upon to perform.[11] It also is well-documented that

[11] CAISO DMM 2018 Annual Report on Market Issues and Performance at 76.

CAISO operators will regularly rely on operator interventions, such as out-of-market exceptional dispatch and load biasing, to increase the quantity of resources committed in order to ensure that there is sufficient flexible capacity online to address system needs.[12] Importantly, these commitments take place outside of the organized markets for energy and ancillary services, with the result that the costs of committed resources are compensated through side payments and are not reflected in market clearing prices. While the use of out-of-market dispatch and operator interventions may be understandable "in-the-moment" given the inability of the existing Resource Adequacy program to ensure that sufficient resources are available to meet system needs, such practices actually exacerbate resource adequacy issues by suppressing market clearing prices for energy and ancillary services, and muting price signals for the development, commitment and deployment of resources necessary to maintain reliability.

The lack of a robust shortage pricing mechanism also contributes to these challenges by preventing scarcity conditions from appropriately being reflected in market clearing prices. Well-designed shortage pricing mechanisms play a critical role in ensuring that tight supply conditions are reflected in market clearing prices thereby creating efficient short-term and longer-term price signals. In particular, applying shortage pricing sends a price signal to incent the participation and performance of existing resources when they are of greatest value, thereby helping maintain reliability. By ensuring that energy prices increase above the variable cost of the marginal resource during periods of scarcity, shortage pricing encourages resources to show up where and when they are most needed. The additional revenues received when shortage pricing increases energy prices above the offer price of the last unit dispatched also improves longer-term investment signals, both for maintaining existing resources and for developing additional resources necessary to meet system needs. As FERC staff has recognized, one of the primary goals of "shortage pricing is to facilitate long-term economic entry through the construction of new supply resources and exit of resources that are no longer economic."[13]

The circumstances of the CAISO market make a robust shortage pricing mechanism particularly important for ensuring that sufficient resources are made available to CAISO on a forward and short-term basis to meet reliability needs. More specifically, the presence of a robust shortage pricing mechanism is critical to attracting the voluntary participation of resources that are located outside of the CAISO BAA, which have the option to sell their energy, capacity, and flexibility to sellers outside of the CAISO BAA. This is the case even for resources that have elected to participate in the CAISO EIM, which have a choice of whether to offer their resources into the EIM or to sell the output of their resources on a bilateral basis outside of CAISO's short-term markets. Shortage

[12] *Id.* at 9.

[13] Fed. Energy Reg. Comm'n, Price Formation In Organized Wholesale Electricity Markets, Docket No. AD14-14-000, Staff Analysis of Shortage Pricing in RTO and ISO Markets at 4 (Oct. 2014) ("FERC Staff Report").

pricing can play a critical role in ensuring that scarcity is appropriately reflected in market prices and that resources that respond during periods of scarcity are appropriately compensated for the role that they play in maintaining reliability.

To date, the efficacy of the shortage pricing mechanism that currently exists in CAISO's short-term markets has been hampered by a market design that results in CAISO operators having to engage in out-of-market procurement and operator interventions to protect reliability, with the unintended consequence of preventing the current shortage pricing mechanism from being triggered. In fact, there is evidence that suggests that the failure to apply shortage pricing during periods of scarcity is directly contributing to supply challenges within California. For instance, the continued application of the load bias limiter currently thwarts the application of shortage pricing where an operator adjustment exposes a supply shortage. Notably, data regarding the application of the load bias limiter have shown that the application of the load bias limiter has the effect of suppressing prices during periods in which the need for flexible capacity is greatest. In particular, Dr. Scott Harvey has observed that the application of the load bias "eliminated a substantial proportion of the shortage of upward ramp capability" in the CAISO real-time dispatch and directly reduced "the market value of flexible capacity during . . . high ramp hours."[14] While the precise impact of the load bias limiter is not clear, the directional effect of the load bias limiter is to artificially suppress prices during periods when the need for flexible resources is greatest, reducing the incentive for internal and external flexible resources to make themselves available to meet CAISO's operational needs by preventing resources from being compensated for the services that they provide for the grid.

Given the foregoing, it is unsurprising that there has not been an abundance of excess supply made available in the CAISO markets during numerous high demand periods in 2018. The lack of excess residual supply, however, should not be taken as a sign that there are system market power issues in the CAISO markets or that additional market mitigation measures are necessary to ensure just and reasonable results. Instead, it is a sign of a Resource Adequacy program that systematically fails to result in the commitment of sufficient capacity and flexibility to meet reliability needs with a high degree of confidence, along with short-term market design and price formation practices that are failing to encourage external resources to voluntarily be available to serve CAISO's needs. Adopting new price mitigation measures will only serve to exacerbate these issues by further suppressing prices, thereby creating additional incentives for external resources to forego participation in the CAISO markets, while also making it more likely that internal resources needed to maintain reliability will seek to retire due to an inability to recover their costs.

[14] The Load Bias Limiter, Price Formation, and the Need for Flexible Capacity at 14 (May 5, 2017), a*vailable at*: http://lmpmarketdesign.com/papers/LoadBiasLimiterandFlexibleCapacityFTIConsulting.pdf.

B. CAISO Should Focus On Addressing Existing Market Design And Price Formation Issues To Promote Competitive Markets

Rather than characterizing the tight supply conditions as a system market power issue and imposing new market mitigation measures, Powerex believes that CAISO should focus its efforts on modifying California's forward and short-term market frameworks to ensure that they send efficient price signals for the commitment, development, and deployment of the quantity and types of resources necessary to meet system requirements. In other words, instead of taking steps that have the potential to exacerbate existing issues by creating a disincentive for suppliers to make their resources available to CAISO, the CAISO should focus on how its existing market frameworks can be improved to encourage voluntary participation and ensure that there are consistently sufficient resources available to meet system needs.

In that regard, it is worth noting that other market operators are proactively taking steps to enhance their shortage pricing mechanisms to adapt to changing grid conditions and reduce reliance on out-of-market dispatch and operator interventions. Most notably, PJM recently submitted a filing to FERC proposing significant changes to the rules governing the procurement of reserves and shortage pricing in order to ensure that prices more accurately reflect the operational value of flexibility. In its filing, PJM explains that PJM dispatchers

> regularly bias (i.e., effectively adding (or reducing) demand that must be balanced with additional (or less) supply) their scheduling of supply resources in an attempt to manage the uncertainty inherent in near-term forecasts of load, wind generation, and solar generation (or for expected plant outages), and taking other out-of-market actions to preserve reliability.[15]

More specifically, PJM explains that while it has already adopted operating reserve demand curves ("ORDC") that apply penalty pricing when supply falls short of minimum reserve requirements ("MRR"), the shape of these current ORDCs do not take into account "uncertainties around load, wind, and solar forecasts, and unanticipated plant outages."[16] While PJM states that PJM operators typically will manage these uncertainties through out-of-market actions to prevent supply from falling below MRRs, these actions are a concern to the extent that they "prevent the market from seeing what would

[15] *PJM Interconnection, L.L.C.,* Enhanced Price Formation in Reserve Markets of PJM Interconnection, L.L.C., Docket No. ER19-1486-000 at 6.

[16] *Id.* at 7.

otherwise be reserve shortages" and that "operator actions should be reflected in clearing price."[17]

Acknowledging that ensuring that such uncertainty is appropriately reflected in market prices is critical to ensuring just and reasonable rates, PJM states that proper price formation will only increase in importance as the expected growth of wind and solar resources within its footprint increases the importance of flexible resources:

> Current reserve market clearing prices—zero in about 60 percent of all hours for Synchronized Reserve and in about 98 percent of all hours for Non-Synchronized Reserve—do not reflect the operational value of resource flexibility. That flexibility is today procured through operator actions but is more appropriately reflected in prices. Proper price formation in this area is important today and will become even more important with the expected growth of wind and solar resources. As shown below, even conservative estimates based mostly on currently enacted mandatory Renewable Portfolio Standards (including minimum solar carve-outs) indicate the PJM Region will see an additional 25,000 MWs of wind and an additional 12,000 MWs of solar resources (with approximately 8,000 MWs of that total behind-the-meter) by 2034. These high absolute MW levels of added intermittent resources indicate a need for a much greater level of flexible resources to help manage the variable output of intermittent resources . . . . PJM is reliant on accurate and effective price signals to incentivize penetration and competition of all resources to provide flexibility. The suppressed signals in the PJM reserve markets today will not accomplish that.[18]

In order to make sure that PJM's market design and price formation practices send efficient price signals that ensure that the costs of addressing uncertainty are appropriately reflected in prices and that it has the flexible resources necessary to meet the challenges of its evolving resource mix, PJM proposes to:

- consolidate its existing reserve products into a single reserve product – Synchronized Reserve –
- modify its ORDCs by:
    - increasing the reserve penalty factor to $2,000/MWh to more accurately reflect the opportunity costs of providing reserves during shortage conditions from foregoing energy market sales; and

[17] *Id.*

[18] *Id.* at 7-8.

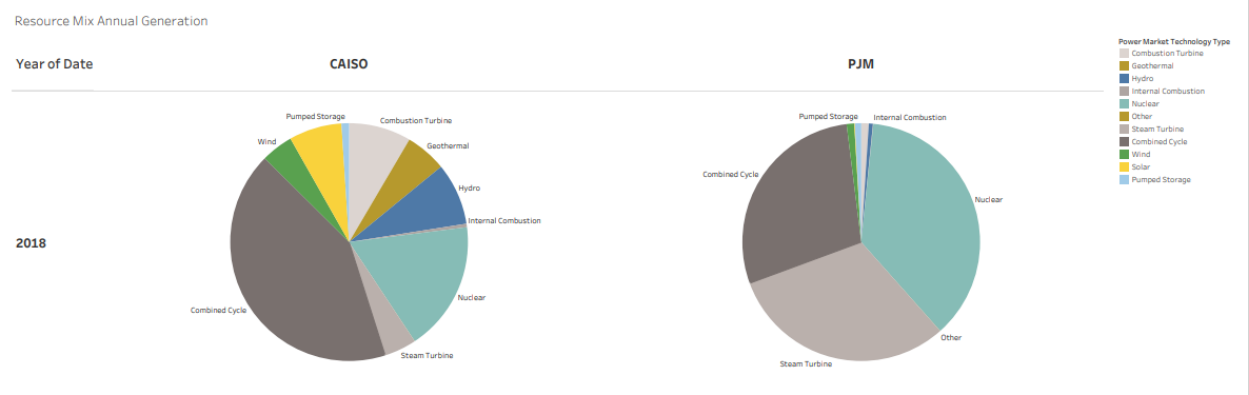
- changing the ORDC curve shape based on a systematic and probabilistic quantification of the load and supply uncertainties that PJM operators are currently trying to address through biasing schedules and other out-of-market actions; and
- aligning the day-ahead and real-time reserve markets to ensure that the reserves needed for real-time market operations are recognized on a forward basis during the scheduling process for the next operating day.

ERCOT pricing rules also employ an ORDC to ensure prices reflect scarcity conditions, and prices are limited by a relatively high offer cap of $9,000/MWh (the High System-Wide Offer Cap). Notably, the offer cap can be reduced to a Low System-Wide Offer Cap of $2,000/MWh once the calculated "peaker net margin" based on real-time market energy prices (including ORDC) reaches three times the cost of new entry ("CONE"). In a recent order, the Public Utility Commission of Texas summarized the purpose of its approach for real-time pricing: "The commission determines that maintaining the '3X' CONE threshold ensures that generators are able to sufficiently recover costs and have proper incentives to continue to provide generation in the market, ensuring a continued availability of generation that is low-cost in the many intervals of the year in which resources are not scarce. This approach also ensures that demand response programs and facilities continue to develop in anticipation of those dynamics."[19]

Powerex believes that other organized markets serve as a useful example for the types of steps that CAISO should consider to address the increasingly tight supply conditions in its markets. It is worth noting that PJM is pursuing the market design changes outlined above in anticipation of seeing an increase in the variable energy resources on its system. The CAISO market, in contrast, has already experienced a dramatic increase in penetration of variable energy resources, with the quantity of such resources far exceeding the quantity on PJM's system, as depicted in Figure 1 below.

[19] Public Utilities Commission of Texas, May 9, 2019 Order in Project No. 48721 at 15.

Figure 1: Comparison of 2018 Resource Mix in PJM and CAISO



In the following sections, Powerex offers suggestions regarding the types of changes that CAISO should consider. Specifically, Powerex believes that CAISO should:

1. Work with the CPUC to close the gaps in its existing System and Flexible Resource Adequacy programs;
2. Adopt a day-ahead flexible capacity product to facilitate the co-optimized procurement of energy and flexible capacity;
3. Implement a robust shortage pricing mechanism that allows prices to increase as reserves are depleted; and
4. Examine CAISO's use of load biasing to identify opportunities to reduce reliance on operator interventions.

Powerex believes that adopting the measures described above would represent a substantial step towards addressing the supply issues identified by the CAISO through market-based mechanisms. Collectively, these measures would:

- Ensure that sufficient capacity and flexibility is committed on a forward basis to allow CAISO to meet system needs with a high degree of confidence;
- Co-optimize the day-ahead and real-time procurement of energy and flexible capacity to ensure that sufficient flexible resources are reserved to meet forecast and uncertain changes in supply and demand;
- Reduce reliance on out-of-market dispatch and operator interventions to meet system needs; and
- Send efficient forward and short-term price signals to increase the incentive for resources to make their energy, capacity, and flexibility available to the CAISO.

1. CAISO Should Take Steps To Strengthen Its Resource Adequacy Program

i. CAISO Should Work To Close Remaining Gaps In Its System RA Program

As noted above, the existing System Resource Adequacy framework currently contains a number of gaps that hamper the ability of this program to accomplish its objectives. In particular, the existing System Resource Adequacy program:

- Systematically understates the level of capacity needed by setting procurement requirements at a level that do not accurately reflect system needs;
- Overstates the ability of committed capacity to actually meet resource adequacy requirements by failing to take into account resource availability in evaluating the quantity of capacity that a resource can provide;
- Fails to ensure that external suppliers that commit to supply System Resource Adequacy have the physical capacity and transmission necessary to support delivery and fulfill their contractual commitments; and
- Erects barriers that prevents external suppliers that have the physical capacity and transmission necessary to help meet CAISO reliability needs from competing to meet Resource Adequacy requirements.

Powerex acknowledges that CAISO has attempted to take substantial strides towards closing these gaps in its ongoing Resource Adequacy Enhancements stakeholder proceeding and encourages CAISO to move forward with its efforts in that proceeding. It is important to recognize, however, that the proposals currently being considered through that proceeding will not be sufficient to ensure that System Resource Adequacy requirements accurately reflect system needs.

Notably, recent experience with the existing approach of basing the System Resource Adequacy requirement on a 1-in-2 forecast of peak load in each month plus a 15% planning reserve margin does not accurately capture actual system needs, with actual peak load during certain periods exceeding System Resource Adequacy procurement requirements by thousands of MWs. Without addressing this element of the existing System Resource Adequacy framework, there will be no assurance that the quantity of resources committed to supply capacity to California will be sufficient to meet actual system needs—even if each MW of capacity committed to meet Resource Adequacy needs is available and capable of performing in a given period.

Powerex believes that the shortcomings of the existing methodology could be mitigated by moving towards a framework that sets System Resource Adequacy requirements based on the forecast peak hourly load for a given season (*e.g.,* summer and winter

season). Powerex believes that such an approach would take into account the potential for significant year-to-year variations in the timing of peak load, as has been seen in recent years, by eliminating the artificial break between calendar months and taking a more holistic look at reliability requirements in a given season. In addition, Powerex believes that LSEs should be required to provide showings meeting 100% of their required Resource Adequacy capacity at least on a season-ahead basis (versus a month-ahead basis) to enable California LSEs to compete with external purchasers to acquire external summer and winter supply.

ii. CAISO Should Restart Efforts To Address The Shortcomings Of The Flexible RA Program

As noted above and described in detail in other proceedings,[20] Powerex believes that the existing requirements respecting Flexible Resource Adequacy do not fully align with the nature of CAISO's flexibility needs or operational timelines. In particular, the existing Flexible Resource Adequacy products do not reflect the flexibility needs experienced by the CAISO or the manner in which CAISO deploys resources through its markets to meet its needs. In addition, similar to the existing System Resource Adequacy program, the existing Flexible Resource Adequacy program:

- Fails to differentiate among resources based on their relative ability to provide ramping capability (*e.g.*, between those resources with significant ramp rates and slow ramp rates), and grossly overstates the collective ability of internal resources to actually providing ramping capability; and

- Largely excludes external resources with significant real-time flexibility from meeting CAISO's flexibility needs.

Powerex encourages CAISO to move forward with efforts to redesign the Flexible Resource Adequacy program to ensure that it more closely aligns with CAISO's operational needs, ensures that resources that are committed to supply Flexible Resource Adequacy actually have the capabilities necessary to support their commitments, and compensates flexible resources for the contribution that they make to meeting system requirements. While CAISO has developed a proposed framework for modifying the existing Flexible Resource Adequacy program through its Flexible Resource Adequacy Criteria and Must-Offer Obligation stakeholder initiative, efforts to finalize that framework have been postponed based on the expectation that similar issues would be addressed through CAISO's Day-Ahead Market Enhancements initiative. Importantly, however, the Day-Ahead Market Enhancements initiative has focused on modifying the day-ahead market to better take into account the need for flexible capacity and has not focused on the types of holistic changes to the Flexible Resource Adequacy

[20] Comments of Powerex Corp. on FRAC MOO – Phase 2 Supplemental Issue Paper, *available at*: http://www.caiso.com/Documents/PowerexComments-FlexibleResourceAdequacyCriteriaMustOfferObligationPhase2-SupplementalIssuePaper.pdf.

framework that are necessary. For that reason, Powerex encourages CAISO to move forward with efforts to reform the existing Flexible Resource Adequacy framework.

2. CAISO Should Pursue Implementation Of A Day-Ahead Flexible Capacity Product

In addition to adopting robust forward procurement mechanisms, Powerex thinks that it is critically important that CAISO move forward with the design and implementation of a day-ahead flexible capacity product to ensure that it markets more accurately take into account the need for flexible capacity to meet real-time imbalances in generation and load. While implementation of a day-ahead flexible capacity product is no substitute for a robust forward procurement framework, such a product can complement the forward procurement of flexible capacity by ensuring that the CAISO's day-ahead market optimization efficiently positions and "holds back" resources necessary to meet CAISO's flexibility needs and compensates these resources for the flexibility that they provide to the system. Without the implementation of a day-ahead flexible capacity product, the day-ahead optimization may result in resources that have been committed to supply Flexible Resource Adequacy being scheduled to provide energy in the day-ahead market such that they are not available to provide flexibility in the 15- and 5-minute markets.

A well-designed day-ahead flexible capacity product has the potential to enhance the effectiveness of the Flexible Resource Adequacy framework by more efficiently positioning and scheduling Flexible Resource Adequacy resources that submit supply offers into the day-ahead market and reduce the potential that such resources will be inefficiently scheduled to provide energy or other products in a way that does not take into account the flexibility attributes of these resources. In addition, by compensating resources for providing flexibility to the CAISO markets, a well-designed day-ahead flexible capacity product will help encourage suppliers to make their flexible resources available to scheduling and dispatch by the CAISO.

Powerex therefore encourages CAISO to move forward with efforts to design and implement a day-ahead flexible capacity product. In designing this product, it is important that CAISO set procurement requirements at a level that ensures that sufficient upward and downward flexibility is maintained in the day-ahead market to allow CAISO to meet forecast and uncertain changes in load and generation under a full range of operational conditions. Ultimately, such a product will increase the likelihood that the resources available and committed through CAISO's short-term markets are sufficient to meet actual system needs and reduce the likelihood that CAISO will be required to continue to rely on out-of-market dispatch or operator interventions to compensate for market shortfalls.

3. CAISO Should Adopt A Demand Curve To More Accurately Reflect The Risk Of Shortfalls In Day-Ahead Flexible Capacity

Well-designed shortage pricing mechanisms play a critical role in ensuring that tight supply conditions are reflected in market clearing prices and creating efficient short-term and long-term price signals. In particular, applying shortage pricing sends a "short-term price signal to incent performance of existing resources and help to maintain reliability."[21] By ensuring that, during periods of scarcity, energy prices increase above the variable cost of the marginal resource, shortage pricing encourages resources to show up where and when they are most needed. The additional revenues received through shortage pricing that increases energy prices above the variable operating cost of the last unit dispatched can improve investment signals, both for maintaining existing resources and for developing additional resources necessary to meet system needs.

Powerex believes that it is critically important that the implementation of a day-ahead flexible capacity product include the use of a demand curve that ensures that prices increase as imbalance reserves are depleted to meet system needs. Powerex believes that ensuring that CAISO has sufficient imbalance reserves, in the form of a day ahead flexible capacity product, is of equal importance to ensuring that CAISO has sufficient energy and contingency reserves available to meet reliability needs. Like a shortage of energy and/or contingency reserves, failing to procure a level of imbalance reserves sufficient to meet ramping needs under a full range of operational needs with a high level of confidence poses a serious threat to reliability. As the supply of flexible reserves decreases and approaches the amount required to meet ramping needs with a high degree of confidence, it is increasingly unlikely that CAISO will have sufficient capacity and flexibility available to meet forecast and uncertain changes in load and generation under a full range of operational conditions.

For that reason, Powerex believes that it is critical that CAISO adopt a robust shortage pricing mechanism that reflects the increased reliability risks as the quantity of imbalance reserves (*i.e*., un-deployed flexible capacity supply) approaches the minimum required quantity of reserve to meet forecast and uncertain changes in demand and supply with a high level of confidence. Adopting a shortage pricing mechanism for the flexible capacity product will create efficient price signals for market participants to make themselves available to provide imbalance reserves, thereby helping to ensure that resources are available to be deployed when and where they are necessary to meet system needs.

In designing a shortage pricing mechanism, Powerex encourages CAISO to pursue an approach similar to that employed by PJM, which uses an operating reserve demand curve that ensures that prices gradually increase as the supply of a given product

[21] FERC Staff Report at 4.

decreases towards the procurement requirement for that product, with prices rising before remaining supply is fully depleted and/or below the established requirement. Under this approach, during periods when the reserve supply approaches the required demand level to meet system needs, shortage pricing is gradually applied to ensure that prices increase above the offer price of the marginal resource to reflect the increased risk of shortage conditions and involuntary load curtailments, with prices set equal to the product of the value of lost load and the probability of involuntary curtailments.

Powerex believes that adopting a similar approach would represent a substantial improvement over the "all or nothing" approach that currently characterizes shortage pricing in the CAISO markets. Under that approach, shortage pricing is only applied if and when demand for a particular product actually exceeds available supply; at that point, a single price step is often applied. The result of this approach is that small differences in supply or demand can lead to extreme differences in price.

This approach can be illustrated using a simplified example consisting of a total of 1000 MW of offers ranging from $30/MW to $50/MW to provide the flexible capacity product. If the market is run with a forecast need for flexible capacity product of 999 MW, the market clearing price will be set based on the offer of the marginal resource (*i.e.*, $50/MW). If demand increases to 1001 MW, however, and the market is unable to meet the need for flexible capacity product the price will be set based upon a single, administratively-determined penalty price (e.g., $2000/MW).

Powerex believes that the use of a demand curve has a number of advantages over the existing approach towards shortage pricing. As an initial matter, waiting until supply is actually insufficient to meet demand before applying shortage pricing increases reliability risks by muting price signals for additional resources to make themselves available to meet system needs. Under the "all or nothing" approach, it is only at the point that supply of the product at issue is less than demand that prices increase above the offer price of the marginal resource. As applied to a flexible capacity product, this would mean that shortage pricing would only be triggered after CAISO had failed to procure the required level of reserves necessary to meet forecast and uncertain changes in load and supply. At that point, however, CAISO would have under-procured the required reserves – meaning that CAISO does not have sufficient flexible ramping capability to meet system needs under a full range of operational conditions – and it may be too late for the higher prices associated with the application of shortage pricing to create an incentive for additional resources to make themselves available. Moreover, resources that respond by making additional supply available may fully eliminate the very price signal they were responding to, reducing the effectiveness of the intended price signal. The use of a demand curve, in contrast, reduces the potential for heightened reliability risk by gradually increasing prices as the quantity of reserves available approaches the established demand for this product, thereby increasing incentive for resources to voluntarily make

themselves available. Additionally, adopting a shortage pricing mechanism that allows prices to gradually increase as reserves are depleted will reduce the incentive for operators to engage in out-of-market dispatch and operator interventions.

For the foregoing reasons, Powerex believes that CAISO should adopt a shortage pricing framework that employs a robust demand curve that ensures that CAISO consistently procures sufficient flexible reserves, and that prices increase as the quantity of flexible resources procured decreases towards the reserve requirement. Powerex emphasizes that it is critical that penalty prices be set at a level that accurately reflects the value of lost load (and the probability of involuntary load curtailment) and ensures that CAISO consistently procures the required level of reserves to meet forecast and uncertain changes in load and supply with a high degree of confidence. As a practical matter, adopting a shortage pricing mechanism that does not include robust penalty pricing is likely to lead to under-procurement of the flexible capacity product, effectively creating an incentive to "go short" on flexible capacity product whenever offer prices are above the penalty price at issue. Such a result would lead to systematic leaning by CAISO and is fundamentally inconsistent with the purpose of developing an imbalance reserve product in the first place.

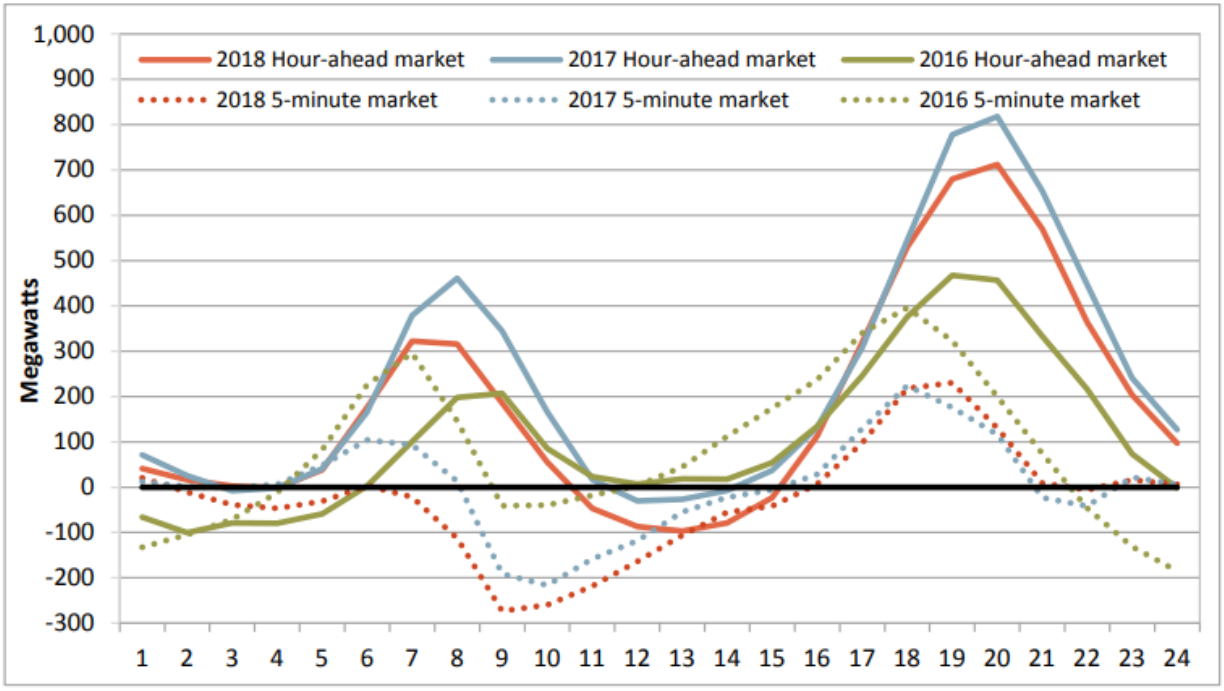
4. CAISO Should Further Evaluate Operators' Use Of Load Biasing

In addition to pursuing the market design and price formation changes set out above, Powerex believes that CAISO should convene a stakeholder proceeding focused on evaluating CAISO operators' practice of making manual adjustments to the load forecast used in the CAISO day-ahead and real-time markets (*i.e.,* load biasing).

Powerex recognizes that CAISO operators should have authority to make manual adjustments to the load forecast used in CAISO market processes where necessary to correct inaccuracies or gaps in the automated load forecasts used in CAISO's market solutions. Powerex believes, however, that CAISO operators' frequent and persistent use of load biasing is masking systematic and material underlying market design issues. If load biasing were being used solely to address random inaccuracies or gaps in automated market processes, it should be expected that CAISO operators' use of load biasing would be infrequent, limited in magnitude, and unpredictable in direction. In practice, however, CAISO operators frequently make significant upward adjustments to load in both the hourly and 15-minute markets, particularly during the morning and evening ramping periods when the need for energy and ramping capability in the CAISO BAA is greatest.

Figure 9.11 below, excerpted from the CAISO DMM 2018 Annual Report on Market Issues and Performance, shows that CAISO operators' use of load biasing exhibits clear and persistent patterns across the day and has increased dramatically in recent years.

Figure 9.11 Average hourly load adjustment (2016 - 2018)



The predictable pattern of load biasing during these periods suggests that load biasing is not being used to correct for random errors or gaps, but to compensate for market processes that chronically underestimate the amount of energy and/or upward ramping capability required to maintain system reliability. Indeed, the CAISO DMM's report explains that one of the primary reasons that CAISO operators have been making these adjustments is to increase imports from external resources in order to preserve the ramping capability of internal resources. Specifically, the CAISO DMM explains that:

> One of the key reasons for the pattern of real-time market load adjustments that has developed over the last few years cited by grid operators is to increase the hourly import bids which are accepted by the market software during the morning and evening ramping hours. By increasing imports in these hours, the supply of remaining generation within the ISO that can be ramped up or down in the 15-minute and 5-minute market remains higher.[22]

Because the CAISO load forecast is a critical input into CAISO market processes, the use of load biasing by CAISO operators has far-reaching implications for dispatch, pricing, and settlement in the CAISO markets.

[22] CAISO DMM, 2018 Annual Report on Market Issues and Performance at 217.

For instance, the likely effect of using load biasing to dramatically increase the quantity of block hourly imports committed in the hour-ahead scheduling process is to suppress prices in the subsequent 15- and 5-minute market runs by substantially increasing the quantity of price-insensitive (*i.e.,* self-scheduled) supply in those market runs. But that additional block hourly supply is not settled at the hour-ahead prices that prompted the software to clear those offers, but rather at the (potentially much lower) prices established in the 15- and 5-minute markets where the hourly supply is treated as a price-taker self-schedule.

Similarly, upward adjustments to load forecasts can be used to force the earlier commitment of additional resources, and hence compensate for an anticipated lack of flexible resources. This, too, can depress energy prices and prevent scarcity from being appropriately reflected in market prices, further muting the ability of the market to send price signals to encourage the development and participation of the resources with the attributes necessary to allow CAISO to meet system needs.

Powerex believes that CAISO should conduct a comprehensive and detailed review of its use of load biasing to identify the factors driving the persistent use of this practice. To the extent that there are system needs that are currently being addressed through the use of load biasing – rather than through existing market processes – then the focus should shift to determining how existing market design and price formation practices can be modified to more accurately capture and address system needs through the market. Ultimately, Powerex believes that the goal of the effort should be to ensure that CAISO's market processes result in the commitment and deployment of sufficient energy, capacity, and flexibility to meet system needs and to reduce CAISO use of load biasing such that the expected load bias for any given operating interval is 0 MW.

III. More Fundamental Market Design Changes Will Be Necessary

Powerex believes that taking the steps identified above has the potential to help mitigate the potential for tight supply conditions by increasing the incentives for resources to voluntarily make themselves available to the CAISO. However, Powerex believes that securing the long-term reliability of the CAISO markets in the face of rapidly changing grid conditions will take more fundamental changes to the design of the day-ahead and real-time markets.

It is important to recognize that there are fundamental differences between the resource mix today and at the time that organized markets were developed. Notably, until recently, the vast majority of generation resources connected to the western grid consisted of thermal and hydro generation resources that were able to supply a wide variety of products and services in addition to supplying energy. This traditional resource mix has meant that there generally was no need to separately procure particular attributes—such as energy, capacity, and flexibility—to meet system needs. Instead, as long as sufficient

energy supply was procured to meet peak demand with a high degree of confidence, sufficient quantities of the other attributes and products necessary to maintain reliability were often automatically "bundled", as a result of the attributes provided by traditional generation technologies. Over time, however, legacy resource fleets have increasingly encountered constraints on their ability to meet system needs, whether in terms of total capacity or in terms of flexibility to respond to more rapid changes in grid conditions. Evolving environmental policies or customer preferences have further increased the attributes sought to be procured in the wholesale markets. Furthermore, the changing mix of resources has also led to potential shortfalls in certain reliability services, such as primary frequency response or inertia. Organized markets that were initially designed to commit, dispatch, and compensate resources for "energy only" are poorly suited to—and were never designed to—separately procure capacity, flexibility, storage services, particular environmental attributes, or particular reliability services.

The CAISO markets largely continue to follow this paradigm, implicitly treating all energy resources as inherently bundled with additional attributes. For instance, under this framework, offers to supply energy from resources that also have capacity and/or flexibility attributes are generally treated—for purposes of dispatch, pricing, and settlement—the same as speculative supply, non-firm supply, or even virtual supply, all of which lack bundled capacity attributes. Under this framework, all energy supply offers are incorrectly treated as if they are interchangeable, without regard to the different bundled attributes, or lack thereof, associated with different energy supply offers.

The problem with this approach is that it can no longer be assumed that resources that are developed or procured to provide energy possess all of the attributes necessary to maintain reliability. Notably, renewable resources typically have limited, if any, ability to increase their output and/or to supply certain essential reliability services. At the same time, the growth in renewable resources and retirement of conventional resources is increasing the need for resources that can provide capacity, flexibility and storage services that CAISO and other market operators can use to respond to changes in the output of variable energy resources and balance their systems. Collectively, the result of these changes is that there is an increasing need to ensure that resources committed through the day-ahead and real-time markets possess the attributes necessary to allow CAISO and other market operators to maintain reliability. However, since organized markets generally do not distinguish between resources based on the attributes that they provide, there currently is no market mechanism to ensure that the full range of attributes are procured and available as necessary to maintain reliability.

The continued reliance on this "energy only" framework creates a number of distinct problems:

- First, the failure of the existing market design to procure the attributes necessary to maintain reliability increases the need to rely on out-of-market procurement and operator interventions to meet system needs and maintain reliability. Because these commitments typically take place outside of the organized market for energy, the resources that are committed to provide flexibility or other services are compensated through side-payments that are not reflected in market prices.
- Second, the capacity and flexibility attributes of suppliers that do offer firm supply into the markets—thereby reducing the need for out-of-market commitments and interventions—are not taken into account in dispatch, pricing, or settlement. Because all supply offers are treated as fungible, lower priced, and less valuable products, such as unit contingent energy, non-firm energy, virtual supply, and speculative supply are permitted to displace firm energy products in the day-ahead and real-time markets, thereby lowering market clearing prices. In addition, to the extent that firm supply offers clear the market, the relevant scheduling coordinator receives the same compensation as a supplier that provides a lower quality product.

In short, the result of the existing "energy only" framework is an inefficient commitment and dispatch of resources, market prices that fail to accurately reflect the costs of meeting demand and maintaining reliability, and the systematic suppression of compensation received by firm supply.

Notably, the "energy only" framework stands in stark contrast to the well-established framework that characterizes bilateral markets. While the bilateral markets are generally viewed as being less efficient from a dispatch perspective than the organized market framework, the commercial framework surrounding bilateral trading in the west outside of the CAISO is far more effective in differentiating supply offers based on the bundled capacity and flexibility attributes. In particular, outside of the CAISO, the vast majority of day-ahead and real-time physical bilateral transactions are under WSPP Schedule C ("Firm Capacity/Energy Sale or Exchange Service"). As a general matter, supply sold as WSPP Schedule C Firm Energy is bundled with sufficient balancing reserve capacity in the source balancing authority to ensure delivery for the period of the sale commitment—regardless of whether the supply is from baseload resources, dispatchable resources, and variable energy resources. While suppliers are permitted to sell lower-quality products that are not bundled with the capacity attributes to ensure delivery (*e.g.,* unit contingent, non-firm, or energy-only products), they must do so explicitly and often at a discount from the prices received for firm supply. In contrast to the "energy only" framework, the commercial framework that characterizes bilateral trading in the west outside of California ensures that the bundled capacity attributes of different resource types are included in bilateral transactions, decisions, and settlement.

Powerex believes that ensuring that organized markets procure the full range of specific resource attributes necessary to meet reliability will require moving toward a market

design that takes into account the different attributes of supply resources in market dispatch, pricing and settlement.

While there may be numerous ways to accomplish this objective, Powerex has drafted a white paper[23] outlining one potential approach, consisting of a market design that provides for the joint and co-optimized procurement of energy, ancillary services, and flexible capacity and takes into account the attributes of different supply offers and resources. Under this approach, the extent to which the commitment of individual resources for energy in the day-ahead and real-time markets contributes to the need for other products would be expressly taken into account in the market optimization. For example, rather than relying on out-of-market procurement and operator interventions to backstop the risks of virtual, speculative, and non-firm supply, the market optimization would expressly recognize the extent to which each of these supply offers would increase the need for hourly and/or multi-hour capacity and/or flexible capacity commitments in the dispatch, pricing, and settlement processes. In other words, the market would co-optimize the procurement of all products to ensure that adequate capacity and flexibility (in addition to energy) was procured to take into account the risk of non-delivery associated with the commitment of virtual, speculative, and non-firm supply. This approach would also ensure that resources are compensated for the capacity and flexibility attributes that they provide, with the result that the compensation paid for firm physical supply would be different than for virtual, speculative, or non-firm supply. As Professor William Hogan and Susan Pope recently observed in discussing PJM's proposed market design enhancements, "as an improvement on the basic market design, co-optimized dispatch of energy and reserves is recognized as the market design standard in order to reliably and economically position resources of all types, including generation, load, imports and exports."[24]

[23] DAM Enhancements: Efficient Day-Ahead Dispatch, Pricing and Settlement of Energy, Capacity, and Ancillary Services (March 2019), *available at* http://www.caiso.com/Documents/PowerexWhitepaper-EfficientDay-AheadDispatchPriceandSettlement.pdf.

[24] PJM Reserve Markets: Operating Reserve Demand Curve Enhancements, William W. Hogan & Susan L. Pope at 7 (Mar. 21, 2019), *available at*: https://sites.hks.harvard.edu/fs/whogan/Hogan_Pope_PJM_Report_032119.pdf.