



PRICE FORMATION IN ORGANIZED WHOLESALE ELECTRICITY MARKETS

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STAFF ANALYSIS OF ENERGY OFFER MITIGATION IN RTO AND ISO MARKETS

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**Staff Analysis of
Energy Offer Mitigation in RTO and ISO Markets**

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1. Executive Summary

This paper is part of an effort to evaluate matters affecting price formation in the energy and ancillary services markets operated by Regional Transmission Operators (RTOs) and Independent System Operators (ISOs) subject to the jurisdiction of the Federal Energy Regulatory Commission (Commission). The RTO and ISO market structures are designed to encourage competitive, efficient outcomes through resource offers made consistent with marginal cost bidding and the use of least cost centralized dispatch. When that is not possible because of structural or behavioral issues, market power mitigation rules take effect. This paper: (1) reviews and summarizes the different approaches to market power mitigation that apply to incremental offers in the day-ahead and real-time energy markets in the RTOs and ISOs; (2) uses information regarding incremental energy supply offers submitted through the RTOs and ISOs' economic market clearing processes, as reported in data submitted to the Commission pursuant to Order No. 760¹, to analyze the operation of market power mitigation rules during a representative peak hour in 2013 for ISO New England Inc. (ISO-NE) and the California Independent System Operator Corporation (CAISO)²; and (3) make some initial observations based on an empirical analysis of the data.

Central to well-functioning market power mitigation, as currently used by the RTOs and ISOs, is the measurement of marginal cost. The mitigation rules employed by the RTOs and ISOs are designed to ensure that resources are able to bid their marginal costs, but are not able to exercise market power. In practice, however, measuring marginal cost can be a complicated endeavor. For example, fuel costs, particularly the costs of natural gas and fuel oil, can change substantially day-to-day and potentially within the day; further opportunity costs for some resources can be difficult to determine with precision. For all of these reasons, mitigation rules have been designed to allow resources some bidding flexibility. Despite this flexibility, other RTO and ISO bidding rules not related to market power mitigation can impair the ability of a resource to bid its marginal cost. Some stakeholders argue that bidding rules that require generators to submit offer prices

¹ *Enhancement of Electricity Market Surveillance and Analysis Through Ongoing Electronic Delivery of Data from Regional Transmission Organizations and Independent System Operators*, Order No. 760, FERC Stats. & Regs. ¶ 31,330 (2012). Paragraph 35 of Order No. 760 states the Commission may make publicly available staff white papers, among other things, that contain analyses derived from data that the Commission uses.

² Out-of-market commitments are not included in this analysis because such commitments do not occur in a competitive framework. Out-of-market commitments often face more stringent market power mitigation rules that are not addressed in this paper.

far in advance of real-time operation or that require the same offer for every hour of the day may limit a resource's ability to reflect its true marginal cost in its offer price.³ In addition, a generator's perception that the rules result in excessive mitigation may lead it to routinely offer in a manner that avoids mitigation but is not necessarily reflective of its marginal cost. As such, this paper attempts to make observations regarding resources' offers relative to their respective marginal costs as represented by their reference levels.

An analysis of incremental energy supply offers shows that in both ISO-NE and CAISO:

- More than half of all resource offers have no markup above reference levels. This is in part because a significant percentage of resources submit self-schedules or negative offers.
- Markups in most portions of the supply curve tend to stay relatively constant as load increases.
- Resource offers in the portion of the supply curve that includes the marginal resource (ignoring transmission constraints) tend to have relatively low markups.
 - In ISO-NE, resources that are just above or just below the intersection of supply and real-time demand have a mean markup of between 7 and 13 percent at almost all load levels.
 - The median markup of such resources was zero for virtually all load levels
 - The 75th percentile markup for such resources were between 5 and ten percent for most load levels.
 - In CAISO, relevant resource offers have a mean markup between 2 percent and 7 percent relative to reference levels that include a ten percent adder.
- The markups of the highest ten percent of offers are substantially more than marginal cost (roughly 60 percent in ISO-NE and 177 percent in CAISO). In addition, the mean markup of resources in the most expensive part of the supply curve is also substantially greater than marginal cost.

The observation that offers are concentrated at levels very close to marginal cost is consistent with either the suggestion that market forces are putting competitive pressure on resource offers or that a resource is inclined to offer close to its reference level to

³ See Electric Power Supply Association, Post-Technical Conference Comments, Docket No. AD14-8-000, at 23-25 (May 15, 2014).

avoid mitigation. The observation that at least some offers exceed marginal costs as represented by the reference levels could be viewed as evidence that the mitigation rules provide some flexibility to account for inaccurate marginal cost estimates. Alternatively, recognizing there may be legitimate reasons resources bid above marginal cost, offers substantially above marginal cost could suggest the lack of competitive pressure to discipline offers.

This paper does not attempt to assess whether existing market power mitigation provisions are appropriate or require revision. The paper is intended to spur discussion and lead to a more comprehensive understanding of how market power mitigation procedures affect price formation. The conference scheduled for October 28, 2014 will provide an opportunity for the Commission staff to learn the views of market monitors, market participants, and RTOs and ISOs.

2. Approaches to Market Power Mitigation

The Commission ensures that the rates, terms and conditions of wholesale market service established by market rules are just and reasonable and not unduly discriminatory or preferential. Prices in organized electricity markets are established through tariffs and practices that enable a competitive market. Market power mitigation measures help to ensure competitive outcomes and are carried out by a combination of independent internal market monitoring units within each RTO and ISO and an independent external market monitor, or an independent external market monitor alone.⁴

The mitigation procedures in the RTO and ISO energy markets, as set forth in the Commission-jurisdictional tariffs, are based on the premise that in a competitive wholesale electricity market, a resource's offer will be approximately equal to its short-run marginal cost (including opportunity costs). All energy offers are capped at an administratively determined value of \$1,000/MWh, such that, in the absence of market power mitigation, resources are allowed to offer at any price up to \$1,000/MWh. If a resource does not have market power, competitive pressure should discipline the resource into bidding offer prices at or near its marginal cost.

⁴ ISO-NE and New York Independent System Operator, Inc. (NYISO) have both internal and external market monitors while PJM Interconnection, L.L.C. (PJM) and Midcontinent Independent System Operator, Inc. (MISO) have external market monitors. CAISO has an internal market monitor and a Market Surveillance Committee that serves as an external market advisor.

The details of the market mitigation provisions in each RTO and ISO vary, but two general approaches are used: “Structural” and “Conduct and Impact.” PJM and CAISO use a Structural approach. ISO-NE, MISO and NYISO use a Conduct and Impact approach.⁵ These approaches are discussed in more detail below.

The following elements are common to all six RTOs and ISOs: the use of reference levels, the \$1,000/MWh offer cap, the use of transmission constraints to identify system conditions where resources may require mitigation, and the consideration of resource ownership and affiliation.⁶ Generally speaking, if a resource is deemed to have market power under the mitigation procedures, the resource’s offer will be mitigated to that resource’s reference level.⁷

Either the market monitors, or the resources themselves in the case of PJM, develop reference levels, which are based on short-run marginal cost estimates for each resource and updated regularly (daily in most markets) based on information from resources and fuel price indices. The marginal cost estimates are referred to as “reference levels” in ISO-NE, MISO, and NYISO, “cost-based offers” in PJM, and “default energy bids” in CAISO. For simplicity’s sake, this paper refers to such estimates as “reference levels.” Reference levels in CAISO and PJM include marginal cost estimates plus a ten percent adder, while reference levels in ISO-NE, MISO, and NYISO only include a marginal cost estimate.

2.1. Structural Approach

In a Structural approach to market power mitigation, resource offers are subject to mitigation when pre-specified conditions are met. The conditions focus on the concentration of ownership among the set of suppliers available to relieve binding transmission constraints that limit competition from neighboring areas.

PJM applies the Three Pivotal Supplier test any time that the market solution indicates that out of merit resources are needed to relieve a given transmission constraint.⁸ Specifically, the Three Pivotal Supplier test determines, using resource distribution

⁵ Southwest Power Pool, Inc. (SPP) also uses a Conduct and Impact approach. SPP’s market power mitigation rules are largely excluded from this discussion because its Day-2 market is fairly new and some of the issues related to SPP’s market power mitigation provisions are currently pending before the Commission.

⁶ Throughout this paper, “supplier” refers to an entity that owns one or more resources.

⁷ Resources that bid below their reference levels are not mitigated.

⁸ Monitoring Analytics, LLC, *2013 State of the Market Report for PJM*, at 81 (Mar. 13, 2014), available at http://www.monitoringanalytics.com/reports/pjm_state_of_the_market/2013.shtml.

factors, the set of resources that are available to relieve a given transmission constraint. For this set of resources, the Three Pivotal Supplier test assesses whether the three largest suppliers available to relieve a given constraint are *jointly* necessary to relieve the constraint. Resources that fail the Three Pivotal Supplier test in PJM are mitigated to their reference level offers, which consist of a marginal cost estimate plus a ten percent adder.⁹

CAISO uses a test similar to the Three Pivotal Supplier test to assess whether a constraint is structurally competitive or non-competitive. If the three largest resources available to relieve a given constraint are jointly pivotal, then the constraint is deemed non-competitive and *all* of the resources that can relieve that constraint are subject to potential mitigation, even if a resource is not among the set of jointly pivotal resources.¹⁰ Resources that are dispatched to relieve a non-competitive constraint in CAISO are mitigated to the higher of their reference level and a competitive proxy price calculated by the internal market monitor. Like PJM, CAISO's reference level includes a ten percent adder above marginal cost.

2.2. Conduct and Impact Approach

The Conduct and Impact mitigation approach requires two steps. The first prong is a Conduct test that establishes whether a resource's offer exceeds its reference level by a pre-specified threshold. The second prong is the Impact test that assesses the impact of that offer on the market clearing price for energy. If a resource's offer fails the Conduct test and the impact of its offer exceeds the pre-specified Impact threshold, that resource's offer is mitigated to its reference level. Thus, mitigated resource offers are replaced with reference level offers.

The Conduct and Impact approach also uses transmission constraints to identify areas vulnerable to market power abuses. ISO-NE, MISO, and NYISO adopted similar approaches and generally define two market "areas" where market power concerns can arise due to transmission constraints: unconstrained and constrained. In unconstrained areas, a resource's energy offer fails the Conduct test if it exceeds its reference level by the lower of \$100/MWh or 300 percent. It is then subject to the Impact test, which determines if that resource's offer will raise the clearing price by the lower of 200 percent or \$100/MWh. Resource offers that fail both the Conduct and Impact tests in unconstrained areas have their offers replaced with reference levels before the market clearing process is executed. In ISO-NE, only pivotal suppliers are subject to the

⁹ See Appendix for details about PJM's mitigation procedures.

¹⁰ See Appendix for details about CAISO's mitigation procedures.

unconstrained area Conduct and Impact tests, while all resources in MISO and NYISO are subject to them.¹¹

Resources located within chronically constrained areas are subject to more stringent Conduct and Impact tests. These chronically constrained areas are typically identified on a static basis, with the designation lasting for approximately 12 months.¹² The New York City zone in NYISO and the Western Upper Michigan zone in MISO are examples of chronically constrained areas. The Conduct and Impact tests for constrained areas in ISO-NE, NYISO, and MISO differ slightly but have the same general structure with a single threshold that serves as both the Conduct and Impact threshold that is applied during periods when transmission constraints bind.

The threshold in ISO-NE is based on a fixed \$/MWh and percentage values, whereas the thresholds in MISO and NYISO depend on other factors and can vary by location. ISO-NE's Conduct and Impact tests for constrained areas evaluate whether a resource's offer exceeds its reference level by the lower of \$25/MWh or 50 percent. The constrained area Conduct and Impact thresholds in MISO are based on the net annual fixed cost of a new peaker divided by the number of constrained hours in the constrained area during the past 12 months.¹³ NYISO's constrained area Conduct and Impact threshold rises with the average historical electricity price in the area and falls with the number of constrained hours.¹⁴ The Appendix provides further details about the market power mitigation provisions in each RTO and ISO.

2.3. Reference Level Calculation

Both the Conduct and Impact and Structural approaches to market power mitigation require the development of reference levels. Market monitors (internal or external) for ISO-NE, MISO, CAISO and NYISO calculate reference levels for incremental energy and ancillary service offers. If fuel prices change daily, as is the case with natural gas resources, the market monitor may update the reference price every day. If a resource in these RTOs and ISOs believes that the market monitor has miscalculated its reference levels, it has the opportunity to contact the market monitor and request that the reference

¹¹ The Commission approved ISO-NE's proposal to eliminate General Area Conduct mitigation on pivotal suppliers in the Day-Ahead market once ISO-NE implements its new Flexible Offer Rules in December 2014. *ISO New England Inc.*, 145 FERC ¶ 61,014 (2013).

¹² Chronically constrained areas can be redesignated as unconstrained if the transmission topology changes due to new transmission or generation capacity.

¹³ MISO posts the Narrow Constrained Area Mitigation thresholds on its website. *See, e.g.*, MISO, Narrow Constrained Area Mitigation Thresholds (Mar. 7, 2014), available at https://www.misoenergy.org/Library/Repository/Report/IMM/2014_NCA_Threshold_Update.pdf.

¹⁴ *See* Appendix for details about NYISO's mitigation procedures.

levels be updated. In contrast, resources in PJM submit their own reference levels pursuant to PJM's Cost Development Guidelines.¹⁵

The market monitors in each RTO and ISO estimate reference levels differently. Market monitors in CAISO, ISO-NE, NYISO and MISO calculate reference levels via several methods, including using a resource's lowest previous offers, using the lowest previous prices at a resource's node, and deriving marginal cost from fundamentals like fuel prices and heat rates. All of the RTOs and ISOs, including PJM, include provisions to account for opportunity costs in reference levels. A key distinction between the Structural and Conduct and Impact approaches is that reference levels in the Structural approach include a ten percent markup over estimated marginal cost. Reference levels equal an estimate of marginal cost in the Conduct and Impact approach.¹⁶

3. Empirical Analysis

3.1. Introduction

Staff undertook an empirical analysis of energy supply offers for a representative peak hour in 2013 for ISO-NE, and CAISO for the purpose of observing offers relative to respective marginal cost as represented by reference levels.¹⁷

The analysis attempts to shed light on whether competitive pressures result in resource offers that are consistent with a resource's short-run marginal cost while allowing a resource to offer at least its short-run marginal cost. Understanding the answers to these questions is an important element to understanding whether energy market power mitigation is inappropriately impeding price formation.

Staff selected one RTO or ISO from each market power mitigation approach for the analysis. ISO-NE was selected for its use of the Conduct and Impact approach and CAISO was selected for its use of a Structural approach.¹⁸ The analysis uses real-time

¹⁵ PJM, Manual 15 Cost Development Guidelines.

¹⁶ Mitigation provisions often permit resource offers that are frequently mitigated to include costs above marginal costs where appropriate.

¹⁷ The analysis does not attempt to discern whether resource offers would be higher in the absence of the mitigation rules. In part, this is because staff took as given the principle that resource offers should reflect short-run marginal cost at all times. In addition, it is inherently difficult to measure the degree to which market power mitigation rules discipline offer prices because the only outcomes observable are those from a regime where all resources are subject to market power mitigation procedures.

¹⁸ This paper's focus on CAISO and ISO-NE is not intended to suggest concern with the manner by which either implements its mitigation procedures.

incremental energy offers submitted by resources and resource reference levels calculated by the market monitors to estimate resource markups. The markup represents the extent to which a resource's real-time energy offer exceeded its reference level. Real-time markets were selected because real-time loads are more volatile and real-time price spikes are more frequent. In addition, some of the uncertainties inherent in measuring a resource's marginal cost are more acute when applied to real-time offers.¹⁹

3.2. ISO-NE

ISO-NE uses Conduct and Impact tests to implement market power mitigation. ISO-NE's mitigation rules depend on whether a resource is located in an area deemed to be constrained. All resources in Constrained Areas²⁰ are subject to the Conduct and Impact screens while only pivotal suppliers in General Areas are subject to them.²¹ Resources in Constrained Areas may not submit offers that exceed their reference levels by the lower of: \$25/MWh and 50 percent (*i.e.*, a 50 percent markup). Resources that are pivotal in General Areas may not submit offers that exceed their reference levels by the minimum of \$100/MWh and 300 percent of its reference level (*i.e.*, a 300 percent markup). Resources that are not located in a Constrained Area and are not pivotal in a transiently constrained General Area are not subject to Conduct and Impact mitigation and are instead subject to a system-wide cap of \$1,000/MWh. If an ISO-NE resource's markup exceeds the relevant Conduct threshold and the impact of that conduct on the clearing price for energy exceeds the pre-determined Impact threshold, that resource's offer is mitigated to its reference level.

3.2.1. Data and Methodology

During the calendar year 2013 study period, resources in ISO-NE were permitted to submit a single incremental energy offer in the day-ahead market that applied to all 24 hours of the following operating day. Offers or portions of offers that did not clear the day-ahead market could be re-offered into the real-time market during the re-offer period, which closed before the operating day began. Offers that cleared the day-ahead market

¹⁹ An examination of day-ahead incremental energy offers yielded similar results to the real-time results presented here.

²⁰ The definition of a Constrained Area in ISO-NE depends on whether the resource is offering supply into the real-time market or the day-ahead market. Constrained Areas in the real-time market are located on the import side of a binding constraint. Constrained Areas in the day-ahead market are defined as resource nodes with LMPs that exceed the Hub by more than \$25/MWh. *See* ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.2.2.

²¹ A resource is deemed to be pivotal if its output is necessary to satisfy load because transmission constraints restrict the availability of supply from other (non-affiliated) resources.

remained in effect throughout real-time. Resources were also permitted to submit self-schedules into the day-ahead market, which in most cases guarantees that the resource would be committed and generate an amount equal to at least its self-schedule quantity.²² As such, the real-time offers consist of a combination of self-schedules, cleared day-ahead offers, original day-ahead offers that did not clear the day-ahead market, and re-offers. During periods of extreme fuel price volatility, it is possible that offer prices were not reflective of the actual cost of production simply because actual fuel costs were realized after offers were submitted. To the extent a resource did not request a fuel price adjustment to its reference level calculation, this will tend to overstate markups during periods of extreme fuel price volatility.

The results that follow are based on calendar year 2013 data that ISO-NE provided pursuant to Order No. 760. The data includes resource offers and resource reference levels that were calculated by the market monitors. However, the data only includes a resource's mitigated offer (which was equal to its reference level). Given that mitigation was relatively rare in ISO-NE during the study period, staff does not expect that using mitigated offers will have a significant impact on the results.²³ Additionally, the data available do not indicate whether resources were subject to General Area mitigation, Constrained Area mitigation, or neither.

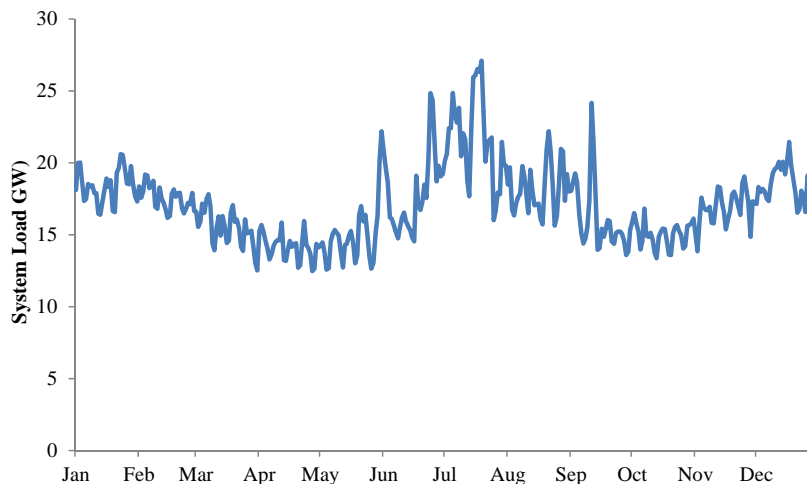
The analysis focused on real-time markups at different load levels because market conditions change with the level of demand. Given that short-run supply is fixed, low periods of demand are typically characterized by more competition than during high demand levels.²⁴ It is instructive to examine markups at different load levels because it gives some sense of how markups change with the level of competition. The hour ending 18:00 is when loads are typically at their highest in ISO-NE. ISO-NE real-time system loads for each day during the hour ending 18:00 are plotted in Figure 1.

²² Resources that self-schedule their capacity essentially self-commit and forego any uplift payments from the RTO or ISO associated with starting up and producing the self-scheduled MW.

²³ According to ISO-NE's Internal Market Monitor, resource energy offers were mitigated on a total of 129 occasions in 2013 in the day-ahead and real-time markets combined. See ISO New England Internal Market Monitor, *2013 Annual Markets Report*, at 30 (May 6, 2014), available at http://www.iso-ne.com/static-assets/documents/markets/mkt_anlys_rpts/annl_mkt_rpts/2013/2013_amr_final_050614.pdf.

²⁴ This is not always the case because supply can be tight relative to demand during periods of relatively low demand due to generator maintenance cycles. However, higher demand typically implies tighter market conditions.

Figure 1
ISO-NE system 2013 real-time load in the hour ending 18:00



Source: ISO-New England

ISO-NE loads in the hour ending 18:00 were highest in the summer months of July and August 2013, and lowest in the spring and fall periods. The peak load during the study period was 27,088 MW and the average load was 17,083 MW.

3.2.2. Markups

Resource markups measure the extent to which a resource's real-time energy offer exceeded its reference level and are defined as follows: $[\text{offer} - \text{reference level}] / \text{reference level}$.²⁵ For example, if a resource offers 10 MW at \$35/MWh and has a \$30/MWh reference level, its markup is 16.7 percent $((\$35 - \$30) / \$30)$. If a resource submitted a self-schedule or an offer less than or equal to its reference level, its markup was recorded as zero.²⁶ Markups were also capped at 300 percent in an effort to limit the impact that high markups bias the summary statistics.²⁷ While a resource's reference level may not exactly equal its marginal cost, the reference level should generally move in the same direction as a resource's actual marginal cost. If the reference level is too low, then the

²⁵ Separate components of block energy supply were treated as separate offers. It was only possible to calculate markups when ISO-NE provided a reference level estimate for the resource.

²⁶ 45.6 percent of the markups were coded to zero to reflect self-schedules.

²⁷ For example, if a resource offer had a markup of 340 percent, its markup was replaced with a 300 percent markup for purposes of this analysis. Of the sample, 2.3 percent of the markups were replaced with 300 percent because they exceeded 300 percent. Capping the markups at 300 percent does not change the results qualitatively but does increase the average markup and standard deviation.

markup in this analysis will be overstated, and if the reference level is too high, the markup will be understated.

Table 1 presents summary statistics for real-time markup in ISO-NE during the study period. The bottom panel of the table contains markup values at key points of the distribution, including its median and major quartiles. The average markup was 21.56 percent and the median markup was zero, which means the bottom 50 percent of resource offers involved a zero or negative markup.²⁸ Many of the zero markups are associated with self-schedules.

Table 1: ISO-NE markup summary statistics from submitted real-time offers

Mean	21.56%
Standard Deviation	55.42%
n. obs.	239,926
Quartiles and key deciles	
10%	0.00%
25%	0.00%
50% (median)	0.00%
75%	12.81%
90%	59.63%
100% (max)	300%

Source: 760 Database, January 1-December 31, 2013

The 75th percentile markup is 12.81 percent, which is lower than the mean markup, evidence that the distribution is skewed.

Several resource offers during the study period had markups that were well above both the General and Constrained Area thresholds.²⁹ Resources with such high markups typically include resources that fall into one of the following categories: resources with a Forward Reserve Requirement³⁰ that are instructed by ISO-NE to submit relatively high

²⁸ If resource offers with negative markups are not coded at zero and instead left unchanged, the mean markup equals 18.72 percent.

²⁹ In ISO-NE, the Unconstrained Area Conduct threshold is a resource offer that exceeds its reference level by the lower of \$100/MWh or 300 percent and the Constrained Area Conduct threshold is a resource offer that exceeds its reference level by the lower of \$25/MWh or 50 percent.

³⁰ Forward Reserve Resources are resources that have received a forward payment to provide reserves. These resources are instructed to submit offers into the real-time energy market “at or above the Forward Threshold Reserve Price” which “should provide a high probability that the generating resource will not be producing Energy, thus allowing the Resource to supply the delivered reserve megawatts when needed.” ISO-NE, Manual 36 for Forward Reserve, Revision 18, § 4.1. The Forward Reserve Threshold price is updated daily based on an assumed

energy offers that indicate they are available but reduce the probability that the resource will clear the energy market; resources that have higher short-run marginal costs than the market monitor's reference level estimate; and resources that simply submit high markups. Recognizing there may be legitimate reasons resources bid above marginal cost, the existence of markups in excess of 60 percent (the 90th percentile) leaves open the possibility that competitive pressure is not disciplining such offers, though further analysis would be needed to reach any conclusion. ISO-NE's external Market Monitor examined energy offers and found little evidence of economic withholding in 2013.³¹

The statistics in Table 1 represent markups of *all* incremental offers submitted into the real-time market for the hour ending 18:00 – not just *cleared* offers. Self-schedules and resources that submit low offers are virtually guaranteed to clear and thus constitute a larger proportion of cleared offers than they do submitted offers. As a result, the markups inherent in cleared offers are much lower than the markups of submitted offers. In its 2013 State of the Market report, ISO-NE's internal market monitor found that markups contained in the offer of the marginal resource contributed an average of \$6.30/MWh to the cleared energy price in 2013. The average real-time hub price was \$56.06/MWh, which suggests that the average resource offer on the margin had a markup that was well below the average markup of all submitted offers in Table 1 (21.56 percent).³²

One would expect that markups depend, at least in part, on where a resource falls in the supply mix. Baseload resources that are operating in all hours are likely to either self-schedule or bid at or below their reference cost to avoid being cycled during low load periods. Energy limited resources and resources that have a forward reserve obligation may bid well above their reference cost.

To better understand how the dynamics of resource markups change in relation to where the resource is in the supply stack, the loads for the hour ending 18:00 on each day were separated into ten groups, or load deciles groups (L-0 through L-9),³³ and energy offers

heat rate and the natural gas price. For example, the daily Forward Reserve Threshold was \$49.99/MWh on September 9, 2014.

³¹ Potomac Economics, *2013 Assessment of the ISO New England Electricity Markets*, at 183 (June 2014) available at http://www.iso-ne.com/static-assets/documents/markets/mktmonmit/rpts/ind_mkt_advstr/ison_e_2013_emm_report_final_6_25_2014.pdf.

³² ISO New England Internal Market Monitor, *2013 Annual Markets Report*, at 58-59 (May 6, 2014), available at http://www.iso-ne.com/static-assets/documents/markets/mkt_anlys_rpts/annl_mkt_rpts/2013/2013_amr_final_050614.pdf.

³³ Decile L-0 represents the lowest ten percent of the hour ending 18:00 loads, and L-9 represents the highest ten percent of the hour ending 18:00 loads.

that made up the real-time supply stack were separated into ten offer deciles (O-0 through O-9).³⁴

Table 2 summarizes the mean markup by load and offer decile. The results are also graphed in Figure 2. Focusing on offer decile 5 (O-5), and reading down the O-5 column of Table 2 gives some indication of how bids in the fifth offer decile changed due to load. For example, in the lowest ten percent of load hours, the mean markup in the O-5 offer decile was 22.8 percent, as compared to 12.7 percent in the top ten percent of load hours (L-9), suggesting that resources in this part of the supply stack may submit lower offers relative to their reference level (which implies a lower markup) in order to increase the likelihood of being dispatched. Viewed across the rows, the markups on days with loads in the bottom ten percent of load during the study period (L-0) show how the average markup changed across the supply stack.

From Figure 2, it can be seen, not surprisingly, that the resource offers with the lowest offers also tended to have the lowest markups. At all demand levels, the bottom 20 percent of the supply stack (O-0 and O-1) consisted of “price takers” that are either self-scheduling or submitting offers at or below reference cost. Recall from the sample summary statistics in Table 1 that the bottom 50 percent of markups are equal to zero. The figures in Table 2 present the mean (rather than median) markups by load and offer deciles, but they also indicate that the bottom portion of the supply curve submits offers with zero or negative markups. More price sensitive behavior occurs at other points of the supply stack. Bidding behavior by resources at the 40th and higher percentiles of the supply stack does not appear to be substantially constrained by the mitigation rules regardless of the load level.

The plots in Figure 2 show that markups for the bottom 40 percent of the supply stack in ISO-NE’s real-time market are relatively stable across load levels. It is interesting to note that the middle of the supply stack has lower mean markups at the highest load levels as compared to lower load levels (O-4 and O-5, respectively at 7.9 and 12.7 for L-9 as compared to 15.7 and 22.1 for L-8). At the top of the supply stack (O-9), the plots show that the markup tends to remain fairly stable or increase as load levels increase. Finally, mean markups tend to fall in all offer deciles during the highest load decile (L-9).

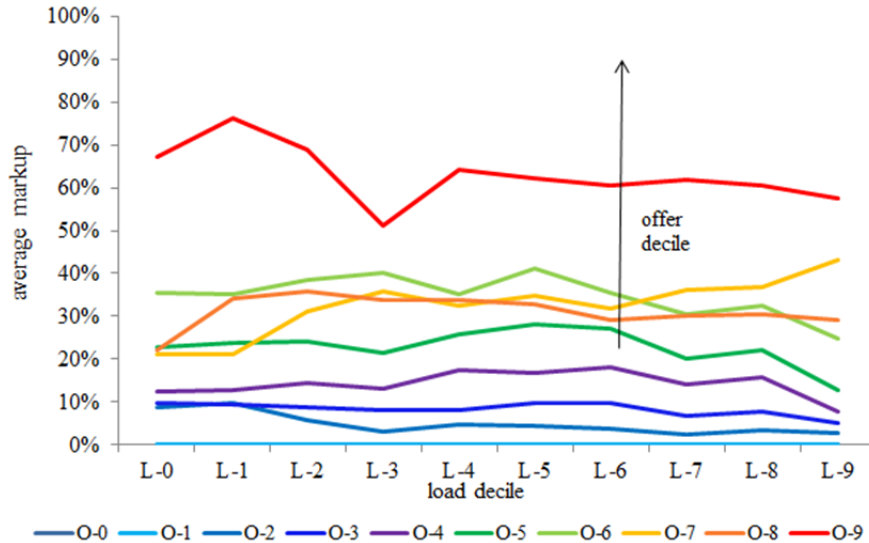
³⁴ The prices were first calculated at the bid-step level for every real-time “market-day” and then sorted into deciles and assigned a decile value of O-0 through O-9. Markups were calculated independently for each portion of a resource’s offer given that marginal costs and offers can vary by output level.

Table 2: ISO-NE mean markups from submitted real-time offers by load and offer deciles

load decile	offer decile									
	O-0	O-1	O-2	O-3	O-4	O-5	O-6	O-7	O-8	O-9
L-0	0.0%	0.0%	8.7%	9.9%	12.5%	22.8%	35.5%	21.3%	22.2%	67.1%
L-1	0.0	0.0	9.9	9.5	12.7	23.9	35.1	21.2	34.1	76.2
L-2	0.0	0.0	5.9	8.7	14.3	24.1	38.5	31.0	35.8	68.9
L-3	0.0	0.0	3.0	8.1	13.0	21.4	40.3	35.7	33.7	51.1
L-4	0.0	0.0	4.8	8.2	17.5	25.9	35.1	32.4	33.9	64.1
L-5	0.0	0.0	4.5	9.9	16.9	28.2	41.3	34.8	32.9	62.3
L-6	0.0	0.0	3.9	9.7	18.1	27.3	35.6	31.8	29.0	60.5
L-7	0.0	0.0	2.3	6.9	14.0	20.0	30.5	36.3	30.1	61.7
L-8	0.0	0.0	3.6	7.9	15.7	22.1	32.6	36.9	30.4	60.6
L-9	0.0	0.0	2.8	5.2	7.9	12.7	24.8	43.2	29.1	57.6

Source: 760 Database, January 1-December 31, 2013

Figure 2
ISO-NE real-time markups by load and offer deciles



Because Conduct and Impact screens are more likely to be implemented during hours with high loads when transmission constraints bind (roughly L-7 through L-9), lower markups could be expected during these load ranges if the mitigation measures limit energy offers in a systematic way. However, the data do not appear to support this. Markups are fairly stable along the supply stack (from O-0 to O-8). Mean markups tend

to fall between load deciles L-8 and L-9, but mean offers in L-9 still involve positive markups that increase with the offer price.

It warrants mention that some of the mean markups in offer decile O-9 are substantial, mostly in excess of 60 percent. Recall that only resources located in Constrained Areas and pivotal suppliers in General Areas during constrained periods are potentially subject to market power mitigation in ISO-NE. Resources located in areas with sufficient competition are not subject to mitigation and are only subject to the system-wide offer cap of \$1,000/MWh. Resources that offer in the top ten percent of the supply stack rarely clear the real-time market because there is typically more than enough capacity in the supply stack to serve load. Given that some resources in the O-9 offer decile submit offers with relatively high markups, they are seemingly unconstrained in their bidding behavior. There may be legitimate reasons to bid above marginal cost. For instance, energy limited resources may bid above marginal cost to preserve limited operating hours. Nonetheless, offers substantially above marginal cost could suggest the lack of competitive pressure to discipline offers.

Some of the dynamics of mean markups apparent in Table 2 seem to suggest that bidding behavior is dependent on when a resource is close to being marginal. For instance, as noted above, resource offers in the 60th and 70th percentile of the supply stack (O-5 and O-6) have lower markups as load reaches the 80th and 90th percentiles (L-8 and L-9). This is consistent with the suggestion that such resources need to bid more competitively to ensure that they are able to operate as load increases to the point that these resources may be close to marginal. Conversely, resources in the 80th percentile (O-7) have higher mean markups as load levels increase. In order to explore this perspective on bidding behavior further, the markups were also examined by “offer group” where the daily offer curve is divided into groups by their proximity to the quantity demanded for that hour.

When resources’ real-time offers are finalized in ISO-NE’s re-offer period, real-time demand is unknown. Therefore, a range of resources along the supply curve could potentially be the marginal unit, depending on where real-time demand intersects the supply curve. In a competitive market, resources with costs in the region of the supply curve that is likely to intersect with demand need to bid at or near their marginal cost to be sure they are called on to operate.³⁵ Resources with costs that typically fall clearly above the intersection of supply and demand - comprising the highest cost resources on the supply curve - are not typically adversely affected by offers higher than their marginal

³⁵ In a market where some resources have the potential to exercise market power and are part of a larger portfolio of resources, they may be able to increase corporate profits by bidding above marginal costs for some resources.

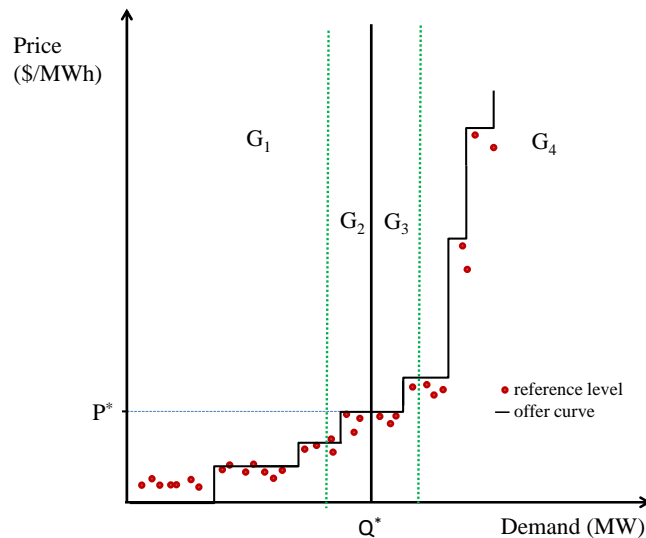
cost because an offer at marginal cost is unlikely to clear in the first place. Finally, the portion of the supply curve to the left of the intersection of supply and demand always contains resources that either self-schedule or submit offers that are virtually guaranteed to clear.

In order to understand how bidding behavior changes depending on whether a resource is clearly inframarginal, close to marginal, or clearly not economic, offers have been grouped into four categories. The first step was to make a market-wide supply curve for real-time offers in the hour ending 18:00 for each day in the sample period by sorting the offers in ascending order of price. As displayed in Figure 3, the next step was to separate the offers into four offer groups based on their proximity to the quantity demanded in a given hour (green vertical line).³⁶ The offer groups are defined as follows: G1 - offers that fell on the portion of the supply stack below 95 percent of the quantity demanded (Q^*); G2 - offers that fell between 95 and 100 percent of the quantity demanded; G3 - offers that fell between 100 and 105 percent of the quantity demanded; and G4 - offers above 105 percent of the quantity demanded.³⁷ This grouping was performed for every day in the sample period.

³⁶ Real-time imports were subtracted from ISO-NE's real-time load in the hour ending 18:00 to estimate the quantity demanded from internal ISO-NE resources.

³⁷ Staff performed a sensitivity analysis of the 5 percent threshold to determine offer groups and found that using 2.5, 7.5, and ten percent thresholds yields similar results.

Figure 3
Offer Grouping Example



By design, “potentially marginal” resources would fall within group G2 or G3. As the focus of this analysis is on whether market power mitigation is affecting offers in ISO-NE *at the margin*, the focus is on offers in G2 and G3. If the resource offers in G2 and G3 are able to bid above marginal cost, but in a manner that appears to demonstrate similar competitive behavior, then there would be evidence consistent with the suggestion that competitive pressure is appropriately disciplining offers at or near the margin while market power mitigation provisions provide flexibility to allow resource offers to reflect marginal cost.

Table 3 and Figure 4 present the mean markup implicit in offers submitted into the real-time market by offer group. The markups of resources in groups G2 and G3 are similar, which suggests that ISO-NE’s current market power mitigation provisions affect potentially marginal resources in a similar way. Furthermore, average markup statistics of the potentially marginal resources in G2 and G3 are significantly below the 50 percent margin that forms one element of the Constrained Area threshold at all load levels.

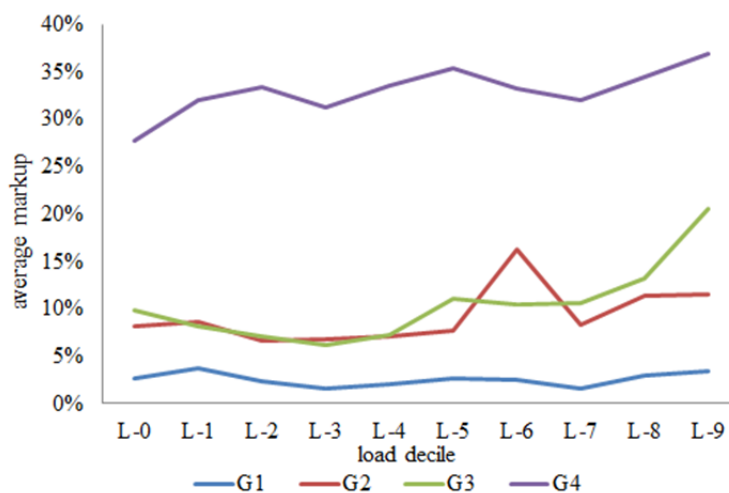
Table 3: ISO-NE average submitted markup by offer group (%)

load decile	offer group			
	G1	G2	G3	G4
L-0	2.7%	8.2%	9.8	27.7%
L-1	3.7	8.6	8.2	32.0
L-2	2.4	6.7	7.0	33.4
L-3	1.6	6.8	6.2	31.2
L-4	2.1	7.1	7.3	33.5
L-5	2.7	7.7	11.1	35.4
L-6	2.5	16.3	10.4	33.2
L-7	1.6	8.3	10.7	32.0
L-8	2.9	11.3	13.2	34.5
L-9	3.4	11.6	20.5	36.9

Source: 760 Database, January 1-December 31, 2013

As such, the markups by offer group do not indicate that market power mitigation procedures have systematically limited offers below marginal cost. With the exception of load deciles L-6 and L-9, markups in offer groups G2 and G3 are similar, as shown in Figure 4 below. The markups of potentially marginal resources also increase with load.

Figure 4
ISO –NE Average markup by offer group and load decile



The within-group variation in the offer groups at each load decile is significant. Table 4 below presents the median and 75th percentile markups to better characterize the markups in the potentially marginal groups.

Table 4: ISO-NE potentially marginal resource markup summary statistics

load decile	G2			G3		
	mean	median	75 th %	mean	median	75 th %
L-0	8.2%	0.0%	8.3%	9.8%	0.0%	9.8%
L-1	8.6	0.0	8.5	8.2	0.0	12.3
L-2	6.7	0.0	6.3	7.0	0.0	7.8
L-3	6.8	0.0	5.4	6.2	0.0	5.7
L-4	7.1	0.0	5.0	7.3	0.0	7.4
L-5	7.7	0.0	5.3	11.1	0.0	10.0
L-6	16.3	0.0	13.1	10.4	0.0	8.1
L-7	8.3	0.0	4.3	10.7	0.0	8.4
L-8	11.3	0.0	6.3	13.2	0.0	12.2
L-9	11.6	0.0	7.8	20.5	0.9	18.2

Source: 760 Database, January 1-December 31, 2013

The mean markup for resources in G3 at high load levels approach the level at which it may be appropriate to consider whether the mitigation rules are working as designed to encourage competitive bidding. That said, the median markup in load decile L-9 for both G2 and G3 is below 1 percent. This suggests that at least 50 percent of resource offers have markups of zero or less than one percent. However, markups increase between the median and 75th percentile, to 7.8 and 18.2% in G2 and G3, respectively. The mean markup for L-9 is higher than the 75th values for both G2 and G3, a further indication of the skew in the data characterized by the majority of resources having zero or no markup and a relatively small share of resources with higher markups. Thus, to the extent that the mitigation rules may not be resulting in competitive bidding for all resources at high load levels, the number of resources that are bidding substantially above marginal cost appears to be relatively small.

3.2.3. Offer Scores

Staff developed an offer score to better understand how resources use the flexibility that mitigation rules provide. The offer score estimates the difference, or “headroom,” between a resource’s offer price and the General Area Conduct thresholds for energy offers. Because data available for this analysis do not indicate which Conduct and

Impact thresholds resource offers are subject to, the following analysis assumed that all resources were subject to the General Area Conduct threshold, which essentially limits resources to the minimum of a \$100/MWh or a 300 percent markup.

The headroom “score” was calculated for each offer segment submitted in the real-time market during the study period. The score for resource j 's offer on day t is defined as follows:

$$\text{score}_{jt} = [\text{offer}_{jt} - \text{reference price}_{jt}] / [\text{General Area threshold}_{jt} - \text{reference price}_{jt}]$$

The score is restricted to a value between zero and one. If the General Area Conduct threshold was systematically restricting bids (*e.g.*, because reference levels were measured poorly or with a systematic low bias), the offer scores would approach one. Offers with scores above one do not contribute to the analysis because they suggest that the resources were *not* restrained to General Area Conduct threshold. Instead, the resource is likely subject to the system-wide ISO-NE offer cap of \$1,000/MWh.³⁸ These scores are an imperfect measure because some resources in ISO-NE are subject to the more stringent Constrained Area threshold, and their scores as calculated here are biased downwards.

Table 5 presents summary statistics of the real-time offer scores in ISO-NE during the study period. Similar to the markup, examining the mean or standard deviation in isolation does not fully describe the score's characteristics. The mean score is 0.139 (*i.e.*, resources use just about 14 percent of the headroom available to them under the General Area Conduct threshold), which implies generous headroom in the average offer and that the General Threshold cap is not constraining average real-time energy offers.³⁹ As before, restricting attention to the sample mean score can be misleading. Table 5 also reflects that a significant portion (at least 50 percent) of resources bid at or below their respective reference levels. The 90th percentile score is 0.545, indicating significant headroom that the resource could have included in its energy offer without triggering the General Area Conduct threshold. It is not surprising that the General Area Conduct threshold did not constrain markups because it enables a resource's offer to exceed its reference level by the lower of 300 percent and \$100/MWh.

³⁸ Offers that fail the General Area Conduct Threshold are not mitigated if they pass the Impact test, meaning that the offer did not increase the real-time energy price at the resource's node by 300 percent or \$100/MWh, whichever is lower. Further, only pivotal suppliers in the General Area are subject to the Conduct and Impact tests.

³⁹ If the Constrained Area general thresholds are used to compute the scores, the mean score is 0.273, which is higher than the score implied by the General Area threshold. It still indicates that, on average, even when subject to the more stringent mitigation thresholds, resources could have submitted higher offers without being mitigated.

**Table 5: ISO-NE real-time score
summary statistics**

Mean	0.139
Standard Deviation	0.277
n. obs.	239,926
Quartiles and key deciles	
10%	0.000
25%	0.000
50% (median)	0.000
75%	0.127
90%	0.545
100% (max)	1.0000

Source: 760 Database, January 1- December 31, 2013

Approximately 6 percent of bids have a score of one. However, many of the scores equal to one involve offers that were well above the General Area Conduct threshold, which suggests that the resource may not have been subject to any energy offer mitigation.⁴⁰

Table 6 presents the mean scores of ISO-NE resource bids for the hour ending 18:00 by both offer and load decile. Figure 5 plots the mean scores presented in Table 6. The score results across offer and load deciles are similar to the markup results.

⁴⁰ The offers with a score equal to one almost always involved offers well in excess of the General Area threshold. The average amount by which the offer exceeded the resource-specific General Area threshold was \$139/MWh.

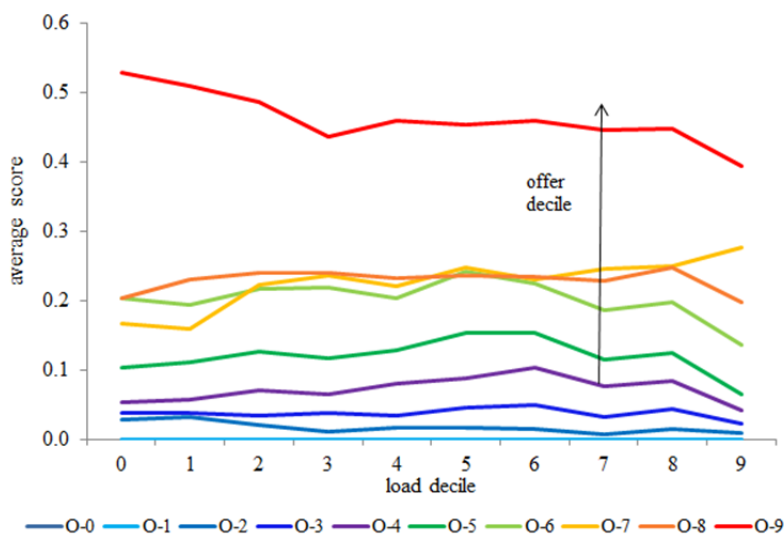
Table 6: ISO-NE average real-time score

load decile	offer decile									
	O-0	O-1	O-2	O-3	O-4	O-5	O-6	O-7	O-8	O-9
L-0	0.000	0.000	0.029	0.037	0.053	0.103	0.204	0.167	0.204	0.528
L-1	0.000	0.000	0.033	0.037	0.057	0.111	0.194	0.160	0.231	0.509
L-2	0.000	0.000	0.020	0.035	0.070	0.126	0.217	0.222	0.240	0.487
L-3	0.000	0.000	0.011	0.038	0.065	0.116	0.219	0.237	0.241	0.437
L-4	0.000	0.000	0.017	0.034	0.081	0.129	0.204	0.220	0.233	0.459
L-5	0.000	0.000	0.016	0.045	0.088	0.153	0.242	0.248	0.236	0.454
L-6	0.000	0.000	0.014	0.050	0.104	0.154	0.225	0.230	0.235	0.460
L-7	0.000	0.000	0.008	0.032	0.076	0.114	0.186	0.246	0.228	0.447
L-8	0.000	0.000	0.014	0.043	0.085	0.125	0.197	0.250	0.247	0.449
L-9	0.000	0.000	0.010	0.023	0.042	0.065	0.137	0.277	0.198	0.395

Source: 760 Database, January 1-December 31, 2013

Figure 5

ISO-NE Scores by load and offer decile



The average scores in offer groups G2 and G3 also exhibit similar characteristics. Table 7 presents the scores by offer group and Figure 6 plots them. As with the markups, the scores of resource offers in G2 and G3 are very similar. Given the significant headroom implied by the scores, these results suggest that General Area Conduct thresholds do not

have a systematic or significant effect on resources that are potentially marginal. In addition, even resource offers that were clearly not economic (group G4) had substantial headroom on average, again suggesting that the mitigation rules did not artificially restrict offers.

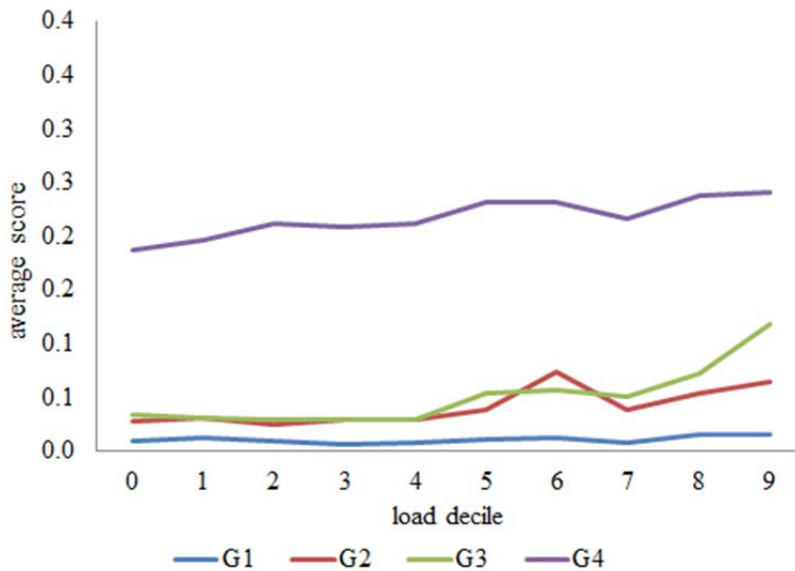
Table 7: ISO-NE RT average score by offer group

load decile	offer group			
	G1	G2	G3	G4
L-0	0.009	0.028	0.034	0.188
L-1	0.013	0.031	0.031	0.196
L-2	0.009	0.025	0.029	0.212
L-3	0.007	0.029	0.029	0.209
L-4	0.008	0.030	0.029	0.211
L-5	0.011	0.038	0.053	0.231
L-6	0.012	0.074	0.056	0.231
L-7	0.007	0.039	0.050	0.215
L-8	0.015	0.054	0.072	0.237
L-9	0.015	0.064	0.118	0.241

Source: Order 760 Database, January 1-December 31, 2013

Figure 6

ISO –NE average score by offer group and load decile



Similar to the markups, the scores in ISO-NE also increase with the loads, particularly in the highest ten percent of loads. Table 8 presents the mean, median, and 75th percentile scores for the potentially marginal offer groups. The offer group scores, like the

markups, exhibit a high within-group variance. The median score of the potentially marginal resource is zero in all load deciles except the 90th percentile (L-9).

Table 8: ISO-NE potentially marginal resource score summary statistics

load decile	G2			G3		
	mean	median	75 th %	mean	median	75 th %
L-0	0.028	0.000	0.028	0.034	0.000	0.034
L-1	0.031	0.000	0.030	0.031	0.000	0.045
L-2	0.025	0.000	0.022	0.029	0.000	0.029
L-3	0.029	0.000	0.022	0.029	0.000	0.021
L-4	0.030	0.000	0.018	0.029	0.000	0.028
L-5	0.038	0.000	0.021	0.053	0.000	0.046
L-6	0.074	0.000	0.066	0.056	0.000	0.041
L-7	0.039	0.000	0.016	0.050	0.000	0.038
L-8	0.054	0.000	0.028	0.072	0.000	0.062
L-9	0.064	0.000	0.043	0.118	0.005	0.120

Source: Order 760 Database, January 1-December 31, 2013

3.3. CAISO

CAISO employs Structural mitigation. CAISO’s internal market monitor, the Department of Market Monitoring, uses a dynamic competitive path assessment to determine whether constraints are competitive or non-competitive. In CAISO, resources that can relieve non-competitive constraints are presumed to potentially possess market power and are consequently subject to automatic Local Market Power Mitigation. CAISO mitigates these resource offers if they exceed the higher of the resource’s reference level and the internal market monitor’s estimated competitive proxy price for the resource’s node.⁴¹ Resources that are mitigated have their bids replaced by the higher of their reference level and the competitive proxy price. During the study period, resources in CAISO were permitted to update their offers between day-ahead and real-time and throughout the operating day. Real-time offers were due 75 minutes prior to the operating hour.

⁴¹ See Appendix for details about CAISO’s mitigation procedures.

3.3.1. Data and Methodology

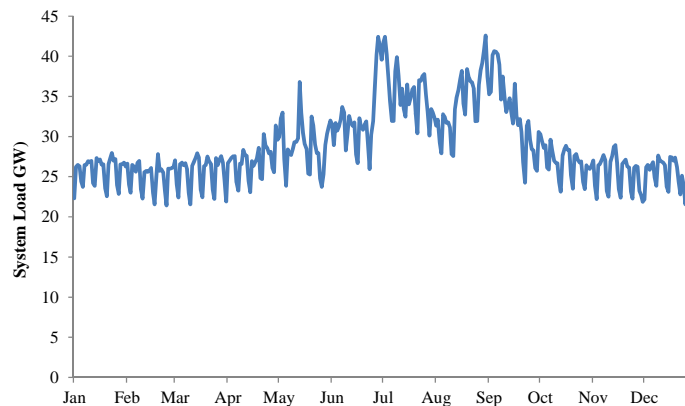
Unlike the analysis above for ISO-NE, this analysis focuses exclusively on markups as they vary across load levels and across supply curve position. This was necessary because CAISO does not use the Conduct and Impact structure from which to compute offer scores. In addition, CAISO is frequently congested, preventing development of a market supply curve and the ability to reliably categorize resource offers into offer groups.⁴² The following analysis of markup in CAISO energy offers mirrors the analysis of markups in ISO-NE.

Reference levels in CAISO are based on marginal cost estimates plus a ten percent adder. Accordingly, when interpreting the results below, the reader should keep in mind that the reference level estimate is designed to be ten percent higher than a resource's marginal cost. Because imports can be a significant resource to CAISO, import offers were used to place offers in the offer deciles. However, imports were excluded from the markup summary statistics because of a lack of access to reference levels for imports.

3.3.2. Markups

Staff examined real-time offers in the hour ending 14:00 during calendar year 2013 because the hour ending 14:00 is frequently the daily peak hour of the day. Figure 7 plots CAISO's system load in the hour ending 14:00 during the sample period, which was 28,797 MW on average and 42,591 MW at its peak.

Figure 7
CAISO system 2013 real-time load in the hour ending 14:00



Source: Ventyx Velocity Suite, 2014

⁴² If one were to identify the marginal resource based on the intersection of quantity demanded and an unconstrained supply curve, the marginal resource would typically be in offer decile O-4 for low load levels and offer decile O-5 for higher load levels.

Markups were calculated for each offer based on the internal market monitor’s reference levels. The mean real-time markup in CAISO during the study period was 25.09 percent, with a standard deviation of approximately 64 percent. As in the ISO-NE analysis, self-schedules and negative markups were recorded as zero and markups were capped at 300 percent.⁴³ Table 9 presents key summary statistics of markups. The CAISO markup statistics are based on the set of mitigated offers that were used to clear the real-time market.⁴⁴ Similar to ISO-NE, the bottom 50 percent of markups in CAISO were at or below zero.⁴⁵ This indicates that a significant amount of resources in CAISO self-schedule or submit energy offers below their reference levels.

Table 9: CAISO markup summary statistics from submitted real-time offers

Mean	25.09%
Standard Deviation	64.30%
n. obs.	368,964
Quartiles and key deciles	
10%	0.00%
25%	0.00%
50% (median)	0.00%
75%	9.44%
90%	77.24%
100% (max)	300.00%

Source: 760 Database, January 1-December 31, 2013 for hour ending 14:00.

The markups summarized in Table 9 reflect all offers submitted into CAISO’s real-time market during the hour ending 14:00, many of which did not clear. The markups inherent in real-time cleared offers - the offers that ultimately affect real-time prices - were much lower during the sample period. CAISO’s internal market monitor estimated that the marginal resource offer (i.e., the offer that established the clearing price for energy) in 2013 contained a negative 3.8 percent markup on average relative to a competitive baseline.⁴⁶ While this figure is not directly comparable to the hour ending 14:00 markups

⁴³ Of the total sample, 42.4 percent of markups were coded at zero to correct for negative offers, self-schedules, or regulatory must-take schedules and 3.2 percent were coded at 300 percent.

⁴⁴ Given the infrequency of mitigated markups relative to the sample as a whole, the sample mean of markups that were not mitigated is quite similar at 25.21 percent.

⁴⁵ If negative markups during the study period were not coded as zero the mean markup of submitted offers falls from 25.09 to 11.55 percent. The CAISO offers contained more negative markups relative to reference levels than the ISO-NE offers because the CAISO reference level includes a ten percent markup.

⁴⁶ CAISO Department of Market Monitoring, *2013 Annual Report on Market Issues & Performance*, at 65-66 (Apr. 2014), available at <http://www.caiso.com/Documents/2013AnnualReport-MarketIssue-Performance.pdf>.

in Table 9, it suggests that resources that submit offers with high markups typically do not clear the market and thus do not impact the market clearing price, except to the extent a resource would have been economic but for bidding above its marginal cost. The markups implicit in cleared offers are much lower than the markups in submitted offers.

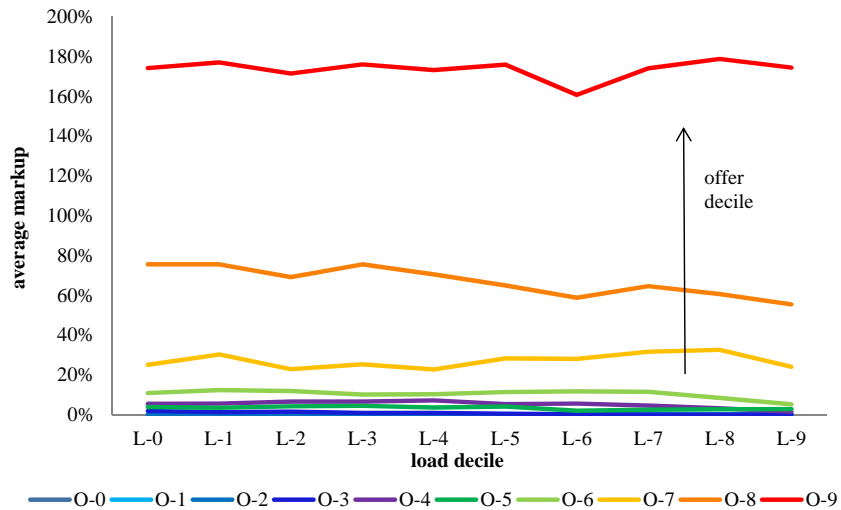
Table 10 presents the average markup in CAISO during the sample period by both load and offer decile. The average markups are plotted in Figure 8. The markups are fairly stable across the load deciles, suggesting that average markups are not highly sensitive to loads. Like ISO-NE, the resources concentrated at the top of the supply curve submitted energy offers with significant markups. Recall that resources that are not capable of relieving a non-competitive constraint in CAISO are free to bid up to the \$1,000/MWh system-wide offer cap. Resource offers below the 70th percentile of offers tend to have very modest markups. This may be in part because the reference cost includes a ten percent adder. As long as the reference cost, including the ten percent adder, is a reasonable estimate of marginal cost, low markups are consistent with competitive pressure disciplining offers and are not necessarily indicative of overly restrictive mitigation rules.

Table 10: CAISO markups from submitted real-time offers by load and offer deciles

load decile	offer decile									
	O-0	O-1	O-2	O-3	O-4	O-5	O-6	O-7	O-8	O-9
L-0	0.0%	0.0%	0.0%	1.9%	5.4%	3.8%	10.8%	25.1%	75.4%	174.1%
L-1	0.0	0.0	0.0	1.2	5.6	3.4	12.2	30.2	75.4	177.0
L-2	0.0	0.0	0.0	1.4	6.5	4.1	11.8	22.7	69.0	171.3
L-3	0.0	0.0	0.0	0.8	6.5	4.4	10.1	25.2	75.5	175.9
L-4	0.0	0.0	0.0	0.8	7.1	3.5	10.1	22.7	70.5	173.1
L-5	0.0	0.0	0.0	0.4	5.2	4.0	11.4	28.3	64.9	175.9
L-6	0.0	0.0	0.0	0.2	5.4	2.0	11.6	27.9	58.7	160.6
L-7	0.0	0.0	0.0	0.0	4.5	2.5	11.4	31.5	64.4	173.9
L-8	0.0	0.0	0.0	0.0	3.2	2.6	8.3	32.5	60.6	178.7
L-9	0.0	0.0	0.0	0.0	1.5	2.7	5.2	24.1	55.4	174.3

Source: 760 Database, January 1-December 31, 2013 for hour ending 14:00.

Figure 8
Average markups by load and offer deciles



3.4. Conclusion

This paper employed an empirical analysis in two ISOs that use different approaches to mitigation in an attempt to ascertain whether mitigation is affecting price formation. An analysis of incremental energy supply offers shows that in both ISO-NE and CAISO:

- More than half of all resource offers have no markup above reference levels. This is in part because a significant percentage of resources submit self-schedules or negative offers.
- Markups in most portions of the supply curve tend to stay relatively constant as load increases.
- Resource offers in the portion of the supply curve that includes the marginal resource (ignoring transmission constraints) tend to have relatively low markups relative to reference levels.
 - In ISO-NE, resources that are just above or just below the intersection of supply and real-time demand have a mean markup of between 7 and 13 percent at almost all load levels.
 - The median markup of such resources was zero for virtually all load levels.
 - The 75th percentile markup for such resources was between 5 and ten percent for most load levels.

- In CAISO, relevant resource offers have a mean markup between 2 percent and 7 percent relative to reference levels that include a ten percent adder.
- The markups of the highest ten percent of offers are substantially more than marginal cost (roughly 60 percent in ISO-NE and 177 percent in CAISO). In addition, the mean markup of resources in the most expensive part of the supply curve is also substantially greater than marginal cost.

The observation that offers are concentrated at levels very close to marginal cost is consistent with either the suggestion that market forces are putting competitive pressure on resource offers or that a resource is inclined to offer close to its reference level to avoid mitigation. The observation that at least some offers exceed marginal costs as represented by the reference levels could be viewed as evidence that the mitigation rules provide some flexibility to account for inaccurate marginal cost estimates. Alternatively, recognizing there may be legitimate reasons resources bid above marginal cost, offers substantially above marginal cost could suggest the lack of competitive pressure to discipline offers.

The conference scheduled for October 28, 2014 will provide an opportunity for the Commission staff to learn the views of market monitors, market participants, and RTOs and ISOs on these observations and other issues associated with the mitigation rules.

Appendix

Appendix: Tariff Review of Energy Offer Mitigation Provisions

The following is a summary of the market power mitigation provisions that govern incremental energy offers submitted into the day-ahead and real-time markets for certain RTOs and ISOs. These provisions are designed to identify and mitigate economic withholding, whereby a resource attempts to increase its profits by raising its incremental energy offer above the competitive level. The RTOs and ISOs have separate market mitigation provisions for resources that are committed out of market, but these provisions are beyond the scope of this paper and not summarized below.

A.1 CAISO

Markets/products Subject to Mitigation

- Energy
- Ancillary services

Monitoring Structure

- Internal: Department of Market Monitoring
- Market Advisor: Market Surveillance Committee

Mitigation Summary

CAISO's market monitoring is conducted by the Department of Market Monitoring, the internal market monitor. The Market Surveillance Committee serves as an external advisor to the CAISO's Chief Executive Officer and Governing Board.⁴⁷ CAISO executes automated local market power mitigation procedures in the day-ahead market, the Hour-Ahead Scheduling Process, and the real-time market.⁴⁸ Under CAISO's mitigation procedures, only resources that affect constraints deemed non-competitive are potentially subject to mitigation. Local market power mitigation uses a competitive path assessment to determine whether constraints on the system are competitive or non-competitive. Constraints that require three jointly pivotal suppliers to relieve them are deemed to fail the Three Pivotal Supplier test and are consequently deemed non-competitive.⁴⁹ Any resource that is dispatched to relieve a non-competitive constraint is

⁴⁷ CAISO Tariff, Att. O, § 1.

⁴⁸ CAISO completed implementation of its local market power mitigation procedures in April 2012 in the day-ahead market and in May 2013 for the Hour-Ahead Scheduling Process and real-time market.

⁴⁹ CAISO Department of Market Monitoring, *2013 Annual Report on Market Issues & Performance*, at 157 (Apr. 2014), available at <http://www.caiso.com/Documents/2013AnnualReport-MarketIssue-Performance.pdf>.

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subject to mitigation. Such a resource is mitigated if its offer would increase the price at the constraint above a competitive proxy price calculated by the market monitor. The competitive proxy price estimates what the price would be in the absence of the non-competitive constraint.

Resources that are mitigated have their offers replaced with the higher of their reference level (referred to as a default energy bid in CAISO), or a competitive proxy price. The internal market monitor explained in a 2013 third quarter report that resource offers were more likely to be mitigated to a competitive proxy price than their reference levels.⁵⁰ CAISO also maintains a system-wide \$1,000/MWh offer cap.

The local market power mitigation process is performed in a pre-market mitigation run and the market (day-ahead or real-time market) is cleared on the set of bids that have been mitigated (where appropriate). While virtual bids and bids from demand response resources are monitored, they are not currently subject to automated local market power mitigation.⁵¹

Calculation of Reference Levels

CAISO refers to reference levels as default energy bids. A resource can request that the CAISO use one of the following three options to calculate its “default bid”:⁵²

1. Variable cost option: incremental costs are calculated based on the following formula: fuel costs + greenhouse gas allowance costs + variable operation and maintenance costs. The reference level is equal to 1.1 times incremental costs (i.e., incremental costs plus a ten percent adder). A Bid Adder is included for frequently mitigated units, if applicable.⁵³
2. Negotiated Rates option: a resource submits a proposed default bid with documentation that is either approved or rejected by the CAISO. If rejected, and if good faith negotiations are not successful, the market participant can make a filing with the Commission.

⁵⁰ CAISO Department of Market Monitoring, *Q3 2013 Report on Market Issues and Performance*, at 72 (Nov. 14, 2013), available at http://www.caiso.com/Documents/2013ThirdQuarterReport-MarketIssues_Performance-Nov2013.pdf.

⁵¹ CAISO Tariff, § 31.2.

⁵² CAISO Tariff, § 39.7.1.

⁵³ A Bid Adder is available for units that were mitigated in 80 percent of hours where they offered energy during the past 12 months. Bid Adders are either negotiated with the CAISO or set at a default level of \$24/MWh. CAISO Tariff, §§ 39.8.1-38.8.3.

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3. LMP option: weighted average of the lowest quartile of LMPs in the relevant market (i.e., day-ahead or real-time) at the resource's node during hours when the resource was dispatched in the last 90 days. Weights are based on the MWh the resource would have been dispatched under its Default Energy Bid curve.

When natural gas-fueled units use the variable cost option, CAISO updates reference levels daily through the use of at least two publically available natural gas price indices. Non-natural gas resources must submit an average cost curve to the CAISO with up to 11 operating points. A resource may contact the internal market monitor and request changes if it believes its calculated reference levels do not reflect its actual incremental operating costs.

Market Monitor Comments about Mitigation Practices

In its 2013 market report, CAISO's internal market monitor, the Department of Market Monitoring, explained that completing its transition to the enhanced mitigation procedures increased the number of units potentially *subject* to mitigation but mitigation remained relatively low. In 2013, an average of 16 units per hour were subject to potential mitigation in the day-ahead market while an average of 0.5 units had their bids changed (i.e., were mitigated). Approximately 0.4 units were mitigated per hour in the real-time, compared to 1 unit per hour in the Hour-Ahead Scheduling Process.⁵⁴

The internal market monitor calculated "competitive baseline prices" for the year 2013 based on market simulation that replaced natural gas unit bids with reference level bids, removed virtual bids, and used actual load levels. The internal market monitor found that the competitive baseline prices were roughly equal to actual day-ahead prices in most months in 2013, while real-time prices were lower than competitive baseline prices in most months.⁵⁵ The internal market monitor also estimated "price-cost markups" by comparing the competitive baseline prices to total average wholesale energy costs and found that the overall combined average of prices in the day-ahead and real-time market was approximately \$1.50/MWh (or 3.8 percent) lower than the competitive baseline prices.⁵⁶

⁵⁴ CAISO Department of Market Monitoring, *2013 Annual Report on Market Issues & Performance*, at 165-166, (Apr. 2014), available at <http://www.caiso.com/Documents/2013AnnualReport-MarketIssue-Performance.pdf>.

⁵⁵ *Id.* at 64-65.

⁵⁶ *Id.* at 65-66.

Appendix

A.2 ISO-NE

Markets subject to mitigation

- Energy
- Unit Commitment
- Ancillary services
- Capacity
- Virtual bids

Monitoring Structure

- Internal: Internal Market Monitor
- External: Market Monitoring Unit -Potomac Economics

Mitigation Summary

ISO-NE has both an internal and external market monitor. ISO-NE takes a two-part “Conduct and Impact” approach to mitigation, which first screens for specific conduct and then estimates the impact of that conduct on market outcomes. The criteria used to determine whether a resource is subject to the Conduct and Impact mitigation tests depends on whether the resource is located in a constrained area or not. ISO-NE’s definition of a Constrained Area changes depending on which market the resource submits an offer to. A real-time resource supply offer is subject to Constrained Area mitigation if it is located on the import side of a binding constraint and the resource is dispatched to relieve the binding constraint.⁵⁷ A day-ahead resource supply offer is subject to Constrained Area mitigation if the LMP at its node exceeds the LMP at the Hub by more than \$25/MWh.⁵⁸

A General Area is defined as any area that is not a Constrained Area. A resource located in a General Area is only subject to General Area Conduct and Impact mitigation if it is owned by a supplier that is unilaterally pivotal.⁵⁹ A supplier is unilaterally pivotal if the sum of the resources it owns in a given area is necessary to relieve a binding constraint in a General Area. ISO-NE uses a unilateral pivotal supplier screen in this case, as opposed to the three pivotal supplier test used in CAISO and PJM. Resources in General Areas that are not owned by pivotal suppliers are not subject to mitigation.⁶⁰

⁵⁷ ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.2.2(a).

⁵⁸ ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.2.2(a).

⁵⁹ ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.2.

⁶⁰ During the 2013 study period, the General Area Conduct and Impact tests were imposed in the day-ahead market. After the implementation of Flexible Offer Rules in December 2014, ISO-NE will not implement the General Area

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The Conduct and Impact thresholds are more stringent in Constrained Areas than they are in General Areas. ISO-NE's Conduct test for General Areas for unilaterally pivotal suppliers during constrained periods evaluates whether a resource's offer exceeds its reference level by the lower of 300 percent and \$100/MWh. The Impact test for General Areas assesses whether the resource offer will raise the clearing price (be it day-ahead or real-time) by the lower of 200 percent or \$100/MWh. Resource offers below \$25/MWh in General Areas are not subject to the Conduct test.⁶¹ The Constrained Area Conduct test evaluates whether a resource's offer exceeds its reference level by the lower of \$25/MWh or 50 percent. The Constrained area Impact test evaluates whether the resource's offer will raise the LMP by the lower of \$25/MWh or 50 percent (the same as the Conduct test).⁶² If a resource's conduct and impact exceed the predetermined thresholds, that resource's original offer is replaced with its reference level offer.

Mitigation is conducted before the final LMPs are calculated in both the day-ahead and real-time markets. ISO-NE's day-ahead market power mitigation is executed manually while the real-time mitigation is executed automatically and runs in parallel with the RT dispatch model.⁶³

Calculation of Reference Levels

ISO-NE's internal market monitor calculates resource reference levels according to the following order of preference:

- (1) Offer-based: reference level based on a resource's accepted offers during previous competitive periods in the last 90 days. The internal market monitor calculates the mean and median of those offers and uses the lower of the two to establish that resource's reference level. Offer-based reference levels are adjusted for fuel prices as necessary.⁶⁴
- (2) LMP-based: calculate reference levels based on LMP's at the resource's node during the lowest-priced 25 percent of the hours that the resource was dispatched

Conduct and Impact mitigation in the day-ahead market. See *ISO New England Inc.*, 145 FERC ¶ 61,014, at PP 4-6 (2014). Instead, ISO-NE will cap start-up and no-load fees in day-ahead energy offers to a 200 percent increase above reference levels.

⁶¹ ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.5.1.

⁶² ISO-NE Tariff, Market Rule 1, App. A, § III.A.5.5.2.

⁶³ Potomac Economics, *2013 Assessment of the ISO New England Electricity Markets*, at 188 (June 2014), available at http://www.iso-ne.com/static-assets/documents/markets/mktmonmit/rpts/ind_mkt_advsr/isone_2013_emm_report_final_6_25_2014.pdf.

⁶⁴ ISO-NE Tariff, Market Rule 1, App. A, § III.A.7.3.

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during the previous 90 days. LMP-based reference levels are also adjusted for fuel price changes and differences between weekday and weekend LMPs.⁶⁵

(3) Cost-based: reference levels are calculated by the internal market monitor based on information provided by the resource, including original equipment manufacturer recommendations, applicable environmental permit costs, and verifiable physical operating characteristics.⁶⁶ Reference levels are also indexed for changes in the daily, or hourly at the internal market monitor's discretion, ICE natural gas index prices at New England trading hubs.⁶⁷ The internal market monitor calculates incremental energy costs with the following formula:

incremental energy cost = (incremental heat rate * fuel costs) + (emissions rate * emissions allowance price) + variable operating and maintenance costs + opportunity costs.

Opportunity costs may include, but are not limited to emissions costs (not already captured), water storage limits; and, other operating permits that limit production of energy.⁶⁸

The ICE natural gas price index may differ from a resource's actual fuel costs given the unique characteristics of the resource's fuel supply portfolio (often composed of multiple contracts of varying lengths), differences between gas nomination and energy market bidding schedules, and differences between same-day and next-day gas prices. A gas-fired generator can request a Fuel Price Adjustment from the internal market monitor if its expected fuel costs differ from the internal market monitor's reference price calculation.

The internal market monitor received 4,298 requests for fuel price adjustments in the period between November 2012 and January 2014. The requests were concentrated in the winter months, with a total of 71 units requesting at least one fuel price adjustment during the period.⁶⁹ ISO-NE will implement new offer-flexibility changes will allow resources to submit day ahead energy supply offers that vary by hour and update their

⁶⁵ ISO-NE Tariff, Market Rule 1, App. A, § III.A.7.4.

⁶⁶ ISO-NE Tariff, Market Rule 1, App. A, § III.A.7.5.

⁶⁷ ISO-NE Tariff, Market Rule 1, App. A, § III.A.7

⁶⁸ ISO-NE Tariff, Market Rule 1, App. A, § III.A.7.5

⁶⁹ ISO New England Internal Market Monitor, *2013 Annual Markets Report*, at 40, (May 2012), available at http://www.iso-ne.com/static-assets/documents/markets/mkt_anlys_rpts/annl_mkt_rpts/2013/2013_amr_final_050614.pdf.

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real-time supply offers up to 30 minutes prior to the beginning of the real-time hour, which includes some changes to the reference level calculations.⁷⁰ ISO-NE also has a \$1,000/MWh cap on incremental energy offers.

Market Monitor Comments about Mitigation Practices

Table 11 shows the instances of mitigation of energy offers in 2013 and 2012.

Table 11: ISO-NE day-ahead and real-time energy offer mitigation events

Year	number of events
2012	131
2013	129

Source: ISO New England, “2013 Annual Markets Report”, May 2014, at 30 and ISO New England “2012 Annual Markets Report”, May 2013, at 31.

According to ISO-NE’s external market monitor Potomac Economics, 51 of the instances of mitigation in 2013 were automatic mitigation in the real-time energy market. ISO-NE has stated that, during the past ten years, no General Area mitigation has been imposed in the day-ahead market.⁷¹ As mentioned previously, in implementing new Flexible Offer Rules, ISO-NE proposed to eliminate General Area Threshold mitigation in the day-ahead market. In its place, ISO-NE proposed offer caps that limit start-up and no-load offer parameters to three times their respective reference level parameters.⁷² The Commission approved ISO-NE’s proposal to be effective in December 2014.⁷³

ISO-NE’s internal market monitor estimated that in 2013, markups at the margin contributed an average of \$6.30/MWh to the real-time clearing price for energy, which was \$56.06/MWh on average at the hub in real-time.⁷⁴ The internal market monitor also estimated average real-time gross margins, which is the resource’s revenue minus its reference level on a \$/MWh basis. The internal market monitor estimated two annual

⁷⁰ *ISO New England Inc.*, 145 FERC ¶ 61,014 at PP 4-6.

⁷¹ *ISO New England Inc. and New England Power Pool*, Direct testimony of Robert V. Laurita and Mario S. DePillis Jr., Docket No. ER14-1147, at 15-16 (filed Jan. 24, 2014).

⁷² *Id.* at 8.

⁷³ *ISO New England Inc.*, Docket No. ER14-1147-000 (July 9, 2014) (delegated letter order).

⁷⁴ ISO New England Internal Market Monitor, *2013 Annual Markets Report*, at 2, 58-59 (May 6, 2014), available at http://www.iso-ne.com/staticassets/documents/markets/mkt_anlys_rpts/annl_mkt_rpts/2013/2013_amr_final_050614.pdf.

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MW-weighted average gross margins for each resource: one based on its actual offers and another based on reference level offers. The average difference between actual offer-based margin and the reference level-based margin was \$4.40/MWh in 2013, which the internal market monitor referred to as the average gross margin above marginal cost.⁷⁵

A.3 MISO

Markets and Offers monitored by external market monitor:

- Energy
- Operating Reserves
- Unit commitment/Revenue Sufficiency Guarantees
- Voluntary Capacity Auctions
- FTRs

Structure:

- Internal: None
- External: Independent Market Monitor - Potomac Economics

Mitigation Summary

MISO's external market monitor monitors for economic withholding via examining offers for energy, operating reserves, start-up and no-load, and related physical parameters. The external market monitor also monitors for the following activities: physical withholding; uneconomic production; uneconomic virtual transactions; and any bidding practices that distort competitive outcomes in MISO-administered markets.⁷⁶

MISO's external market monitor relies on a Conduct and Impact structure to implement its market mitigation procedures in energy markets. The Conduct and Impact thresholds to which a resource is subject depends on whether it is located in a Narrow or Broad Constrained Area as defined below:

- *Narrow Constrained Area*: Area with transmission constraints or reserve zone constraints that are expected to bind for at least 500 hours during a given 12-month period and where one or more resources is pivotal to relieving the constraint. Narrow Constrained Areas are defined in advance by the external market monitor.⁷⁷

⁷⁵ *Id.* at 58-59.

⁷⁶ MISO Tariff, Module D, § 63.3

⁷⁷ MISO Tariff, Module D, § 63.4.1

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- *Broad Constrained Area*: Area where transmission constraints and reserve zone constraints bind infrequently but in which substantial market power can result when constraints bind. Broad Constrained Areas are not defined in advance by the external market monitor. Instead, MISO continuously monitors for constraints in Broad Constrained Areas.⁷⁸

MISO's Narrow Constrained Areas in 2013 were Minnesota, Western-Upper Michigan System, and North Western-Upper Michigan System in the Midwest region and Amite South and West of the Atchafalaya River Basin in the South region.⁷⁹ If a resource's offer exceeds its reference level by an amount in excess of the Conduct and Impact thresholds described below and there is a binding transmission constraint, MISO will mitigate its offer.

In Broad Constrained Areas, energy offers trigger the Conduct threshold if they exceed reference levels by the lower of 300 percent or \$100/MWh. Offers below \$25/MWh are not mitigated.⁸⁰ The Impact test in Broad Constrained Areas evaluates whether a resource's offer will result in a 200 percent or \$100/MWh increase in the LMP, whichever is lower. The Conduct test for resources located in Narrow Constrained Areas is triggered when a resource energy offer exceeds its reference level by more than the Narrow Constrained Area Threshold, which is equal to the net annual fixed cost of a new peaker divided by the number of constrained hours during the past 12 months.⁸¹ MISO posts the Narrow Constrained Area mitigation thresholds on its website and they vary by location.⁸² During periods when constraints bind, the Narrow Constrained Area Impact test assesses whether the resources' offer raises the LMP by an amount that exceeds the relevant Narrow Constrained Area threshold.⁸³

If a resource is mitigated, the relevant part of its offer is replaced with reference levels. The mitigation takes place before the final network model run is performed. A resource that is not located in either a Narrow Constrained Area or a Broad Constrained Area is not subject to MISO's automatic market power mitigation provisions and only subject to the \$1,000/MWh offer cap.

⁷⁸ MISO Tariff, Module D, § 63.4.2

⁷⁹ Potomac Economics, *2013 State of the Market Report for the MISO Electricity Markets*, at 65-66 (June 2014), available at <https://www.misoenergy.org/Library/Repository/Report/IMM/2013%20State%20of%20the%20Market%20Report.pdf>.

⁸⁰ MISO Tariff, Module D, §§ 64.1.1-64.1.3

⁸¹ MISO Tariff, Module D, § 64.1.2.

⁸² See, e.g., MISO, *Narrow Constrained Area Mitigation Thresholds* (Mar. 7, 2014), available at https://www.misoenergy.org/Library/Repository/Report/IMM/2014_NCA_Threshold_Update.pdf

⁸³ MISO Tariff, Module D, § 64.2.1.c.

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Calculation of Reference Levels

Reference levels in MISO are calculated based on one of the following three methods, subject to data availability, using the first method for which sufficient data is available:

1. Offer-based: The lower of the mean or the median of the unit's accepted offers during competitive periods in similar hours or load levels during the previous 90 days, adjusted for fuel prices.
2. LMP-based: The mean of the LMP or applicable Market Clearing Price at the unit's location during the lowest 25 percent of hours where the unit was dispatched during the previous 90 days, for similar hours or load levels, adjusted for fuel prices .
3. Cost-based: Consultation between the external market monitor and the market participant wherein the resource submits supporting cost information to the external market monitor. These costs can include risk premiums and opportunity costs, or justifiable technical characteristics for physical offer parameters.⁸⁴

If sufficient data for options 1 through 3 do not exist, the external market monitor will determine a reference level based on (a) its estimate of the costs taking into account operating cost data, input from the market participant, and the best information available to the external market monitor, or (b) an appropriate average of competitive offers of one or more similar generation resources.

If a resource's reference levels are developed through consultation with the external market monitor, they may be based on the resource's documented going-forward costs. Fuel price adjustments to the offer- and LMP-based reference levels are based on fuel price indices that are updated daily. Resources may contact the external market monitor and request changes if their reference levels do not reflect their incremental operating costs.

Market Monitor Comments on Mitigation Practices

The external market monitor's 2013 State of the Markets report for MISO indicated that mitigation was infrequent in 2013. Mitigation was higher in the real-time market as compared to the day-ahead market. In 2013, 41 Broad Constrained Areas unit-hours (1,825 MWh) were mitigated compared to 40 Narrow Constrained Areas unit-hours (or

⁸⁴ MISO Tariff, Module D, § 64.1.4.

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1,504 MWh).⁸⁵ The external market monitor estimated that the average markup of the system marginal price in MISO was 1.7 percent in 2013.⁸⁶

A.4 NYISO

Markets and offers subject to mitigation

- Energy
- Ancillary services
- Bid production cost guarantees
- Installed Capacity Auctions
- Transmission Congestion Contracts

Structure

- Internal: Market Monitoring Unit
- External: Market Monitoring Unit - Potomac Economics

Mitigation Summary

NYISO has both an internal and external market monitor. NYISO's internal market monitor is called the Market Monitoring Unit.⁸⁷ NYISO, like ISO-NE and MISO, implements market mitigation based on Conduct and Impact tests. Mitigation applies to two broad categories: resources in Unconstrained Areas; and resources in Constrained Areas. A resource is defined as located in a Constrained Area if the interface or facility into the area in which it is located has a shadow price greater than \$0.04/MWh. A resource is defined as located in Unconstrained Area if it does not meet the definition of located in a Constrained Area.

The Constrained Area Conduct test assesses whether a resource's energy offer exceeds its reference level by more than the following threshold:

$$[2\% * \text{Avg. Price} * 8760] / [\text{constrained hours}]$$

where the "Avg. Price" is the relevant average price (be it real-time or day-ahead), adjusted for fuel prices and out-of-merit generation and "constrained hours" is the

⁸⁵ Potomac Economics, *2013 State of the Market Report for the MISO Electricity Markets*, at A-171 (June 2014), available at <https://www.misoenergy.org/Library/Repository/Report/IMM/2013%20State%20of%20the%20Market%20Report.pdf>.

⁸⁶ *Id.* at 66.

⁸⁷ NYISO also has a Market Mitigation and Analysis Department that works collaboratively with the Market Monitoring Unit and NYISO to carry out the NYISO tariff. See NYISO Tariff, Market Services, Att. O, § 30.3.3.

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number of hours when the shadow price of the constraint exceeded \$0.04/MWh during the past 12 months.⁸⁸ If the Unconstrained Area threshold is lower than the Constrained Area threshold, then the Constrained Area resource is subject to the Unconstrained Area threshold.

The Constrained Area Conduct threshold is designed to become less stringent as the number of congested hours falls. If the area has been constrained for less than 2 percent of the hours during the previous 12 months, then a resource in a Constrained Area can submit an offer that exceeds its reference level by an amount equal to the average LBMP for its location in the past 12 months. If the area has only been constrained during 1% of the hours in the previous 12 months, a resource's offer can exceed its reference level by twice the average locational based marginal price (LBMP) for its area. If a given Constrained Area were constrained for 50 percent of the hours during the past 12 months, then a resource in that area can submit offers that exceed its reference levels by up to 4 percent of the average LBMP in the past 12 months. The Constrained Area Impact threshold assesses whether the resource offer will raise the clearing price by an amount that exceeds the Constrained Area Conduct threshold.

In Unconstrained Areas, a resource's energy offer fails the Conduct test if it exceeds its reference level by the lower of \$100/MWh or 300 percent. If a resource offer fails the Unconstrained Area Conduct test, it is subject to the Impact test, which determines if that resource's offer will raise the clearing price by the lower of 200 percent or \$100/MWh. If a resource's offer fails the Conduct and Impact tests, NYISO mitigates the offer and replaces any mitigated offer parameters with reference level parameters.⁸⁹ NYISO also has a \$1,000/MWh offer cap on incremental energy offers.⁹⁰

Calculation of Reference Levels

Reference levels can vary over the output range of each unit and are computed for all elements of a resource's bid, including start-up cost, economic minimums, and the physical parameters governing the operation of the unit.⁹¹ The internal market monitor accepts three types of reference level in the following order of preference:

⁸⁸ NYISO Tariff, Market Services, Att. H, § 23.3.1.2.2.1.

⁸⁹ NYISO Tariff, Market Services, Att. H, §§ 23.3.1.2.3 and 23.3.2.2.3

⁹⁰ NYISO Tariff, Market Services, Att. H, §§ 21.4 and 21.5.1.

⁹¹ NYISO Tariff, Market Services, Att. H, § 23.3.1.4.

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- 1) Offer-based: compute reference levels based upon the resource's accepted bids during periods deemed competitive in the previous 90 days, adjusted for fuel prices as necessary.⁹²
- 2) LMP-based: calculate reference levels based on the mean of the LBMP at the resource's location during the lowest-priced 50 percent of hours when the resource was dispatched in the previous 90 days.⁹³
- 3) Cost-based: determine reference levels in consultation with the resource based on the resource's documented marginal costs, which are defined as follows: (heat rate * fuel costs)+(emissions rate * emissions allowance price) + other variable O&M costs.⁹⁴

The internal market monitor updates reference levels based on daily fuel indices but resources may request consultation with NYISO and the market monitor to revise their reference levels if necessary.

Market Monitor Comments about Mitigation Practices

According to NYISO's 2013 State of the Market report, which was written by the internal market monitor, the majority (92 percent) of automatic energy offer mitigation in NYISO occurs in the day-ahead market because most of the load is scheduled day-ahead. Areas within New York City were mitigated most frequently.⁹⁵ Automatic mitigation of incremental energy offers in NYISO's day ahead and real-time energy markets fell from an hourly average of 95 MW in 2012 to 55 MW in 2013.⁹⁶

A.5 PJM

Markets subject to mitigation

- Energy
- Ancillary services
- Capacity

Monitoring Structure

⁹² Reference levels are based on the lower of the mean or median of a resource's accepted bids from hour ending 7am to hour ending 10pm, excluding weekends and holidays during competitive periods during the previous 90 days. NYISO Tariff, Market Services, Att. H, § 23.3.1.4.1.1.

⁹³ NYISO Tariff, Market Services, Att. H, § 23.3.1.4.1.2.

⁹⁴ NYISO Tariff, Market Services, Att. H, § 23.3.1.4.1.3.

⁹⁵ Potomac Economics, *2013 State of the Market Report for the New York ISO Markets*, at 20 (May 2014), available at http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2013/2013%20State%20of%20the%20Market%20Report.pdf.

⁹⁶ Potomac Economics *Analytic Appendix - 2013 State of the Market Report for the New York ISO Markets*, at A-58 (May 2014), available at http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2013/2013%20State%20of%20the%20Market%20Report.pdf.

Appendix

- Internal: none
- External: Market Monitoring Unit – Monitoring Analytics

Mitigation Summary

PJM market power mitigation is carried out by an external market monitor and employs the Three Pivotal Supplier test. The Three Pivotal Supplier test is used in both the day-ahead and real-time energy markets when operators have to re-dispatch out-of-merit to relieve a transmission constraint.⁹⁷ The Three Pivotal Supplier test determines whether the three suppliers are jointly necessary to relieve a given constraint. PJM examines the distribution factors (dFax) of a constraint to identify which resources are physically capable of relieving the constraint. Resources with a dFax value of three percent are deemed capable of relieving the constraint.⁹⁸ To identify the set of resources against which PJM will measure the three largest suppliers' market share, PJM considers only those suppliers that are offering capacity at or below a price level equal to 1.5 times clearing price that would result from the intersection of supply and demand, including the demand necessary to relieve the constraint.⁹⁹ PJM considers the capacity offered by suppliers in this range to be the only meaningful competition that the three pivotal suppliers face.

Once the relevant resources are identified, PJM conducts the Three Pivotal Supplier test on the three largest suppliers by calculating the following ratio for each supplier deemed capable of relieving the constraint:¹⁰⁰

$$\text{Three Pivotal Supplier test}_i = (S - L2 - S_i) / [\text{MW needed to relieve constraint}];$$

where S is the sum of the effective supply available to relieve the constraint, S_i is the capacity of the resource i being tested, and $L2$ is the sum of the capacity of the two largest suppliers available to relieve the constraint (other than resource i).¹⁰¹ If the ratio is less than one, PJM deems resource i to be jointly pivotal with the two largest suppliers

⁹⁷ Monitoring Analytics, *2013 State of the Market Report for PJM*, at 81 (Mar. 13, 2014), available at http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2013.shtml.

⁹⁸ PJM may change the dFax value from three percent and changes will be posted to the PJM website pursuant to Section 6.4 of Attachment K to the PJM tariff.

⁹⁹ Monitoring Analytics, *2010 State of the Market Report for PJM: Technical Reference for PJM Markets*, at 45 (Mar. 10, 2011), available at http://www.monitoringanalytics.com/reports/Technical_References/docs/2010-som-pjm-technical-reference.pdf.

¹⁰⁰ The Three Pivotal Supplier test does not evaluate resources on a standalone bases. Resource ownership is taken into consideration and resource capacity is aggregated by owner or "supplier".

¹⁰¹ Monitoring Analytics, *2010 State of the Market Report for PJM: Technical Reference for PJM Markets*, at 45-46 (Mar. 10, 2011), available at http://www.monitoringanalytics.com/reports/Technical_References/docs/2010-som-pjm-technical-reference.pdf.

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and replaces resource i's offer with its cost-based offer. The two largest suppliers are deemed jointly pivotal if the third largest resource is found to be jointly pivotal. This calculation is done until all pivotal suppliers are identified.

PJM does not mitigate resources that have already been committed to operate during the interval.¹⁰² Resources that fail the Three Pivotal Supplier test are mitigated to their "cost-based" bid, equal to 110 percent of incremental production costs or to costs plus relevant adders for frequently mitigated units.¹⁰³ All energy offers in PJM are subject to a \$1,000/MWh cap.¹⁰⁴ Mitigation occurs before the final network model run that determines dispatch and LMPs.

Calculation of Reference Levels

Resources in PJM submit a single incremental energy offer for the entire operating day (i.e., energy offers may not vary hour-to-hour). PJM defines incremental production costs as the sum of fuel, emissions, and other variable operations and maintenance costs. Resources calculate their own reference level costs, which are referred to as cost-based offers, pursuant to a fuel cost policy that must be approved by PJM.¹⁰⁵

A resource can also include opportunity costs that are legitimate and verifiable such as an operating constraint imposed by an external regulatory agency (e.g., an air permit).¹⁰⁶ The external market monitor can verify the incremental costs submitted by resources at its discretion.¹⁰⁷ Resources may contact the external market monitor and request changes if their calculated reference levels do not reflect their actual incremental operating costs. Finally, units that are frequently mitigated are entitled to Frequently Mitigated Unit adders which were originally designed to ensure that such units are able to recover all fixed costs.

Market Monitor Comments on Mitigation Practices

The 2013 State of the Market report for PJM indicates that the Three Pivotal Supplier test results in very few mitigation events in its energy markets. Table 12 summarizes the instances of mitigation in PJM from 2009 through 2013. In 2013, 0.4 percent of unit

¹⁰² Monitoring Analytics, *2013 State of the Market Report for PJM*, at 81 (Mar 13, 2014), available at http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2013.shtml.

¹⁰³ PJM Tariff, § 6.4.2.

¹⁰⁴ PJM Tariff, Att. K App., § 1.10

¹⁰⁵ PJM, Manual 15 Cost Development Guidelines, § 2.3.

¹⁰⁶ PJM, Manual 15 Cost Development Guidelines, § 12.1.

¹⁰⁷ PJM Tariff, Att. M, § II.A.2.

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hours were capped in the real-time market and 0.1 percent of unit hours were capped in the day-ahead market.¹⁰⁸

Table 12: PJM summary of energy offer mitigation

	Real-Time		Day-Ahead	
	Unit hours capped	MW capped	Unit hours capped	MW Capped
2009	0.4%	0.1%	0.1%	0.0%
2010	1.2%	0.4%	0.2%	0.1%
2011	0.6%	0.2%	0.0%	0.0%
2012	0.8%	0.4%	0.1%	0.1%
2013	0.4%	0.1%	0.1%	0.0%

Source: Monitoring Analytics, LLC. "2013 State of the Market Report for PJM" at 80 (Table 3-20).

Note: mitigation statistics exclude mitigation of units committed for reliability reasons.

PJM's external market monitor examined the markups of marginal resources (i.e., resources whose offer set the energy component of the LMP) and found that 93 percent of marginal offers in the real-time market had average dollar markups (measured in \$/MWh) that were less than zero in 2013 as measured against the resource provided reference cost (or cost-based offer), which includes the ten percent adder of measureable costs. In 2013, ninety-nine percent of the offers that were marginal in the day-ahead market had average dollar markups below zero.¹⁰⁹

¹⁰⁹ Monitoring Analytics, *2013 State of the Market Report for PJM*, at 83 (Mar. 13, 2014), available at http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2013.shtml.