

Opinion on Oversight and Investigation Review
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Summary

As part of the market redesign process, the California ISO is seeking additional authority for market oversight and investigation, including a process for imposing penalties and sanctions on market participants judged to be in violation of market rules. This aspect of the market redesign has taken on added prominence with the revelations and discussions about the trading practices of Enron. The need to strengthen the ISO's ability to apply such sanctions in cases of clear rule violations is widely acknowledged, and we too support this application. To deter these rule violations, such penalties must extend beyond simply a refund of the profits made from the violation.

We are concerned, however, about the impression held in some circles that the trading strategies undertaken by Enron were the root cause of California's electricity crisis, and that a more aggressive application of administered penalties and sanctions would solve the California market's problems. This is simply not true. The impact of those practices that appear to be clearly detrimental to the market was modest when compared to the enormous harm due to the unilateral exercise of market power by firms selling in California. Therefore, while we generally support the ISO's efforts to create a more rigorous regime of penalties and sanctions, we emphasize that these efforts should not be pursued at the expense of fundamental reforms to the market structure that allowed firms to exercise significant market power.

We also recommend that the oversight process make a distinction between clear rules violations and potentially beneficial trading activity. Arbitrage trades, if they can be implemented without harming system reliability, can benefit the market and consumers. However, California's market rules make it impossible to execute arbitrage trades without also misrepresenting the state of physical resources being offered. The problems with such trades in California were created not by the arbitrage of prices, *per se*, but by the fact that such trades took the form of false schedules. The inaccuracy of schedules made it more costly for the ISO to maintain reliability. However, there are ways to harness the forces of arbitrage without encouraging these negative impacts on system reliability.

We begin by outlining several important general concepts to foster market-efficiency-enhancing arbitrage but prevent misrepresentations or other market participant actions that harm system reliability or artificially increase wholesale energy prices:

- 1) The majority of the ISO's initial oversight and investigation efforts should be devoted to implementing mechanisms for imposing penalties and sanctions on actions that are clear and verifiable rules violations, as opposed to violations that would require a finding of intent.

- 2) Bids and offers to any market overseen by the ISO should be firm contractual obligations. Entities that fail to honor their contractual obligations should be at least required to compensate the ISO for the costs it incurs as a result of this violation.
- 3) To deal with market rule violations that require a finding of intent, the ISO should implement an administrative process for investigating and penalizing persistent behavior by one or more market participants that causes significant harm to system reliability or market efficiency.
- 4) Explicitly financial or 'virtual' trades should be allowed in order to harness the inevitable pressures created by arbitrage opportunities without compromising system reliability.
- 5) Elements of the current market design make it profitable for firms to deviate from their obligations. The adoption of ex-post pricing would reduce the incentives of firms to deviate from these obligations and reduce reliance on administrative processes of penalties and sanctions.

Introduction

As part of its oversight and investigation review process, the California ISO would like to implement penalties and sanctions for behavior that it determines to be in violation of its market rules. We strongly support giving the ISO the authority to enforce its tariff through financial penalties and sanctions for market rule violations. All formal markets for commodities, stocks, bonds, and other financial instruments have the ability to both penalize market participants and impose sanctions for violations of market rules. These penalties and sanctions are necessary because the unilateral violation of a market rule can sometimes be extremely profitable for an individual market participant. Therefore, the explicit and implicit penalties associated with any rule violation must be greater than the additional profits a market participant expects to earn from violating that market rule. Otherwise, an expected profit-maximizing market participant will find it in their best interest to violate this rule.

The recently released “Enron memos” have led to significant confusion about the underlying causes of the “California electricity crisis.” As has been discussed elsewhere, many of the strategies described in these memos can be interpreted as standard arbitrage strategies that were known to the independent market monitoring committees for California ISO and Power Exchange well before the summer of 2000.¹ Because several of the strategies described in the Enron memos did involve clear market rule violations (e.g., bidding non-firm energy as firm), there is a need for the California ISO to implement a formal oversight and investigation process for potential market rule violations. However, we wish to emphasize that such a process need not preclude trading activities that can benefit the market.

In designing an oversight and investigation process, four points about these strategies are important to emphasize. First, versions of most of these strategies exist in the three wholesale electricity markets operating in the eastern US. Second, none of these strategies involved zero risk on the part of the trader executing them. For example, a trader would lose money from buying energy in the day-ahead market and selling it in the real-time market if, contrary to the trader’s expectations, the price in the ISO’s real-time market was less than the price in the PX’s day-ahead market. Third, all of the strategies described in the Enron memos were available to all buyers and sellers in the California market. Consequently, like all arbitrage strategies, as more market participants gained experience participating in the California market, their profitability most likely declined. Finally, these strategies were not the major cause of the dramatic increase in wholesale electricity prices during the period June 2000 to June 2001. In fact, to the extent that arbitrage can aid the convergence of prices to a level that accurately conveys market conditions, it can enhance the efficiency of the market.²

¹ Statement of Frank A. Wolak Professor of Economics at Stanford University and Chairman of the Market Surveillance Committee of the California Independent System Operator Before the Senate Committee on Commerce, Science and Transportation, May 15, 2002 (available from <http://www.stanford.edu/~wolak>).

² For example, average market prices during the winter of 1998 through much of 1999 were very close to perfectly competitive levels. Over this period, prices in the day-ahead market of the California Power

The fundamental cause of the “California electricity crisis” was unilateral exercise of market power by sellers into the California market. A firm exercises its unilateral market power by withdrawing generating capacity from the market either by bidding extremely high prices for some or all of its capacity or by refusing to make a portion of its capacity available to the market at any price. The goal of both of these strategies is to create an artificial scarcity of energy in order to drive up the market price. Borenstein, Bushnell and Wolak (2002) quantify the extent of unilateral market power exercised in the California market over the period June 1998 to October 2000.³ For the period June 2000 to October 2000, the cost of wholesale power to California consumers was estimated to be \$4 billion more than it would have been had the California electricity market been workably competitive.

Strategies that involve arbitraging price differences for the same or similar products across markets, time, and locations can enhance the performance of the California market. For this reason, we believe that the ISO should design an oversight and investigation mechanism that allows market-efficiency-enhancing arbitrage, but limits the incentives firms have to exercise unilateral market power. Our recommendations are designed to achieve these two goals.

A cornerstone of a successful oversight and investigation process is authority for the ISO to assess penalties and sanctions for verifiable market rule violations. The penalties and sanctions should be sufficiently high to make it unilaterally unprofitable for any market participant to violate the ISO’s tariff. The ISO does not currently have the authority to assess such penalties, and has been limited to ordering firms that have violated market rules to return the profits gained from their violation. In order to deter violations, however, such penalties must be greater than the profits gained from violating the market rules. Otherwise, firms have little to lose from violating rules because their violation may not be detected and, even if it is detected, they are not made any worse off than if they had followed the rules in the first place.

Implementing market rules that prohibit rather than accommodate arbitrage by market participants will reduce market efficiency and system reliability and therefore increase the average price consumers pay for wholesale electricity. In this regard, it is important to recognize that market participants are willing to take actions that degrade system reliability because the expected profit increase associated with these actions is often so much greater than the expected profit reduction that results from the reduced system reliability caused by these actions. Consequently, if the ISO succeeds in eliminating the expected profit increases associated with market participant actions that reduce system reliability, there would be little need to impose explicit penalties on these actions. The expected profit reduction due to the reduced system reliability caused by

Exchange increasingly converged to those in the ISO’s imbalance energy market. The fact that PX prices more accurately reflected expected system conditions allowed for a more effective scheduling of both production and consumption of electricity.

³ Borenstein, Severin, Bushnell, James, and Wolak, Frank A. (2002) “Measuring Market Inefficiencies in California’s Restructured Electricity Market,” June, available from <http://www.stanford.edu/~wolak>.

these actions should be sufficient to discourage this behavior, because a less reliable transmission network reduces the likelihood that any energy or ancillary services a firm produces will ultimately be consumed. Consequently, the ISO oversight and investigation process should focus on eliminating the significant expected profit increases associated with behavior that degrades system reliability and market efficiency but allow beneficial financial arbitrage.

Strategies for Setting Penalties and Sanctions

In developing a strategy for setting and enforcing penalties and sanctions, we believe that it is important for the ISO to make a distinction between those actions that represent easily verifiable rule violations and those actions for which a violation would require a determination of intent. The first type of violation should be dealt through automatic penalties administered by the ISO that are at least as large as the cost the ISO incurs as a result of this market rule violation. Violations that require a determination of intent should be dealt with through a multi-stage administrative process such as the one outlined below.

An example of the first type of market rule violation is a failure to fulfill a contractual commitment. For example, if the owner of a 250 MW unit commits to supply 100 MW of spinning reserve from the unit, then the owner has a contractual obligation to leave at least 100 MW of capacity from this unit unloaded until the ISO issues a dispatch instruction to this unit. If this unit supplies more than 150 MWh of energy per hour during any settlement period within the hour (more explicitly if its meter reads more than 25 MWh of energy in a 10-minute interval) without being instructed by the ISO to produce such additional energy from spinning reserve capacity, then it has violated its contractual obligation to supply 100 MW of spinning reserve for that hour. More straightforward market rule violations also fit into this general category. The ISO's participating generator agreement (PGA) is a contract between the market participant and the ISO. Therefore, failure of a generating unit owner to provide the ISO with information required by the PGA under the terms and conditions given in the agreement is a market rule violation.

The second type of behavior that could be subject to penalties and sanctions would require that the ISO determine the intent of a market participant in order to find it in violation a market rule. For example, a general provision in the ISO tariff prohibiting behavior detrimental to system reliability and market efficiency would require the ISO to determine whether the behavior by a market participant was intended to have either of these effects. To enforce such a provision, the ISO would have to infer from a market participant's behavior whether it's bidding or scheduling intended to harm system reliability or market efficiency, unless the market participant provided direct evidence of intent to the ISO. If ISO identifies behavior that is detrimental to system reliability, and has clear evidence (e.g., a whistleblower or internal correspondence) that the market participant engaged in this behavior with full knowledge that it significantly harmed system reliability or market efficiency, penalties may be imposed without first going through the administrative process described below.

However, it seems very unlikely that the ISO would have direct evidence of intent, particularly if the ISO imposes significant penalties on the market participants that they determine engage in this type of behavior. Enforcing a "behavior detrimental to system reliability and market efficiency" provision would be more difficult if the ISO also imposed the very reasonable requirement that this detrimental behavior must also have a significant impact on market outcomes. This would require the ISO to make the often very subjective determination of what constitutes a "significant" market impact. Despite these difficulties with determining intent and significant market impacts, we believe that an administrative procedure along the lines discussed below can adequately address these complications in making the finding of "intent to impose significant harm."

A necessary first step for the ISO in any process for determining intent is the ability to demand and receive information from market participants. Therefore, a pre-condition for participation in the ISO's markets should be a contractual agreement between the market participant and the ISO to provide, in a timely manner, all information necessary for the ISO to undertake an investigation of intent to impose significant harm to system reliability or market efficiency. This agreement to provide information should be subject to the constraints that the information request is necessary to undertake the current investigation and does not impose costs on the market participant that are out of line with the alleged harm that the market participant is imposing on the California market.

Because the ability to enforce contractual commitments is necessary to operate any market and undertake productive investigations of intent, we believe that the ISO should focus its efforts on designing penalty and sanction mechanisms that enforce the contractual obligations market participants have with the ISO. Because of the factual nature of failing to honor a contractual obligation, the ISO can detect and penalize these sorts of market rule violations without having to infer intent from a market participant's actions. Imposing penalties and sanctions for behavior that requires the ISO to infer intent without a clearly specified administrative process for determining intent has a large potential downside. Market participants will be reluctant to engage in behavior that enhances market efficiency and system reliability if it is likely to be interpreted by the ISO as harming system reliability or market efficiency. Mechanisms for imposing penalties that require the ISO to determine intent from a market participant's actions will also require the ISO to incur significant expense to hire the legal and administrative staff necessary to make this determination, with no guarantee that system reliability or market efficiency will be improved. For this reason, the focus of the administrative process we propose is on halting or rendering unprofitable the behavior causing harm as soon as possible.

In spite of these drawbacks, we support the ISO implementing a general process for determining intent to harm market efficiency and system reliability, because this process may be the only way to stop some behavior that is extremely privately profitable, but very harmful to system reliability or market efficiency. However, we believe that if the ISO concentrates its oversight and investigation efforts on making it profit-maximizing for market participants to honor their contractual obligations, the ISO would

have to use this process for determining intent rarely, if ever. Consequently, we strongly urge the ISO to determine what easily verifiable actions by market participants (that do not require a finding of intent) degrade system reliability or market efficiency and implement automatic penalties for these actions. These penalties and sanctions must be sufficiently high to deter profit-maximizing market participants from engaging in rule violations. This strategy for setting penalties and sanctions should improve system reliability and market efficiency and limit the likelihood that the sanctions process will be bogged down by costly investigations into determinations of intent.

Sanctionable Actions

In order to manage the California ISO grid reliably in real-time, the ISO operators must have the utmost confidence that any bid submitted to one of the ISO markets will meet all of the terms and conditions associated with that bid. For example, a spinning reserve bid with an associated ramp rate (or non-spinning reserve bid with an associated time delay and ramp rate) must be able to supply additional energy when called upon by the ISO operators at the ramp rate (and within the time delay) submitted to the ISO. A bid in the ISO's real-time energy market must provide the promised quantity of energy (subject to the resource's ramp rate) if the market-clearing price rises above the bid price associated with that amount of energy and the market participant receives a dispatch instruction from the ISO operators. For this reason, the ISO should establish that all bids into all ISO markets represent firm contractual commitments and are therefore subject to liquidated damages.

The following example illustrates how this market rule would function. Suppose a market participant submits a bid for 60 MWh at a price of \$40/MWh into the ISO's real-time energy market. This bid is a firm financial commitment to supply 60 MWh of energy per hour if the real-time energy price at this location rises above \$40/MWh and the unit owner receives a dispatch instruction from the ISO. Under no circumstances should a market participant be allowed to refuse to honor this commitment if the real-time price is above its bid price and it receives a dispatch instruction from the ISO. While a market participant may withdraw their bid from the real-time market before the close of this market, no market participant that sells spinning reserve, non-spinning reserve or replacement reserve may withdraw their bid from the ISO's real-time energy market. This is because part of the contractual obligation associated with selling ancillary services is the promise to provide real-time energy from this capacity should the real-time energy price rise above that unit's energy bid and the unit owner receive a dispatch instruction from the ISO.

Maintaining system balance in the ISO control area is considerably more difficult for ISO operators than it was in the former vertically integrated monopoly regime because generation unit owners routinely refuse to honor their bids. For example, if a generator bids \$45/MWh to supply 50 MWh in the real-time energy market, often this generator simply refuses to respond to the dispatch instruction. The ISO should treat all accepted bids and their associated dispatch instructions as firm energy and charge all market participants that fail to live up to their contractual obligations at least the full cost

to the ISO of purchasing the necessary replacement energy. This is an example of the general principle that the consequence of a contract violation is compensating the ISO for at least full-liquidated damages. If there are instances when liquidated damages are not a sufficient penalty to deter violations because the market participant stands to benefit from these actions for all of the generating units they own, the ISO should increase the penalty accordingly. Similarly, the ISO could reasonably increase a penalty to account for imperfect detection of certain rules violations. Consequently, the two principles that should guide the ISO in assessing penalties and sanctions are: (1) full-liquidated damages and (2) sufficient to make the rule violation unprofitable. We believe that in most circumstances properly computed full-liquidated damages should be sufficient to make the rule violation unprofitable.

The ISO should treat all ancillary services bids in the same manner as energy bids and schedules. If an ancillary services bid is accepted from a market participant, the ISO should deem it as delivered and charge any market participant that fails to deliver on its contractual obligations the full cost to the ISO of replacing these ancillary services. We should note that because the ISO may be forced to purchase the required reserves outside of formal ISO markets, the potential cost to the market participant could be extremely high. Even in those circumstances when the per-unit cost to the ISO of replacing the energy or ancillary services is above the ISO's price cap, this market participant should be fully liable for this cost. There may even be circumstances when the ISO cannot find the necessary replacement energy or ancillary services. In this case, the ISO should assign an administrative charge for the cost of failing to fulfill the market participant's contractual obligation. For example, if replacement energy or ancillary services cannot be obtained, then the ISO could set the administrative charge for failing to honor a contractual obligation to supply energy at \$5000/MWh, or some other value that is sufficiently high to make expected profit-maximizing market participants honor their contractual obligations. Basing this penalty on the ISO's marginal cost of purchasing additional load curtailment services would be a reasonable approach to setting this administrative charge.

An Administrative Procedure for Determining Intent to Harm

To address the second type of market participant behavior that could result in penalties and sanctions, the ISO should implement a multi-stage process for determining intent and imposing penalties commensurate with harm caused by these actions. We believe that it would be counterproductive for the ISO to prohibit actions that are difficult to define and even more difficult to determine if they occur, such as gaming, market manipulation, or false scheduling. Prohibiting these ill-defined activities without first finding intent and significant harm will cause market participants to avoid behavior that often enhances market efficiency and system reliability that might be interpreted by the ISO as one of these prohibited actions. Instead, the ISO process for determining intent should recognize that it is extremely difficult to distinguish legitimate profit-maximizing behavior from actions that intend to harm competition and market efficiency without some exchange of information between market participants and the ISO. In addition, behavior that might be interpreted by some observers as gaming or market manipulation is often rendered unprofitable by the actions of other market participants. Consequently,

these sorts of market efficiency or system reliability problems can often be solved through information provision by the ISO to the market at large, thereby eliminating the need for further action by the ISO.

Rather than prohibit a list of seemingly nefarious but nebulous actions, the ISO should adopt a general provision against behavior by any market participant that intentionally causes significant harm to market efficiency or system reliability. A key feature of this market rule is a transparent process for identifying intentional behavior detrimental to system reliability or market efficiency and for taking the actions necessary to stop this behavior or the harm that it causes. The focus of the ISO process should be on stopping as quickly as possible intentional behavior that it determines causes significant harm to market efficiency and system reliability.

The first step in this process is to identify behavior that is likely to harm to market efficiency and system reliability. Two findings are necessary for the ISO to continue to the next step of the process. The ISO must first determine if this behavior is persistent, and if it has the potential to impose significant harm either because it is very persistent or extremely harmful when it does occur. The next stage of the process involves alerting all market participants to the existence of this behavior and publicly disclosing the identity of the market participant engaging it. The goals of this stage of the process are to subject this market participant to public scrutiny and to provide all market participants with information that they can use to take actions that attempt to render this behavior unprofitable.⁴ This public disclosure is very important step in the process of determining intent because all market participants, including the market participant engaging in the behavior, know that the ISO has publicly stated that this behavior is harmful to system reliability or market efficiency. Consequently, continued behavior by this market participant that imposes significant harm provides strong evidence in favor of a finding of intent.

In most cases, this stage of the process will put an end to the behavior or the harm it causes. However, in those instances when the actions are sufficiently profitable to the market participant or group of market participants that they continue to cause significant harm, the ISO should initiate a formal investigation of intent. To do this the ISO needs the ability to request and receive in a timely manner the information from the offending market participant necessary for the ISO to make a credible determination of intent to impose harm. An important goal of this information gathering effort is for the market participant to provide information to the ISO showing that there is no direct causal link between its behavior and harm to system reliability or market efficiency.

If the ISO's information gathering efforts reveal substantial evidence of a direct causal link between this market participant's behavior and the presumed harm, then the ISO should find that this market participant did intend to harm system reliability or market efficiency. If there is an affirmative finding of intent, the ISO may need to collect

⁴ Several of the strategies described in the "Enron memos" would have been much less profitable if information about their existence and how to counteract them had been made available to all market participants.

additional information to determine the appropriate magnitude of penalties. The requirement to provide this information would be a contractual obligation between the ISO and each market participant. For this reason, the ISO should have the authority to impose penalties on this market participant for failure to comply with reasonable and necessary information requests by the ISO in a timely manner.

If the ISO makes an affirmative finding of intent it would then be required to set the appropriate level of penalties. These penalties should be at least as large as the harm caused by the market participant's actions. The results of the investigation and the ISO's rationale for its recommended level of penalties would then be forwarded to the Federal Energy Regulatory Commission for final review and implementation.

As should be clear from the above discussion, the major focus of this process should be on eliminating the harmful behavior as soon as possible, not on assigning blame. Only when public disclosure of the actions and the ISO's own investigation fails to stop or eliminate the harm associated with this behavior should the ISO attempt to determine intent and assign penalties for this behavior.

Market Rule Changes to Enhance System Reliability

One source of alleged market abuses is that the current California market design does not accommodate legitimate and potentially beneficial financial arbitrage across its various markets. Under the current system a firm cannot engage in financial arbitrage across ISO energy and ancillary services markets without engaging in behavior that may sometimes degrade system reliability or market efficiency. It is important to recognize that many of the problems associated with these trades do not stem from the financial trades themselves, but from the misleading characterization of system conditions that such trades present to the ISO. To address this problem, many eastern ISOs now explicitly distinguish between 'virtual' bids, which do not imply an underlying physical commitment to supply or consume power and 'physical' bids associated with a legitimate expectation to supply or consume. We recommend that the California ISO also adopt such conventions.

While the incentives provided by arbitrage opportunities will always be present in any market, the current California market rules can channel these forces into trades that harm system reliability. The most prominent example of the problems created by the current system was apparent in the arbitrage between day-ahead prices and the ISO's real-time energy prices. Explicit financial trades on the price difference between these two prices are not possible. The only way for a market participant to arbitrage between these two market prices is to schedule more or less energy in the day-ahead market than it intends to deliver (or consume) in real time. Buying more energy than necessary in a day-ahead market, for example, allows a firm to financially 'buy' power at the day-ahead price and, by not consuming, 'sell' that power at the imbalance energy prices. Such behavior was commonplace amongst market participants to varying degrees during the operation of the California Power Exchange (PX) and was at the heart of the debate over which market participants caused the under-scheduling of the energy relative to real-time

production and consumption. With virtual bidding, both generation unit owners and load-serving entities could take financial positions that eliminate the differences in prices across the day-ahead, hour-ahead and real-time energy markets without having to misrepresent their physical resource commitments.

Arbitrage trades that give firms incentives to misrepresent their expected electricity supply or consumption creates an added burden on the ISO. Operators cannot tell if the energy schedules submitted by a firm represent production and consumption decisions that it intends to undertake in real-time or simply actions necessary to exploit profitable financial arbitrage opportunities across markets. Therefore, operators are often forced to acquire additional reserves or undertake other costly actions in order to reconcile ISO forecasts with the potentially distorted schedules of market participants.

For this reason, we urge the ISO to allow market participants to submit virtual schedules and bids. A virtual bid or schedule would not require the market participant to schedule or bid a physical resource in order to attempt to exploit profitable financial arbitrage opportunities. A market participant could use virtual bidding to take a financial position in the market without adversely impacting system reliability. Consider the case of a scheduling coordinator wishing to sell 50 MWh of its 100 MWh of energy in real-time. This is accomplished by submitting a balanced day-ahead schedule composed of 100 MWh of energy from a specific unit or set of units and 50 MWh of load at a specific location in the ISO network and 50 MWh of virtual load at another location in the ISO network. The only difference between virtual scheduling and bidding is that a market participant would designate to the ISO whether each component of its schedule is physical or virtual. Under this scheme, market participants would no longer have an incentive to distort physical schedules in order to take advantage of financial arbitrage opportunities. For this same reason, the ISO could also set a higher standard for compliance by generators and loads with their physical day-ahead schedules, which should reduce the cost of operating the ISO control area in real time.

In the eastern ISOs, all virtual bids are cleared against the real-time price at that location. For example, if a market participant has a 50 MWh virtual supply bid accepted, this implies the subsequent purchase of the energy necessary to cover this virtual supply at the real-time price at that location. Conversely, if a market participant has a 50 MWh virtual demand bid accepted, this implies a sale of the same quantity of energy at the real-time price at that location. Because the California market has a day-ahead, hour-ahead and real-time market for energy, the option exists to clear all virtual schedules against the hour-ahead price of energy at a given location, with no virtual schedules allowed to persist into real-time system operation. Alternatively, market participants could also be allowed to submit virtual schedules in the day-ahead and hour-ahead markets and have all virtual schedules cleared against the real-time price, as is the case in the east coast ISOs. In either case, because virtual schedules would be identified to the ISO operators, they should not interfere with real-time system operation.

With the ability to submit virtual schedules or bids, market participants should no longer have any reason to misrepresent the commitment or physical capabilities of load

or generation resources. The penalties for misrepresentations should therefore be severe because system reliability could be endangered if market participants do not use virtual bids and schedules in the manner intended.

Ex-Post Pricing versus Ex-Ante Pricing with Penalties

The ISO should also consider implementing ex-post pricing along with virtual bidding. This would help to solve another problem that has existed in California since the start of market—the failure of both generation unit owners and load-serving entities to honor their final schedules or to follow dispatch instructions. These actions often take the form of generation unit owners using some units they own to cause the ISO to set very high prices for energy at the start of a given settlement period (currently every 10 minutes). The firm then responds by producing more than the final energy schedule from all of the other generating units it owns. These actions can cause the ISO operators to set significantly lower prices in subsequent settlement periods, which provides strong incentives for the generation unit owners to produce significantly less than their final energy schedules in these periods.

Generation unit owners chasing prices set at the beginning of settlement periods can cause the ISO to purchase large amounts of reserves (particularly regulation reserve) to guarantee that the system remains in balance. These increased reserve purchases limit the amount of capacity available to sell energy and other ancillary services and thereby reduces the competitiveness of the energy markets and ancillary services. This results in higher prices for both energy and ancillary services. The PJM ISO currently uses ex-post pricing and the New York and New England ISOs are in the process of implementing this pricing mechanism. A properly implemented ex-post pricing mechanism similar to the one that exists in the PJM ISO would allow the California ISO to procure significantly less regulation reserve capacity and therefore free up more generating capacity to compete in the energy and other ancillary services markets.

Under ex-post pricing the ISO operators would issue dispatch instructions to specific generators in real-time based on the unit-level bid curves these firms submitted to the ISO. The ISO would then record the actual amount of energy the market participant produced from each of its units during each settlement period. The system operator would then run the price-setting algorithm and compute the price that each unit receives for the actual output produced during that settlement period. Generators whose actual output was significantly in excess, say more than 105%, of the sum of their final schedule and the ISO's dispatch instructions, would be unable to set the real-time price at that location. These unit owners would be treated as price-takers in the ISO's ex-post pricing process.⁵

⁵ The amount of allowable overproduction from a unit could be adjusted to account for the differences in the reliability of the underlying energy source. For example, higher numbers could be set for intermittent sources like wind and solar energy, and lower numbers for quick response resources such as combustion turbine peaking units.

Assume a unit owner had a day-ahead energy schedule of 50 MWh and received a real-time dispatch instruction to produce 50 MWh more. Under this 5% over-production rule, if this unit owner produced 105 MWh or less of energy, the ISO would include this unit owner's bid curve in the price-setting process. If it produced more than 105 MWh in real-time then it would be treated as a price-taker in the ex-post price-setting process. Taking the example of California's zonal price-setting process, if the firm produced more than 105 MWh during the settlement period, this production would be netted out of the total zonal demand during that settlement period and the resulting net demand would be used along with the aggregate bid curve of all other market participants to set the zonal price for the settlement period. If the ISO used a nodal-pricing scheme in real-time, the market participant that produced more than 105 MWh during the settlement period would be included as fixed injection of the actual quantity of energy that the unit owner supplied at that location in the network during the settlement period. The price that unit owner receives for its output would be determined by the bids submitted by all other market participants whose actual output was less than 105% of the sum of its final schedule and the real-time dispatch instructions it received from the ISO.

Virtual load and generation could be incorporated into this ex-post price-setting process without impacting real-time reliability, because the ISO would run the price-setting process after actual production for the hour had taken place. In this manner, market participants would be able to engage in all potentially profitable arbitrage opportunities without endangering real-time system reliability. This combination of virtual bidding and ex-post pricing appears to be the best available remedy to the problems the ISO faces with generators failing to honor dispatch instructions and generators and loads not accurately scheduling in the ISO's forward market. Ex-post pricing also holds significant promise for allowing loads to become more active participants in the real-time market. The effects of ex-post pricing on the development of effective demand-side participation should be analyzed to ensure that this promise is realized and provides significant benefit to final consumers.

If the ISO would like to continue with ex-ante pricing—setting a price at the beginning or during a settlement period that is paid for all incremental energy supplied or paid to all decremental energy purchased during the period—it may want to consider a real-time trading charge on generators and loads for the cost they impose on the system by leaving significant trades for the real-time market. The size of this charge should be linked to the economic and reliability costs imposed on the system by excessive deviations from scheduled or instructed activity. To take the extreme case, it is virtually impossible for the ISO to find and dispatch 10,000 MWh in a short period of time. Put simply, the assumption that time does not matter makes little sense when the ISO is a few minutes away from declaring a system emergency and must find the necessary energy wherever it can.

In applying such a charge, however, it is important that both loads and resources be treated symmetrically. Otherwise, one side or the other would have an economic incentive to refuse to transact at reasonable prices in advance markets, knowing that the

other side faces an additional penalty for spot market transactions. As discussed above, a certain amount of transactions can be exempt from the real-time trading charge to account for uncertainties that are plausibly beyond the control of the load or generation resource. However, market participants with positive or negative real-time transactions above this level should bear the full cost of the reduced system reliability they impose on all other market participants in a form a trading charge on these excessive real-time transactions. A small trading charge, applied equally to buyers and sellers, will at least provide incentives to both sides of the market to transact in advance of real-time.

While some measures directed at reducing activity in the imbalance energy market may be warranted, it is also important to recognize that there are costs as well as benefits created by such measures. Spot market prices can convey vital information about market conditions to participants, allowing them to adjust their supply and consumption in response to those conditions. In electricity markets, conditions in real time can differ significantly from the conditions anticipated even a day before. Measures directed at reducing reliance on the spot market can enhance reliability and force firms to internalize the reliability implications of their scheduling and operating decisions. If such measures go too far, however, they could also distort the spot price and significantly reduce the economic benefits that can be provided by an imbalance energy market. We therefore urge that these two considerations be balanced when adopting policies aimed at reducing activity on the imbalance energy market.