UNITED STATES OF AMERICA

BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

Modifications to Commission Requirements for Review of Transaction Under Section 203 of the Federal Power Act and Market-Based Rate Applications under Section 205 of the Federal Power Act	**)** **)** **)** **)** **)**	**Docket No. RM16-21-000**

Comments of

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I. INTRODUCTION

Our names are Dr. Romkaew Broehm, Dr. Jeremy Verlinda, and Dr. James Reitzes. We are economists of The Brattle Group who consult on energy matters and have been active in Federal Energy Regulatory Commission ("FERC" or "the Commission"), international, state regulatory proceedings and antitrust matters for many years. We have provided testimony and/or advice for a number of merger and acquisition ("M&A") cases over the past 15 years. Our credentials are attached to our comments. We offer our comments in response to the Commission's *Notice of Inquiry on Analysis of Modifications to Commission Requirements for Review of Transaction Under Section 203 of the Federal Power Act and Market-Based Rate Applications under Section 205 of the Federal Power Act* (hereafter "2016 M&A and MBR NOI").

The Commission aims to determine whether it should modify its horizontal market power review standards for M&A and MBR approvals. It seeks comments on whether it should

improve and harmonize the competitive screen analyses it uses for M&A and MBR approvals. Specifically, the Commission seeks comments on six specific questions as to whether the Commission should: (1) establish a specific *de minimis* test for a certain Section 203 transactions that are unlikely to raise market power concerns; (2) add a supply curve analysis to its M&A approval evaluation; (3) improve its single pivotal supplier screen analysis in reviewing the MBR applications, and adding a similar pivotal supplier screen analysis to its M&A approval evaluation; (4) add a market share screen analysis to its M&A review; (5) modify how capacity associated with long-term power purchase agreements ("PPAs") should be attributed in its M&A review; and (6) require submission of applicant's merger-related documents. We provide comments on the first four of these questions.

II. COMMENTS ON SPECIFIC QUESTIONS

A. SHOULD THE FERC ESTABLISH A SPECIFIC *DE MINIMIS* TEST?

With the exception of *de minimis* M&A cases, the Commission requires merger applicants to perform a full-fledged market power screen analysis, following its prescribed steps in analyzing their potential competitive impact on relevant markets.[1] In this 2016 M&A and MBR NOI, the Commission seeks comment on whether it should establish a specific threshold to define a *de minimis* transaction.[2] The definition of *de minimis* is clear when merging parties operate entirely in separate regions. There is no overlapped market, and thereby a DPT is exempted.

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[1] FERC Order 592, 77 FERC ¶ 61,263, December 18, 1996 ("Order 592"); and later FERC Order 642, 93 FERC ¶ 61,164, November 15, 2000. The Commission's competitive impact analysis is also known as a Delivered Price Test (DPT) or Competitive Analysis Screen.

[2] *See* 2016 M&A and MBR NOI at PP 13-19.

However, according to the Commission, M&A applicants also have provided a simplistic calculation using a "2ab analysis" where geographic overlap exists between the merging parties.[3] The Commission's concern is 'whether the "2ab analysis" may lead to false results in situations where the proposed transaction is a partial acquisition of a competitor in the same market, given that a partial acquisition does not yield the same mathematical result as when two firms merge.[4]

The Commission is correct that the mathematical equations describing the change in the Herfindahl-Hirschman Index ("HHI") differ for a partial acquisition and a full acquisition. With a partial acquisition, the mathematical expression includes additional terms that can make the transaction-related change in the HHI positive, negative, or zero, depending upon a seller's and a buyer's market shares after the transaction.[5] Essentially, the use of the "2ab analysis" for a partial acquisition is likely to create a false positive outcome, particularly when the assets being acquired are from a firm that still has a larger share of the market than the acquiring firm (after the assets are sold).

To demonstrate this point, we offer examples in **Table 1** below of partial acquisitions, comparing the appropriately measured HHI change with the HHI change predicted by the 2ab analysis (where the formula for the appropriate HHI change is derived in Appendix A). All three of our illustrative examples indicate that the 2ab formula yields a larger increase in the HHI than the true HHI change (compare Line [8] with Line [7] in Table 1).

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[3] The 2ab formula refers to the mathematical change in Herfindahl-Hirschman Index ("HHI") that arises from a merger where all assets/operations of the target firm in the relevant market are acquired (as opposed to merely a portion of the acquired firm's assets/operations).

[4] *Id.* at P 17.

[5] *See* Appendix A for our mathematical derivation.

Table 1
Comparison of Simplified Change in HHIs and 2ab Calculations
Numerical Examples

	Line	Market Share (%)		
		Example 1	*Example 2*	*Example 3*
	Before Acquisition			
Firm A	[1]	3	5	15
Firm B with Plants X and Y	[2]	8	8	8
Plant X	[3]	5	5	5
Plant Y	[4]	3	3	3
	After Acquisition			
Firm A with Plant Y	[5]	6	8	18
Firm B with Plant X	[6]	5	5	5
Chang in HHI	[7]	***-12***	***0***	***60***
2ab with b=Y's share	[8]	***18***	***30***	***90***

Note: [7]: 2x[4]x([1] – [3]). See Appendix A for a change in HHI mathematical formula.
[8]: 2x[1]x[4]

In Example 1 of **Table 1**, suppose before an acquisition that Firm A has a market share of 3%. Firm B, which owns Plant X and Plant Y, has a total market share of 8% (5% from Plant X and 3% from Plant Y), as shown in Lines [1] to [4], respectively.

Now, let Firm A acquire Firm B's Plant Y. This causes Firm A's market share to increase to 6% and Firm B's market share to decrease to 5%, as shown above in Lines [5] and [6], respectively. Using our formula in Appendix A, the change in HHI shown in Line [7] is -12, indicating that this acquisition potentially reduces concentration in the market. If one were to calculate "2ab" for this acquisition, its result would show a change in the HHI of +18 (Line [8]), suggesting that the transaction increases the market concentration.

We reach analogous findings in Examples 2 and 3, where we change Firm A's market share from 3% to 5% and 15%, respectively. Consequently, the "2ab analysis" produces an inaccurate estimate of the impact of the partial acquisition on the HHI, as it overstates

the impact of the transaction in terms of increasing market concentration (see Appendix A for proof).

Thus, the HHI mathematical formula used to demonstrate that a transaction has a *de minimis* anti-competitive effect must be applied with care. First, we agree with the Commission's proposed preliminary steps that applicants must take in order to present their *de minimis* analysis.[6] Defining relevant geographic and product markets is a prerequisite for performing a market power analysis, particularly one that includes market share calculations. Some transactions may produce significant price impacts during specific market conditions, such as at times when transmission limitations create small relevant geographic markets in which market power potentially can be exercised. Applicants should consequently demonstrate that any potentially adverse impact on competition during these periods is also *de minimis*. Regardless of the analytical techniques chosen for merger effect assessments, the Commission should continue to emphasize the importance of appropriately defining relevant markets.

Second, the simplified change in HHI analysis does not provide a level of HHI or the level of market concentration, which the Commission also uses to establish its safe harbor threshold.[7] A small acquisition size does not automatically suggest that the potentially adverse effect on competition is *de minimis*. This depends upon the buyer's market share. In Example 3, Firm A has 15% market share before the acquisition of Plant Y. Thus, the transaction increases the size of Firm A from 15% to 18% and increases the HHI by 60 points. This change in HHI may or may not result in failure depending upon

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[6] 2016 M&A and MBR NOI at P 16.

[7] The transaction is unlikely to harm competition if 1) the market is unconcentrated-- the post-transaction HHI is below 1,000, regardless of the change in HHI; 2) the market is moderately concentrated-- the post-transaction HHI is between 1,000 and 1,800 and the change in HHI is less than 100; and 3) the market is highly concentrated-- post-transaction HHI is greater than 1,800 and the change in HHI does not exceed 50.

the post-transaction HHI level. If the examined market has a post-transaction HHI between 1,000 and 1,800, the transaction would be within the Commission's safe harbor threshold. But if the post-transaction HHI is above 1,800, there would be a rebuttable presumption that this transaction creates potentially adverse effect on competition. In this circumstance, applicants would need to conduct a supplemental analysis or a full-fledged DPT.

It is our opinion that the Commission does not need to establish a specific threshold for a *de minimis* pre-transaction market share. The change in HHI mathematical formula as shown in Appendix A should be used for a partial transaction's competitive screen evaluation, in combination with the Commission existing safe harbor threshold.

B. SUPPLY CURVE ANALYSIS

The Commission is considering whether the supply curve analysis ("SCA") is warranted for its Section 203 review.[8] It seeks comments on whether it should require M&A applicants to submit a supply curve analysis in addition to the current DPT. As the Commission explains in the 2016 M&A and MBR NOI, a supply curve analysis assesses whether a transaction will materially increase the ability and/or incentive to withhold generation capacity in the combined portfolio. The analysis explicitly models the withholding decisions of a portfolio owner based on the benefits that may accrue to the entire generation portfolio. The Commission has also sought comments "as to what information it should require and what metrics it should evaluate, as part of such supply curve analysis."[9]

Although the Commission has not yet required M&A applicants to submit a supply curve analysis for Section 203 reviews, it has used this tool to analyze some M&A applications

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[8] 2016 M&A and MBR NOI at PP 20-21.
[9] *Id.* at P 21.

in the past, particularly when applicants have failed their DPT screens. The Commission stated in its Section 203 Supplemental Policy Statement that:

> If the screen is failed, then, as discussed in paragraph 59 above, the Commission examines the factors that could affect competition in the relevant market. Specifically, in these circumstances the Commission typically considers a case-specific theory of competitive harm, which includes, but is not limited to, an analysis of the merged firm's ability and incentive to withhold output in order to drive up prices.[10]

For instance, in its review of Saddle Mountain's acquisition of New Harquahala, it appears that the Commission utilized a supply curve analysis and found that:

> This is of particular concern because the Harquahala Facility and the Gila River Facility (the two facilities that would be commonly-owned and controlled by Wayzata) operate using similar generation technology: combined-cycle natural gas-fired turbines. Under competitive conditions, each facility would have a similar dispatch cost and could be available at a similar point on the supply curve.[11]

This raises a key issue that differentiates the current DPT regime from one where a supply curve analysis is always included: while the Commission has prescribed how M&A applicants should perform the DPT analysis so that it provides a straightforward, bright line test that indicates whether the merger passes or fails the competitive screen, an important virtue of a supply curve analysis is that it can (and should) be flexible to the facts of the case (and subsequent theory of competitive harm) at hand.

We do not comment as to whether the Commission should require all M&A applicants to submit a supply curve analysis. Instead, we submit *a* hypothetical supply curve analysis for the purpose of providing a common framework for discussion of the underlying mechanism for determining offers and market-clearing prices. It is important to stress that we examine just one form that a supply curve analysis might take. While something

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[10] FPA Section 203 Supplemental Policy Statement, 120 FERC ¶ 61,060 (2007) at P 65.

[11] *Order Denying Disposition of Jurisdictional Facilities*, Mach Gen LLC, et al., 142 FERC ¶ 61,178 (2013) at P 27.

similar could be prescribed for applicants in every Section 203 review, we caution that the commission should avoid doing so. This hypothetical example of a supply curve analysis is provided in Appendix B.

In our discussion we emphasize the concepts of ability and incentive and formalize mathematically their role in offer determination. We also point out that a supply curve analysis will often predict pre-transaction withholding of capacity. Such pre-transaction withholding may be relevant if it becomes important to calibrate the modeling in order to approximate observed real-world behavior and competitive outcomes. But ex ante calibration of the model may only be a secondary (or lower) goal of a supply curve analysis. The primary purpose of conducting an SCA is to predict potential M&A-related differences in behavior and competitive outcomes. To that end, a supply curve analysis should be used both to identify problematic mergers—those where the merged firm would be expected to significantly *increase* the amount of capacity withheld from the market by at least some of the generation assets in the newly combined portfolio—and how specifically to mitigate, if possible, the expected harm from the merger.

Among the issues that must be considered in any given merger review, Applicants and the Commission should pay particular attention to the following real-world considerations that can affect a supply curve analysis:

- identification of the appropriate geographic market and related issues of load pockets and transmission network constraints;
- treatment of unit-operating characteristics and limitations;
- incorporation of load obligations and long-term contracts as to their influence on the incentive to withhold capacity from the market;
- selection of a model for dealing with strategic interactions among plant owners;
- assessment of the identity and asset ownership of potential divestiture recipients;

- determination of the predicted merger-effect thresholds beyond which (further) mitigation may be required;
- consideration of differences between traditional markets and day-2 auction markets; and
- allowance for the role of regulatory oversight, market monitoring, and offer curve mitigation.

Should the commission decide to require applicants to submit a supply curve analysis, it will be important to consider these issues explicitly.

C. PIVOTAL SUPPLIER SCREEN ANALYSIS

1. Should Peak Load Replace the Wholesale Load Proxy in MBR Reviews?

The Commission proposes to replace the current wholesale load proxy with the study area's annual peak load.[12] According to the Commission, MBR applicants rarely fail the pivotal supplier screen, partly in consequence of remote sellers' ability to serve an area's wholesale load. It believes that this is unlikely in practice[13] and that the use of a wholesale load proxy may be partly contributing to the lack of screen failures.[14]

We agree with the Commission that the use of annual peak load could trigger false positives that would in those cases place undue extra burden on sellers to rebut the presumption of market power.[15] The Commission ought to consider other key drivers in its market power calculation. We explain this below.

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[12] 2016 M&A and MBR NOI at P 24.
[13] *Id*.
[14] *Id.* at P 23.
[15] *Id.*

To understand the impact of the Commission's peak load proposal, we calculate a hypothetical MBR applicant's pivotal supplier index under three scenarios. Column [A] of Table C.1 in Appendix C presents the Commission's current wholesale load proxy scenario (Scenario A), while Columns [B] and [C] illustrate the peak load scenarios with MBR applicant's total capacity (Scenario B) and uncommitted capacity (Scenario C), respectively. In these illustrative examples, we assume that there is 100 MW of imported power into the market. For Scenarios A and C, we calculate each pivotal supplier index based on the applicant's uncommitted capacity relative to the supply margin, or the total market supply after serving wholesale load (peak load). For Scenario B, the pivotal supplier index is the ratio of the applicant's total capacity to the supply margin. But the supply margin of Scenario B is the difference between the total market supply and peak load in the market. The applicant's pivotal supplier index (shown on Line [21]) exceeds the threshold value of 1.0 in Scenarios A and B, indicating that it fails the pivotal supplier screen under those two scenarios, and is less than 1.0 in Scenario C, indicating that it does not fail the screen in that scenario. Under Scenarios A and B, the applicant's capacity is essential to meet market demand. In fact, both scenarios are conservative, considering that competing suppliers have uncommitted capacity after serving their peak load, as shown in Line [8] of Column [B]. The relevant question should be "under which scenario do we obtain an accurate assessment of the applicant's incentive and ability to exercise market power?"

We believe that the use of the wholesale load proxy—the difference between the examined market's annual peak load and average daily peak load—appropriately captures the relevant product in the Commission's pivotal supplier screen, particularly when a seller is a utility with retail load obligation. Because many investor-owned utilities must meet their system peak loads plus planning reserves, they are likely to fail the pivotal supplier screen in their own service areas, using total capacity and peak load as a product

measure.[16] Any withholding from retail loads will be scrutinized by their state regulators. The Commission has recognized this by allowing Applicants to use Available Economic Capacity and uncommitted capacity when analyzing horizontal market power in the DPT and market share screen analyses, respectively. Replacing wholesale load with peak load is likely to yield a more overly restrictive outcome where there is little or no ability or incentive to exercise generation market power.

If the Commission considers examining a seller at time of peak load, we suggest that the Commission measures a seller's ability and incentive to exercise market power based on its uncommitted capacity after serving its peak load. This is similar to Scenario C. However, the Commission could extend a scenario to capture potential real-time energy demand.[17]

Alternatively, we recommend that the Commission consider an alternative explanation for the lack of screen failures in the current pivotal supplier test: the amount of imports from competing suppliers. Amending our earlier example, suppose there are now 300 MW of imports from competing suppliers, as shown on Line [9] of Table C.2 in Appendix C. The applicant no longer fails in the Commission's current pivotal supplier test (Scenario A), while the result is unchanged in Scenario B. The pivotal supplier index reduces from 1.36 to 0.74 in Scenario A, and from 4.76 to 2.59 in Scenario B.

Although the Commission has recognized this key factor and imposed the use of Simultaneous Import Limits in the market power analyses, if the value used for imports is unrealistically high compared to real-world experience, then the pivotal supplier test will

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[16] To replace wholesale load with peak load, we assume that the Commission also proposes to use an applicant's total owned and controlled capacity, as shown in Scenario B. In this circumstance, it appears that the Commission defines a relevant product as a total wholesale load rather than load in a spot power market.

[17] Based on our experience, an average on-peak demand for real-time energy ranges between 2% to 3%.

be overly permissive. Additional historical data on transmission usage should be examined to verify the appropriateness of the import supply used in the test. Such data could include available transfer capability, transmission rights of competing suppliers or third-parties with load in the examined market, and the number of transmission requests that were refused into an examined market.

Finally, we note that wholesale market and MBR seller competitive conditions can change after the Commission has granted sellers MBR authority. This is why the Commission provides a safeguard by requiring MBR sellers to submit their changes in status as well as quarterly reports of their wholesale transactions. Such information supports the Commission's on-going monitoring of potential exercises of market power.[18]

2. Should the Pivotal Supplier Screen Be Used in the Section 203 Review?[19]

It is reasonable for the Commission to use a pivotal supplier screen to enhance its evaluation of the competitive effects of a proposed transaction under the Section 203 review. In fact, in our previous comments we had suggested that the pivotal supplier index was a better structural and more direct indicator of the likely unilateral effects of mergers.[20] The calculation places little additional burden on applicants since it can be done with the output generated from the DPT analysis. We agree that the pivotal supplier screen analysis would be useful to determine not only whether an applicant gains its pivotal position in a market due to its M&A, but also whether any screen failures from a DPT analysis are likely to reflect real or false positive outcomes.

However, we suggest that the Commission exercise caution in applying the pivotal supplier test in Section 203 reviews, based on the following observations. First, the

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[18] ISO/RTO market monitors also dynamically assess competitiveness of their markets.

[19] 2016 M&A and MBR NOI at PP 26-27.

[20] *See* Comments of Romkaew Broehm, Peter Fox-Penner, Oliver Grawe, and James Reitzes, The Brattle Group, Analysis of Market Power Under the Federal Power Act, Docket No. RM11-14 (2011).

standard of review for Section 203 applications is to assess the potential adverse effects of a proposed transaction on competition. The Commission has set a safe harbor threshold for a proposed transaction based on changes in pre-transaction and post-transaction HHIs in relevant product and geographic markets. As the Commission also noted in this 2016 M&A and MBR NOI, its review does not focus on "…whether there is a dominant market participant,"[21] but rather on its potential adverse effects.[22] Thus, if the Commission decides to use a pivotal supplier screen in its Section 203 evaluation, it still needs to create both pre- and post-transaction cases. The change in pre- and post-transaction pivotal supplier indices can be calculated to measure whether a combined firm could become pivotal in the market after the merger. This test will not reveal new information to the Commission if, prior to its proposed transaction, an acquirer has no market-based rate authority to sell short-term power in a relevant market. In this circumstance, the Commission should not be concerned.

Second, the Commission would need to spell out what changes in the pivotal supplier test would trigger a mitigation. One possibility might be where neither Applicant is pivotal (index < 1.0) pre-transaction and post-transaction the acquirer becomes pivotal (index > 1.0). But what if the acquisition only just passes the screen, as might be the case if pre-transaction the acquirer had an index value of, say, 0.75, and post-transaction the acquirer had an index value of, say, 0.97. Is this change (0.22) in the index sufficient to warrant concern? What if the values were 0.80 and 1.02 instead (same change in the index value)? Will the Commission set a metric as a bright line test, similar to "yes" or "no" in the Section 205 review? The California Market Surveillance Unit (MSU) did not use a binary pivotal supplier test. Based on the its experience, the MSU recommends a range of the indices to form its opinion as to whether a supplier had market power.[23]

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[21] 2016 M&A and MBR at P 26.

[22] *Id.*

[23] *See* more discussion in Taylor Gary, Ledgerwood, Shaun, Broehm, Romkaew, and Fox-Penner, Peter, "Chapter 6, Market Power vs. Scarcity in the California Crisis,"

Third, the Commission currently requires MBR sellers to perform a pivotal supplier screen for only one period, while under the Section 203 assessment the Commission requires M&A applicants to perform at least 10 sub-periods in a DPT analysis.[24] We urge the Commission to retain the relevant product definition details if it will require the pivotal supplier screen analysis for the Section 203 review.

Fourth, even if a proposed transaction were to fail the Commission's pivotal supplier screen, the Commission should not automatically mandate a mitigation plan. It should allow the applicant to rebut why its M&A will not adversely affect competition. As we explain in Section II.C.1, imports from competing suppliers play a key role in a market power analysis. The historical data on transmission, such as hourly available transmission capacity, transmission rights of third-parties inside examined markets, transmission constrained hours, and transmission refusals, will be useful to understand whether the applicant can raise price effectively. In other words, would the applicant lose money by withholding because third-parties can replace its power with imports?

D. MARKET SHARE ANALYSIS

The Commission is considering whether it should include an examination of market share in its Section 203 review.[25] Specifically, it seeks comment on whether a market share threshold is appropriate, and, if so, what the threshold level should be.[26]

We understand that the Commission's motivation stems from an M&A applicant with a series of successive acquisitions in a market over time. The Commission foresees that this action could harm competitive market conditions, and is concerned that market

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Market Power and Market Manipulation in Energy Markets from the California Crisis to the Present, Public Utilities Reports, Inc. 2015.

[24] An MBR seller performs a DPT analysis to rebut presumption of having market power when it fails either a pivotal supplier screen or a market share screen.

[25] 2016 M&A and MBR NOI at PP 28-30.

[26] *Id.* at P 29.

concentration statistics and their changes will not capture the M&A applicant's accumulation of market power.[27] We applaud the Commission in raising this issue and encourage it to set out guiding principles at the early stage of its review to assess the potential harmful effects of this type of successive M&As.

However, we do not agree that the Commission should prescribe a market share threshold to its Section 203 review. First, the Commission's current threshold in approving an M&A transaction has been tied to M&A applicants' market shares. This is because an HHI is a composite of market shares in a market. The mathematical expression for calculating a simple M&A effect is 2ab, where 'a' is a market share of Firm A and 'b' is a market share of Firm B. Merger applicants will fail a DPT screen even when Firm A's market share does not exceed 20 percent. For example, suppose that before the merger a market has an HHI of 1800. A proposed merger of Firm A with a 10% market share and Firm B with only a 2.5% market share will not pass the Commission's current screen because its merger potentially changes market concentration by 50 points. But when a market's HHI is only 1,000 (or below 1,750), this merger will pass the Commission screen. In fact, for the same transaction Firm A's market share could be as high as 20% and would not fail the Commission's current screen if the HHI is below 1600.

Second, the Commission should examine the pre-merger market HHI closely because it is an essential indicator in determining the level of market concentration, which under appropriate circumstances may bear a relationship to competitive conditions in the market. The HHI tends to be higher in a market that is dominated by fewer suppliers, which could facilitate tacit collusion in the market. The Commission therefore should examine not only applicants' market share but also other firms' market shares.

Finally, market shares and HHI by themselves are neither a necessary nor sufficient basis for challenging a transaction or inferring that the transaction will harm competition (and

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[27] *Id.* at P 30.

accordingly, the public interest). Other factors, such as the distribution of merging parties generating units on a market's supply curve, should inform the Commission's analysis on the potential harm of a series of acquisitions by the same acquirer.

III. CONCLUSION

In this notice of inquiry, the Commission seeks comments on several changes that it is considering for strengthening its market power screens for Section 203 and Section 205 reviews. Among the Commission's proposed changes, we offer commentary on the following: (1) measuring *de minimis* effects, (2) prescribing a supply curve analysis for its Section 203 approval screen, (3) improving Section 205's pivotal supplier screen and incorporating it into Section 203 review, and (4) setting a market share threshold for Section 203 review.

We commend the Commission for choosing to revisit the tools used in assessing market power, given changes in the electricity market environments. However, because each M&A transaction exhibits a different set of facts and may involve transaction-specific modeling considerations, we caution against the Commission prescribing a fixed formula across all transactions for assessing competitive effects under Section 203 review. Regarding the four specific issues above, we contribute the following:

- In the case of *de minimis* transactions, we believe that the change in the HHI mathematical expression, if applied correctly, will allow the Commission to screen for *de minimis* effects without having to depart from the Commission's current safe harbor threshold;

- We have provided the Commission with an example of how a supply curve analysis might be conducted in an M&A review. We also present a detailed discussion of the real-world issues that the Commission must consider if it is to require M&A applicants to submit a supply curve analysis as part of their Section 203 review;

- Regarding the Commission's concern on the current pivotal supplier screen, we recommend that the Commission explore alternative explanations for the lack of screen failures in the current pivotal supplier test. For example, we have shown that the amount of imports from competing suppliers is a key driver in the calculation. Historical data such as pricing information from quarterly reports, transmission availability, transmission usage, transmission rights of third parties with load in the examined market, and the number of transmission refusals can help shed lights on the amount of import capacity available. If the value used for imports is unrealistically high compared to actual experience, then the pivotal supplier test will be overly permissive.

- For a series of successive M&A transactions, we believe that a flexible set of tools, including the delivered price test, pivotal supplier analysis, and supply curve analysis, is likely sufficient for identifying potentially problematic transactions.

Appendix A

Change in HHI from a Partial Acquisition

The FERC measures the impact of the proposed transaction on competition by calculating the change in Herfindahl-Hirschman Index (HHI) before and after the transaction. The HHI is the sum of the squared market shares of all sellers in the market. Mathematically, the HHI can be written as:

$$\text{HHI} = \sum_{i \varepsilon N} (MS_i^2) \qquad [1]$$

where MS_i is the market share of firm *i,* which is one of the set of *N* firms in the market.

Suppose, Firm *B* owns two plants, *X* and *Y*, *B*'s market share then can be decomposed as:

$$MS_B = (MS_X + MS_Y) \qquad [2]$$

Substituting [2] in [1], $\text{HHI}_{\text{before}}$ can be written as:

$$\begin{aligned} \text{HHI}_{\text{before}} &= MS_A^2 + (MS_X + MS_Y)^2 + MS_C^2 + \ldots + MS_N^2 \\ &= MS_A^2 + MS_X^2 + 2MS_X MS_Y + MS_Y^2 + MS_C^2 + \ldots + MS_N^2 \qquad [3] \end{aligned}$$

Now suppose B sells a plant with *Y* market share, $\text{HHI}_{\text{after}}$ transactions can be written as:

$$\begin{aligned} \text{HHI}_{\text{after}} &= (MS_A + MS_Y)^2 + MS_X^2 + MS_C^2 \ldots + MS_N^2 \\ &= MS_A^2 + 2MS_A MS_Y + MS_Y^2 + MS_X^2 + MS_C^2 + \ldots + MS_N^2 \qquad [4] \end{aligned}$$

The change in HHI caused by the transaction equals equation [4] less equation [3]:

$$\begin{aligned} \Delta HHI &= \text{HHI}_{\text{after}} - \text{HHI}_{\text{before}} \\ &= 2MS_A MS_Y - 2MS_X MS_Y \\ &= 2MS_Y (MS_A - MS_X) \qquad [5] \end{aligned}$$

Thus, if $MS_A = MS_X$, there is no change in HHI. If $MS_A > MS_X$, ΔHHI is positive. However, if $MS_A < MS_X$; ΔHHI is negative, which implies that the transaction reduces market concentration as measured by the HHI.

Since a traditional "2ab analysis" produces an estimated change in the HHI of $2MS_A MS_Y$ (which is the same as $2MS_Y MS_A$), the 2ab analysis overstates the acquisition-related change in market concentration as described above in equation [5].

Appendix B

In this appendix, we provide a description of a simple supply curve analysis ("SCA") to illustrate some of the basic mechanics of how an SCA could work in a hypothetical utility merger. The SCA below relies upon a particular, stylized optimal offer curve model ("Optimal Offer Curve") that is described in further detail in the first section below.

This offer curve model highlights the concepts of *ability* and *incentive* that differentiate an SCA from the structural Delivered Price Test ("DPT"). That is, whereas the DPT is used to determine the potential impact of a merger or acquisition on market concentration, an SCA helps to identify merger-related withholding that arises from direct consideration of the profitability of withholding generating capacity as a function of its potential benefit to the entire generation portfolio. This can potentially cause an SCA to reach different conclusions than a DPT about the impact of a merger or acquisition.

Optimal Offer Curves have important implications for modeling pre-merger conditions. For certain portfolios, an SCA will predict some degree of pre-merger economic withholding of generation assets, possibly even for each firm. However, such withholding presumably would not be the target of any *merger-related* mitigation, as it would be predicted to occur irrespective of the merger. Likewise, an SCA will be likely to predict post-merger withholding. This too would not be the target of any merger-related mitigation unless it represents an increase in the predicted pre-merger withholding.

Furthermore, an SCA may or may not be calibrated to fully and accurately approximate observed, real-world features of a given energy market (the need for which may be case-specific). The relevant features of an SCA are (a) predictions of *differences* in pre-merger versus post-merger behavior of the merging firms (and potential merger-related price effects); and, (b) identification of asset-specific remedies (such as physical divestiture or conduct restrictions) to sufficiently restore pre-merger outcomes. These issues are also addressed in more detail below.

In the next section, we first present a mathematical model of Optimal Offer Curve determination for any generating capacity held in a utility's generation portfolio, which provides a framework for the concepts of ability and incentive to withhold.[1] The reader

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[1] Limited public commentary exists on supply curve analysis of electric utility mergers. Wolak and McRae discuss the Exelon-PSEG merger and a residual-demand based analysis; see Wolak, Frank and Shawn McRae, "Market Analysis in Restructured Electricity Supply Industries: The Proposed PSEG and Exelon Merger (2006)," in L.

may be able to skip this section with minimal loss of understanding for the remaining discussion. We next describe the market characteristics of the hypothetical example merger that will motivate the remainder of the discussion. The remaining three sections explain the predicted pre-merger conditions, the predicted post-merger changes in behavior and outcomes, and a use of SCA in potential divestiture remedy.

Finally, we discuss at some length a variety of issues and considerations that may arise in an SCA, including, but not limited to: geographic market identification and related issues of load pockets and transmission network constraints; unit-operating characteristics and limitations; the influence of load obligations and long-term contracts; the role of strategic interactions among plant owners; the identity and asset ownership of potential divestiture recipients; the predicted merger-effect thresholds beyond which mitigation is required; differences between traditional markets and day-2 auction markets; and the role of regulatory oversight, market monitoring, and offer curve mitigation.

I. Optimal Offer Curve Determination

This discussion presents a simple model of unit offer determination in a day-2, single market-clearing price market. It is intended to represent a simplification of the day-2 markets operating in the California ISO, ERCOT, ISO New England, Midwest ISO, NYISO, and PJM.

Many real-world considerations influence the actual offers submitted into an electricity auction market. Nevertheless, this model provides a useful construct for assessing the roles played by (i) the ability to influence price by withholding a particular unit (either physically or economically) and (ii) the amount of capacity owned by the same firm that is inframarginal (i.e., lower cost) to the unit in question.

Let:

Π_r = the firm's profit if the unit runs
Π_w = the firm's profit if the unit is withheld
P_r = uniform price if the unit and all of the firm's inframarginal units run
P_w = uniform price if all of the firm's inframarginal units run, but the unit is withheld
$\Delta P = P_w - P_r$ = the firm's expectation of the market price effect from withholding the unit while running all of the firm's lower cost units

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White and J. Kwoka, The Antitrust Revolution. Gilbert and Newberry discuss a "competitive residual demand" model that is also similar in many respects to the supply curve analysis described here; see Gilbert, R.J. and D.M. Newbery (2007) 'Analytical Screens for Mergers', Review of Industrial Organization.

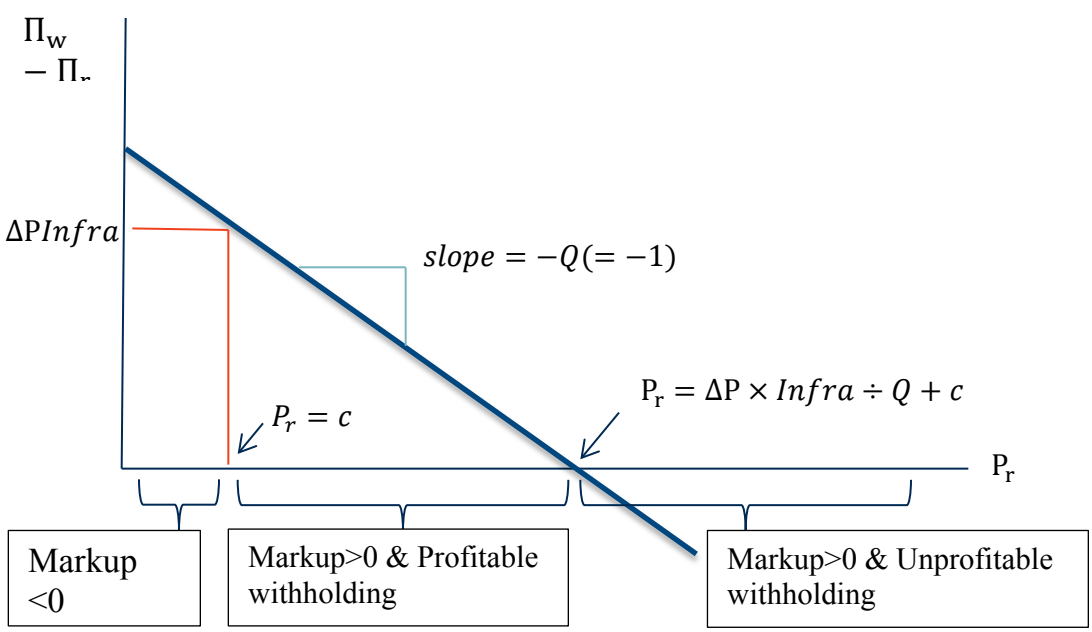
Q = Capacity from the unit that must be withheld to achieve the (expected) price change ΔP
c = the unit's production cost per MWh
Infra = the firm's inframarginal (to the withheld output) capacity, net of any retail load obligations, long-term hedging positions, and fixed-price power purchase agreements
C_{Infra} = total cost of running all inframarginal capacity

Then:

$$\Pi_r = Infra \times P_r + (P_r - c) \times Q - C_{Infra}$$
$$\Pi_w = Infra \times (P_r + \Delta P) - C_{Infra}$$

$$\Pi_w - \Pi_r = \Delta P \times Infra - (P_r - c) \times Q$$

For simplicity, assume that ΔP is constant in the range of demand/price realizations where the firm is considering placing the offer. For example, the firm might consider offering a 200 MW unit in the $25 range, and, in that range, the firm believes that withholding 1 MW would likely produce a $0.15 price increase. Under this assumption, plot $\Pi_w - \Pi_r$ as a function of P_r:



If the markup on the unit $(P_r - c)$ from an offer P_r is negative, then the firm is better off not running the unit. For positive markup offers, the profitability of withholding depends on the tradeoff between profits earned on the withheld capacity versus incremental profit gains on inframarginal capacity. The optimal offer is the one where the firm is indifferent between running the unit or not, *i.e.*, at the point where $\Pi_w - \Pi_r = 0$.

For generic withheld capacity$Q$,

$$\text{Optimal Offer} = \Delta\text{P} \times \text{Infra}/Q + c.$$

As a markup above cost,

$$\text{Optimal Markup} = (\text{Optimal Offer} - \text{c}) = Infra \times \Delta P \div Q$$

In this framework, optimal markups are proportional to inframarginal capacity: if inframarginal capacity doubles, the optimal markup on the unit also doubles. Similarly, if the firm has taken on (long term, fixed price) retail load obligations that just offset the inframarginal generating capacity relative to the unit, then the firm has no portfolio-based incentive to mark up the unit above cost. This demonstrates the *incentive* element of the portfolio effect on unit offers.

The model also demonstrates the role of *ability* in determining unit offers. The greater is the expected effect of withholding the unit, the higher will be its offer. This ability will depend explicitly on the location of the unit's offer in the supply stack. If the unit's marginal cost is in a steep portion of the supply stack, withholding the unit could have a large effect on the market-clearing price; its offer markup would be accordingly greater. Likewise, if the unit's marginal cost is in an exceptionally flat portion of the supply stack, then withholding the unit could have a minimal effect on the market-clearing price; its offer markup would be accordingly lower.

Finally, if the opportunity cost of withholding the unit is high in order to achieve the increase in market-clearing price (ΔP in the model), as reflected in the profits earned if the withheld capacity were running instead, then the optimal unit offer will be moderated. This appears in the markup equation, where the amount of capacity that must be withheld to achieve the price effect appears in the denominator.

II. Description of the hypothetical example

In order to illustrate a hypothetical SCA, we conjecture a simplified market design for an imagined day-ahead (or multi-day-ahead) schedule. The market operator sets a price in each hour in the scheduling period based on the expected load for that hour and the submitted unit-level offers from all participating power generators; all units with an offer at or below the market-clearing price in a given hour are dispatched by the market operator to run. The geographic market may be a load pocket or an island with limited import capability, and within this market there are no internal transmission constraints, such that there is a single market-clearing price each hour. All energy imports enter the market either at a cost lower than any unit modeled (such that the network operator seeks

to meet residual load with in-market units, after exhausting low-cost imports) or at the market offer cap of $999. There is an infinite amount of energy available at the offer cap.

An offer is assumed to hold for the entire period (possibly longer than a day) during which the owner knows only the distribution of load and has no actionable information on likely load realizations for any specific hour in the period. Unit owners submit a single offer for the entire capacity of the unit (e.g., $25.14 for all 200 MW of functional operating capacity of the unit), and there are no operating constraints on the unit.

There are a number of firms operating in the market, some with a portfolio of generating assets and some with just a single unit. Generating units in the market are of four basic varieties: 500 MW capacity units with average marginal operating costs of $15/MWh ("baseload" units); 100 MW capacity units with average marginal operating costs of $35/MWh ("load-following" units); 50 MW capacity units with average marginal operating costs of $50/MWh ("low-cost peaking" units); and 5 MW capacity units with average marginal operating costs of $90/MWh ("high-cost peaking" units). Across all generating units in the market there is 4,400 MW of capacity (excluding out-of-market supply at the market cap).

Load expectations are such that maximum load is approximately 5,000 MW and median load is around 3,000 MW. Load is expected to exceed 4,000 MW in only 5% of hours, and to exceed 4,500 MW in about 1% of hours.

III. Above-cost pre-merger offers

Two firms, Firm A and Firm B, are proposing to merge their combined portfolios of generating units. Table 1 below provides a description of the units owned by the merging firms. Firm A has a portfolio of two baseload units and two load-following units. Firm B has a portfolio of one load-following unit and three low-cost peakers.

Table 1: Plant portfolios for Firms A and B, pre-merger

Plant Number	Capacity	Marginal Cost	Inframarginal Capacity	Expected Price Effect (Premerger)	Markup	Pre-Merger Offer
Firm A						
1	500	$13.09	0	$2.31	$0.00	$13.09
2	500	$16.02	500	$0.06	$0.06	$16.08
3	100	$36.03	1000	$0.93	$9.29	$45.32
4	100	$36.96	1100	$0.71	$7.85	$44.81
Firm B						
1*	100	$28.20	0	$6.96	$0.00	$28.20
2	50	$53.56	150	$1.04	$3.13	$56.69
3	50	$57.08	200	$3.30	$13.20	$70.28
4*	50	$64.09	250	$34.88	$174.42	$238.51

Following the model described in Section I, optimal offers for a unit depend on the unit owner's portfolio capacity that is inframarginal to the unit's own marginal operating costs (the unit's "inframarginal capacity", all of which is assumed to be operating) and the unit-owner's expected change in the market-clearing price if the unit is withheld. Inframarginal capacity provides *incentive* to withhold the unit; the slope of the third-party supply stack in the neighborhood of the unit's competitive offer provides *ability*.

For purposes of this modeling exercise, we assume that all market participants maintain strict beliefs that all other market participants submit purely cost-based offers; *i.e.*, each firm acts as if it were the sole strategic player in the market. Consequently, each firm's beliefs about the expected change in market-clearing prices from withholding are determined by the shape of a supply stack where all unit offers are at marginal cost, and all owned inframarginal capacity is operating. We discuss this assumption in further detail in the "real world considerations" section below.

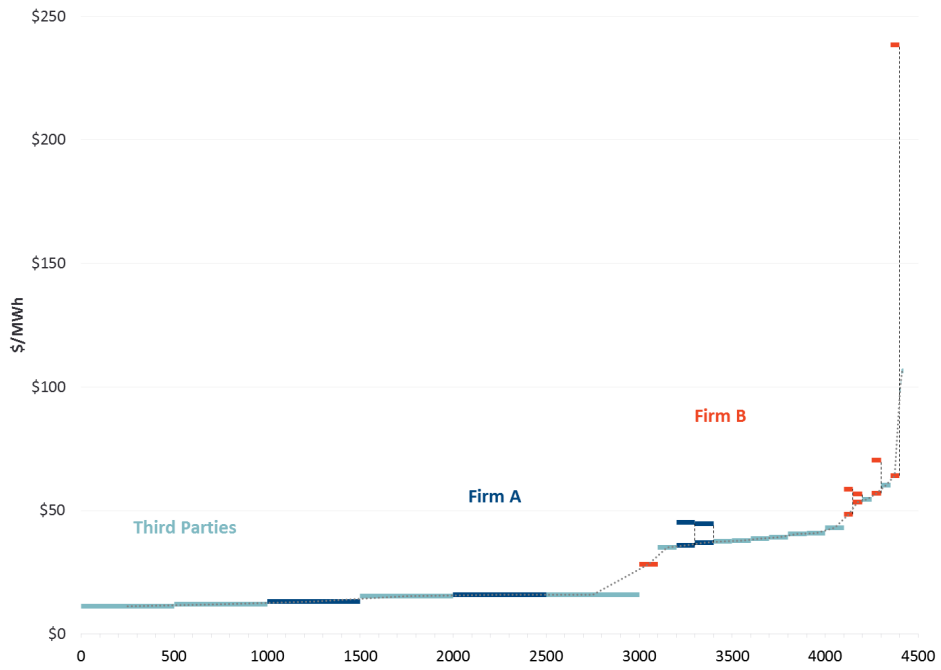
Table 1 also provides the amount of within-portfolio inframarginal capacity for each unit. In general, Firm A's large amount of baseload capacity provides its load-following units with possibly substantial amounts of incentive to use any owned assets to raise price. While its two load-following units have a relatively small expected effect on market-clearing prices, this large incentive would lead Firm A to submit offers with significant markups (21% to 26% above cost).

Firm B has no baseload units, and comparatively little inframarginal capacity for each of its units. Nevertheless, Plant No. 4 of Firm B (Unit B4) faces particularly steep residual demand for its capacity, such that Firm B expects a price effect that is an order of

magnitude greater than any units owned by either of the two firms. This leads to a near-trebling of the offer for Unit B4 relative to its marginal cost.

These offers are illustrated in the modified supply curve below, which overlays onto a marginal-cost based supply curve the "optimal" pre-merger offers for the Firm A and Firm B units. Offer markups are shown by the height of the vertical dashed line connecting the offer to its marginal cost. As with most markets, the supply curve is nearly flat across all baseload units, exhibits modest slope for load-following units, and is quite steep for peakers, providing relatively intuitive identification of those units in the two portfolios likely to provide significant ability to influence prices. Incentive to withhold capacity for any unit is given by the amount of within-firm capacity observed to the left of any unit. This is perhaps most obvious when reviewing Firm B's portfolio: Unit B1 ($28 marginal cost and the leftmost red line) has no capacity to its left, and so in spite of having some ability to increase market-clearing prices in hours when load is expected to be near it, its markup is $0. Yet the very next unit in the portfolio has a substantially smaller expected market-clearing price effect and a $3 markup, driven entirely from its ability to increase prices for unit B1 in those hours when it can move the market-clearing price by withholding.

Figure 1: Pre-merger offer markups for A and B
$/MWh as a function of load



IV. Post-merger versus pre-merger offers

In this particular hypothetical merger, Firm A's generation portfolio consists mainly of incentive units and only modest ability, while Firm B's generation portfolio consists mainly of ability units and little incentive. The merger of the two firms will combine a set of strong incentive assets with a set of strong ability assets into the same generation portfolio. We discuss the distribution of market-clearing prices that result from these (and other market participants') pre-merger offers in the next section.

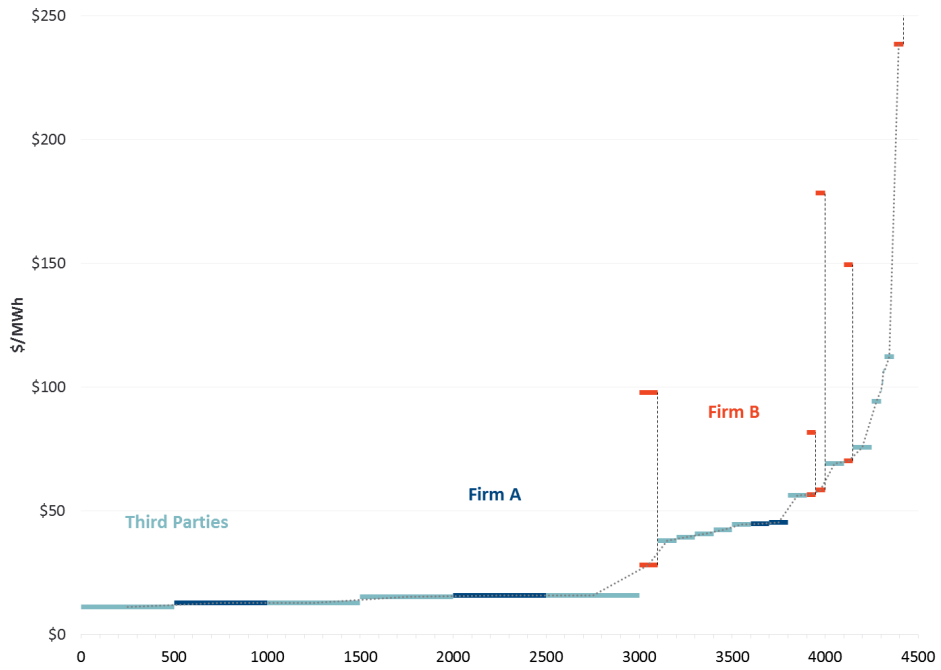
Table 2 below shows the changes in offers for each unit that would occur if the merged firm continues to follow the same optimal offer rule formation as outlined above (and in Section I). The offers for A1 and A2 are unchanged following the merger, as no additional incentive to withhold accrues from the merger. Units A3 and A4 acquire a modest amount of additional incentive (unit B1), and increase their offers accordingly. Unit B1 acquires new incentive when merged into a portfolio containing units A1 and A2; combined with the relative steepness of the nearby supply stack, post-merger offers for B1 are more than three times higher than pre-merger. Units B2 and B3 also have significant new incentive (all of the Firm A portfolio), and therefore would submit significantly higher offers. Unit B4, with the steepness of the supply stack and the entire Firm A portfolio as additional inframarginal capacity, now finds it optimal to bid the offer cap of $999.

Table 2: Change in offers post-merger

Plant Number	Pre-Merger Offer	Post-Merger Offer
Firm A		
1	$13.09	$13.09
2	$16.08	$16.08
3	$45.32	$46.25
4	$44.81	$45.52
Firm B		
1*	$28.20	$97.75
2	$56.69	$81.75
3	$70.28	$149.46
4*	$238.51	$999.00

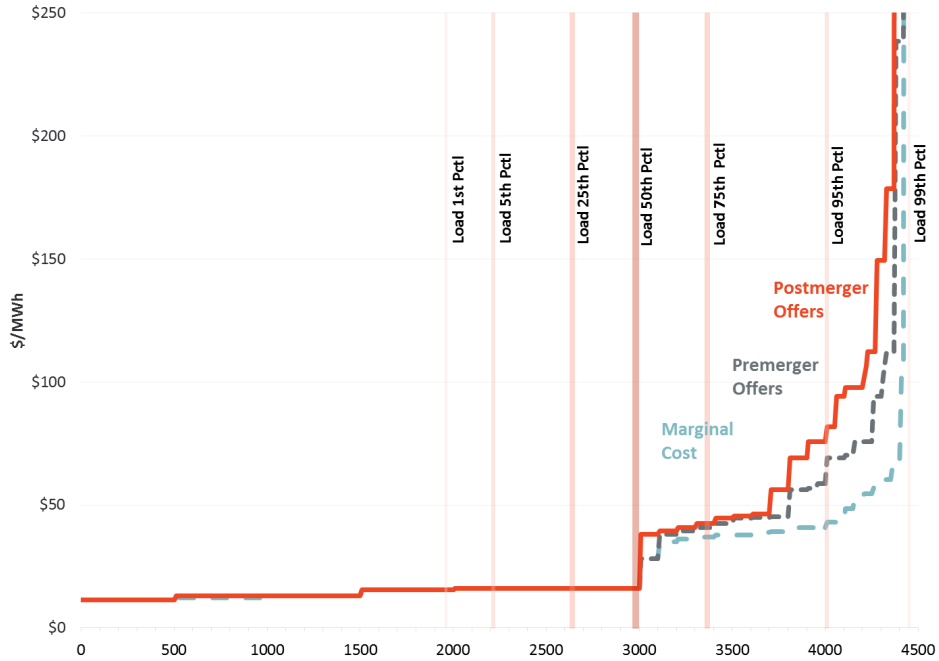
As with the pre-merger scenario, these offers are illustrated below. Figure 2 shows a supply stack based on pre-merger offers (not marginal costs) and overlays onto this the merged firm's incremental markup (over the pre-merger offer).

Figure 2: Post-merger markups for A and B, versus pre-merger offers $/MWh as a function of load



The magnitude of price effects for the merger-induced offer increases depends on the distribution of load. Some mergers may only result in predicted price increases in just a handful of super-peak hours, while others may predict price increases in a significant fraction of peak, off-peak, or shoulder hours. The basic distribution of load is described above, and has been overlaid onto the set of pre-merger and post-merger offer stacks in Figure 3 below. Market-clearing prices will be set at the intersection of an expected load condition for the hour and the offer stack. The greatest price effects of the merger occur during high load conditions (above 3,700 MW), where post-merger offers significantly exceed pre-merger offers. We also see an expected price effect near the median load condition associated with the increased offer markup for unit B1.

Figure 3: Market-clearing prices as a function of load without divestiture remedy



Finally, in Table 3 below we summarize these price effects across hours based on the distribution of load. In 51% of hours (load below 3,000 MW) there is no expected increase in price. In 44% of hours (load between 3,000 and 4,000 MW), prices are expected to be approximately $4/MWh to $6/MWh higher). And in 4% of hours prices are expected to be about $70/MWh higher. Averaging across all hours, the price effect of the merger is an increase from an average of $41.58/MWh to $46.48/MWh, or about 12%.

Table 3: Expected price effects of post-merger changes in offers

Load	Percent of Hours	Avg Pre-Merger Price	Avg Post-Merger Price
Less than 2500	16%	$16.03	$16.03
2501 - 3000	35%	$16.08	$16.08
3001 - 3500	30%	$36.63	$40.17
3501 - 4000	14%	$47.94	$54.62
4001 - 4500	4%	$151.80	$222.23
More than 4500	1%	$999.00	$999.00
Overall	100%	$41.58	$46.48
Pct-Chg vs. Pre			11.8%

V. Mitigation of predicted merger effects

As described earlier, an SCA provides a tool for identification of unit-specific remedy of any merger effects, whether divestiture or conduct-based. For example, if the remedy is divestiture, the analyst can run a computer algorithm that loops through each combination of possibly divested units and calculates post-divestiture price effects at various load levels and in aggregate. Comparison of these price effects will reveal the set of candidate divestiture remedies that may reasonably be expected to preserve most or all of the pre-merger competitive outcomes.

It may also be the case that review of the price effects in the post-merger load distribution will suggest likely remedy candidates. For example, given the offer changes observed in the hypothetical example above, it seems possible that divestiture of units B1 and B4 might restore much of the competitive outcomes that were observed in the pre-merger portion of the SCA. Table 4 appends to Table 2 the model-predicted offers for each unit if the merger were to occur but units B1 and B4 were sold to separate, independent operators with no other generation assets in the market.

Table 4: Change in offers, post-divestiture of plants B1 and B4

Plant Number	Pre-Merger Offer	Post-Merger Offer	Post-Divestiture Offer
Firm A			
1	$13.09	$13.09	$13.09
2	$16.08	$16.08	$16.08
3	$45.32	$46.25	$45.32
4	$44.81	$45.52	$44.81
Firm B			
1*	$28.20	$97.75	$28.20
2	$56.69	$81.75	$79.66
3	$70.28	$149.46	$142.86
4*	$238.51	$999.00	$64.09

Under this divestiture scenario, the new owners for these units would have no incentive to mark up the unit offers. In the case of B1 this would restore the pre-merger offer for the unit. However, in the case of unit B4 this would result in a significant reduction in its offer relative to pre-merger, from about $238/MWh down to its marginal cost of about $64/MWh. This can be seen in Figure 5 below, where the two circled units are the potential divestiture candidates and the vertical lines illustrate the change in markup versus pre-merger offers (post-merger markups for the merged firm's retained units are

also illustrated. In this case, it is also worth pointing out that divestiture of B1, in addition to restoring its pre-merger offer, also causes the pre-merger offers for units A3 and A4 to be restored. Likewise, while the offers for units B2 and B3 still exceed pre-merger levels, the merger's effect on those offers has been mitigated somewhat.

Figure 4: Post-divestiture markups for candidate divestiture plant versus pre-merger markup

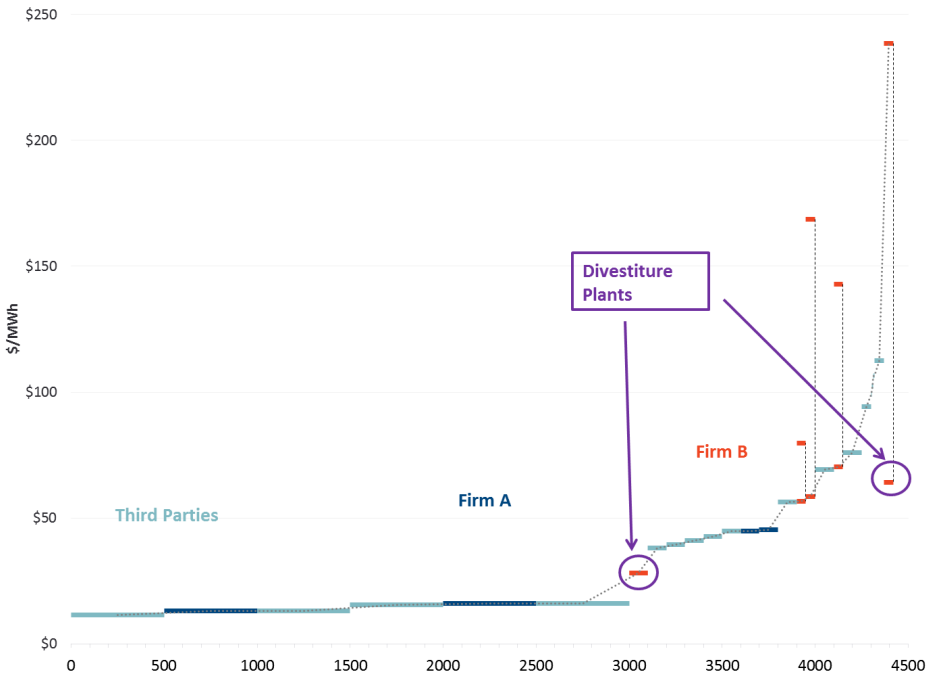


Figure Notes: The upper-right divesture plant exhibits an offer decrease after divestiture, to its marginal cost of $64.09, relative to its premerger offer of $238.51.

Finally, the effect of this possible divestiture on market-clearing prices is shown in Figure 6 below. In contrast to the post-merger depiction in Figure 3, there is now only a modest increase in the post-divestiture offer stack relative to the pre-merger offer stack.

Figure 5: Market-clearing prices as a function of load with divestiture remedy

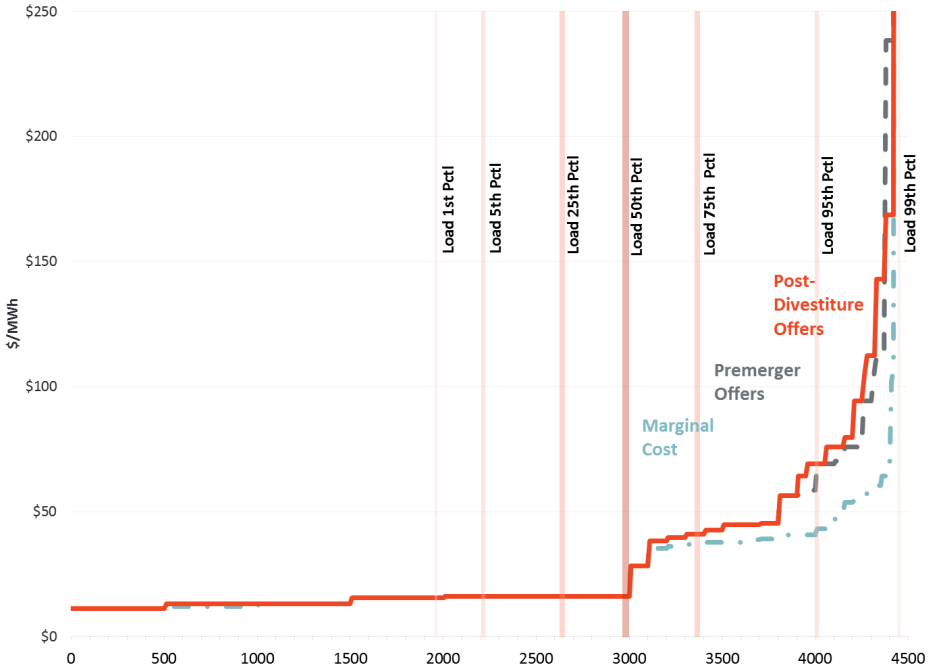


Table 5 summarizes these price effects across hours based on the distribution of load. Whereas the merger leads to predicted price increase for load between 3,000 MW and 3,500 MW, the post-divestiture price in this range equals the pre-merger price. Likewise, the price effect for load between 3,500 MW and 4,000 MW decreases from about $6/MWh down to around $1/MWh. Between 4,000 MW and 4,500 MW the predicted price effect drops from around $70/MWh down to under $4/MWh. Across all hours the predicted price effect drops from almost $5/MWh down to $0.28/MWh. In percentage terms, the price effect drops from a nearly 12% increase to less than 1%. In this hypothetical, divestiture of Units B1 and B4 might prove sufficient to mitigate the harm of the merger, particularly if further merger-related benefits exist.

Table 5: Expected price effects after divestiture of plants B1 and B4

Load	Percent of Hours	Avg Pre-Merger Price	Avg Post-Merger Price	Avg Post-Divestiture Price
Less than 2500	16%	$16.03	$16.03	$16.03
2501 - 3000	35%	$16.08	$16.08	$16.08
3001 - 3500	30%	$36.63	$40.17	$36.63
3501 - 4000	14%	$47.94	$54.62	$48.90
4001 - 4500	4%	$151.80	$222.23	$155.52
More than 4500	1%	$999.00	$999.00	$999.00
Overall	100%	$41.58	$46.48	$41.86
Pct-Chg vs. Pre			11.8%	0.7%

VI. Real-world considerations and model complications

As mentioned earlier, the SCA discussed here is a simplified model of both wholesale energy markets and the strategic decisions and interactions of their participants. While it provides a useful framework for considering the key issues in an SCA, there are a number of real-world issues that should be considered in application to an actual merger review. We discuss them below.

A. Geographic market identification and related issues of load pockets and transmission network constraints

The simple model described here assumes an easily-identified load pocket and no transmission network constraints within the load pocket. In some instances this may be a reasonable approximation of real-world conditions; in others it may not. Many transmission networks have fluid geographic boundaries over time, across and within years, seasons, weeks, and hours. This affects both the set of generating units that are able to supply incremental power to a given load location as well as the prices that they receive for that power. At certain times network congestion may create significant price separation across units or regions, with potentially major implications for the effects of withholding on the portfolio profitability.

Complex linear programs of security-constrained economic dispatch ("SCED") can resolve the fluid geographic market problem and inform the amount of price separation. Unfortunately, the most precise of such models also tend to be extremely time

consuming, making the cost of running multiple scenarios potentially cost-prohibitive.[2] In such cases, simplified models may be useful, including DC load flow models that rely on generation shift factors and other simplified inputs and assumptions to provide approximations of a full SCED model run.

Using these models (either full SCED models or simplified DC load flow variants) can reduce reliance on a bright-line definition of the geographic market, by allowing the analyst to examine the whole portfolio of generation assets. If the transmission network model predicts no effect from withholding a particular unit on prices for certain other units in the portfolio, then those units will provide no incremental incentive to withhold from the unit in question. In other instances, while there may be an effect on units in the portfolio, their location on the transmission network may be such that this effect is muted. For example, a large baseload facility located hundreds of miles from a load pocket may receive a minimal price increase when a peaking unit within the load pocket withholds its capacity. Instead of providing 1000 MW of inframarginal incentive capacity, this baseload unit may only provide 100 MW of *effective* inframarginal incentive capacity if the withholding price effect is just 10% of the price effect observed within the load pocket. Under these conditions such capacity warrants inclusion in the analysis (the effective inframarginal incentive is not zero), but likewise it would be a mistake to attribute its full capacity as benefitting from the withholding strategy.

B. UNIT-OPERATING CHARACTERISTICS AND LIMITATIONS

Plant and network operators must consider the engineering constraints placed on a plant. Nuclear and certain coal units have slow ramp times and limited or virtually no ability to vary the amount of output. A nuclear unit may run near full capacity for nearly a year before undergoing a complete shutdown for several weeks. Gas turbines are significantly more flexible, although achieving the high economic efficiency potential in certain units, such as combined cycle facilities, still places practical limitations on ramp speeds and minimum efficient output.

The model described here ignores these complications, assuming that a plant can be scheduled by the network operator to switch on or off in any hour. This is not realistic.

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[2] SCED models may also help to inform the expected effect of withholding a particular unit on market-clearing prices for other units in the portfolio. While a combined full offer optimization with SCED modeling may be impractical due to computational constraints, in some instances it may be the case that the value of the expected effect of withholding can be approximated with just a few SCED model runs. A subsequent approximation of the full offer optimization can then be performed along the lines of the model in Section I and the associated market-clearing price effects of those offers can be estimated with a final run of the SCED model.

Fortunately, it is also not difficult to incorporate small modifications to approximate more realistic conditions. For example, nuclear units can be assumed to always operate. Coal plants can be assumed to only be able to withhold a fraction of their output, and likewise for combined cycle plants. If the situation warrants, it may be feasible to explore the influence of approximate restrictions on plant operations by comparison to a full linear program that captures all operating limitations.

C. THE INFLUENCE OF LOAD OBLIGATIONS AND LONG-TERM CONTRACTS

The above hypothetical merger considered firms that had no load obligations or strategic long-term market hedges. When they exist, load obligations and long-term contracts must be considered. Bushnell, Mansur, and Saravia (2008),[3] Wolak (2000),[4] and others[5] have shown that when such obligations involve fixed prices over a long duration, they reduce incentives to withhold energy from the market.

In an extreme example, consider a municipality with a small generation portfolio (perhaps a share of a regional baseload unit and a small peaker) and a comparatively larger retail load obligation. This municipality must purchase power, either directly from a regional transmission operator in the spot market, or (more likely) in longer-term, bilateral power contracts. Regardless, the municipality has no incentive to withhold power from its few units, as it may reasonably anticipate that the effect of doing so could lead to it paying *higher* prices for energy purchased in the power market.

For a less extreme example, consider an integrated utility that holds 10,000 MW of baseload capacity, 4,000 MW of load-following capacity, and 1,000 MW of peakers. This utility also has a fixed-price, long-term load obligation that ranges from 12,000 MW to 14,000 MW. In any hour it could withhold some of its 1,000 MW of peakers, but to what end? In many hours the net exposure to the wholesale market will be just those peaking units—the net inframarginal capacity to the peakers will be zero and so provide no incentive to withhold them.

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[3] "Vertical Arrangements, Market Structure, and Competition: An Analysis of Restructured U.S. Electricity Markets," (with James B. Bushnell, Celeste Saravia), American Economic Review, Volume 98, Issue 1, March 2008, pages 237-266.

[4] Wolak, F.A. 2000. "An Empirical Analysis of the Impact of Hedge Contracts on Bidding Behavior in a Competitive Electricity Market," International Economic Journal, 14(2): 1-39.

[5] See, for example, the pioneering work of Allaz and Vila on the effects of hedging on competitive outcomes: Allaz, Blaise and Jean-Luc Vila (1993). "Cournot Competition, Forward Markets and Efficiency," Journal of Economic Theory, 53(1), February, pp. 1-16.

Load and contract obligations can be directly incorporated into an SCA by careful consideration of the long-term obligations of the merging (and significant third-) parties.[6] Where load obligations are expected to vary with the market load distribution, incorporation of the load obligation into the estimate of net inframarginal capacity becomes a load-specific calculation, which will require an assessment of whether to preserve the restriction of single offers per period or allow more flexible offers. However, it is important to note that many load obligations are not fixed price, such that wholesale power cost changes may be passed through to customers on a monthly or quarterly basis. In such cases, the existence of the load obligation is not long-term and it may be inappropriate to model it as such.

D. THE ROLE OF STRATEGIC INTERACTIONS AMONG PLANT OWNERS

In the SCA example presented here, we have made the simplifying assumption that each firm assumes non-strategic behavior on the part of all other market participants. While this may not be realistic for some transactions, it is important to recall that the important feature of an SCA is the merger effect and not necessarily the specific levels of the pre- or post-merger price predictions. To the extent that the effect of ignoring fully strategic behavior across firms appears mainly in levels, then the difference will disappear in calculating the post-merger versus pre-merger price change.

Nevertheless, in some instances strategic behavior could influence the curvature of residual demand faced by some firms, which might be sufficiently different pre- versus post-merger that the effect on model predictions is not merely in levels. How should we model such cases? While supply-function equilibria models[7] are possibly infeasible to operationalize, particularly if other real-world considerations are to be incorporated, there may be reasonable, simpler to implement alternatives. Cournot models have been shown to approximate some market outcomes in a variety of markets in the U.S.,[8] and could be an element of an SCA.

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[6] The discussion here assumes that these obligations can be considered to be exogenously determined. While this seems appropriate in the case of regulated load obligations, it may be less so for long-term contracts, the net position of which may be jointly determined with the ability to influence market prices. We do not address this issue here.

[7] See, for example, Green, R.J., and D.M. Newbery (1992). "Competition in the British Electricity Spot Market," Journal of Political Economy, October, 100(5): 929-53.

[8] See Bushnell, Mansur and Saravia (2008), supra note 3.

E. THE IDENTITY AND ASSET OWNERSHIP OF POTENTIAL DIVESTITURE RECIPIENTS

The SCA example presented here describes a divestiture remedy where the units are divested to separate owners who hold no other assets in the market. Real-world remedies may result in potential divestiture recipients who already own other assets in the market or who wish to take on more than one or even all of the units to be divested. In such cases, these market participants will need to be modeled into the pre- and post-merger offer determinations in order properly to assess the extent of mitigation achieved.

F. THE PREDICTED MERGER-EFFECT THRESHOLDS BEYOND WHICH MITIGATION IS REQUIRED

Absent the introduction of behavioral restrictions within the model, an SCA will predict that any M&A transaction involving units in the same geographic market will lead to some degree of additional withholding by one or more units in the combined portfolio. This will in turn lead to predicted increases in market-clearing prices. Implicit in the example above is that the average expected price increase of 12% implies a need for remedy, and that divestiture of the two plants bringing the expected price effect below 1% might be sufficient. Neither of these should be taken to indicate a recommendation for the appropriate thresholds.

The Commission will need to provide clarity on the following questions should a supply curve analysis be required of Applicants:[9]

- What threshold on incremental withholding or price effects should trigger mitigation?
- What threshold target would indicate that a particular divestiture remedy is sufficient?
- Does a public-interest standard mean that numerical calculation of predicted price effects requires estimation of merger-related benefits that more than offset those price effects?

G. DIFFERENCES BETWEEN TRADITIONAL MARKETS AND DAY-2 AUCTION MARKETS

Up to this point we have mostly focused attention on day-2 auction markets and ignored traditional markets.[10] This highlights issues that potentially fall outside the scope of the

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[9] This list of questions is not intended to be exhaustive.

[10] We define a traditional market as one that has not been restructured to have a regional transmission or system operator that has taken over the duties of the vertically integrated utility as balancing authority. The locus of competition in traditional markets is often in bilateral contracts for energy between generation owners (usually

current inquiry, although it may warrant acknowledging that the locus of competition in some markets may reside outside short-term power sales. For example, in many traditional markets short-term power sales may account for a small fraction of commerce. A contributing factor may be the heavy reliance in the wholesale market on requirements contracts that can have multi-year contract durations and limit or even eliminate the purchaser's (often a municipality or utility co-operative) need to seek short-term power.

To the extent that multiple firms can compete to serve long-term contracts, the competitive process may be reasonably approximated by something like an SCA.[11] Determining whether an SCA may provide useful insight into a merger review depends on an examination of the locus of competition in a market (for which customers and which types of products are power generators competing with each other), and ultimately on whether material competition between generators exists or is allowed by the regulatory environment. This assessment is necessary regardless of whether the market is a Day-2 auction market or a traditional market.

H. THE ROLE OF REGULATORY OVERSIGHT, MARKET MONITORING, AND OFFER CURVE MITIGATION

Most wholesale energy markets impose some restrictions on offers. For example, investor-owned utilities ("IOUs") may in some markets be unable to charge market-based rates. In such cases, an SCA might need to be modified such that the regulated IOU generation in the geographic market always enters the market at cost. While power generation owners in day-2 markets typically (though not always) can charge market-based rates, they still may face other regulatory restrictions that either directly limit the ability to withhold power or they restrict the incentive to do so.

For example, a mitigated offer curve, such as exists in the PJM market monitor's three-pivotal supplier test, limits the offer markups on certain units. The three-pivotal suppler test can be directly incorporated into the SCA. Offer caps, based on maximum percent or absolute markups, can be imposed as approximations to any real-world offer curve

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investor-owned utilities and independent power products) and load serving entities (usually municipalities or utility co-operatives). Conversely, the locus of competition in day-2 markets is often in the day-ahead scheduling/commitment auction operated by the RTO or ISO.

[11] Careful attention may be required for modeling the supply of any regulated utility generation, particularly if it does not have market-based rate authority. Independent power producers could be able and find it profitable to mark up their offers in such markets, but the third-party supply that they face from regulated utilities might be best modeled as if it were cost-based, effectively increasing the elasticity if residual demand faced by independent power producers.

mitigation that may be present. Note that this is not absent from the hypothetical example above, which imposed an absolute offer cap of $999/MWh.

Regarding incentive, as we have mentioned earlier some power generation companies hold load serving entities in their company with retail load obligations at fixed prices (either as a conglomerate or, more typically, as vertically integrated utilities). Moreover, in many cases vertically-integrated utilities must pass on to their retail customers some or all of their excess wholesale market profits, further limiting the benefit of any withholding strategy and therefore any potential merger effect. These can be modeled directly in an SCA where appropriate.

Appendix C

Table C.1
Pivotal Supplier Test: Illustrative Examples
Wholesale Load vs. Peak Load with Total Capacity and Uncommitted Capacity
Imports = 100 MW

			Wholesale Load	Peak load	
	Line	Formula	Uncommitted Capacity [A]	Total Capacity *[B]*	Uncommitted Capacity [C]
Applicant					
Generation	[1]		1140	1140	1140
Load	[2]		760	950	950
7% Op Reserves	[3]	[2]x.07	53	67	67
Uncommitted Capacity	[4]	[1]-[2]-[3]	*327*	*124*	*124*
Competing Suppliers					
Generation	[5]		230	230	230
Load	[6]		160	200	200
7% Op Reserves	[7]	[6]x.07	11	14	14
Uncommitted Capacity	[8]	[5]-[6]-[7]	*59*	*16*	*16*
Imports	[9]		*100*	*100*	*100*
Market					
Generation plus imports	[10]	[1]+[5]+[9]	1470	1470	1470
Load	[11]	[2]+[6]	920	1150	1150
7% Op Reserves	[12]	[11]x.07	64	81	81
Uncommitted Capacity	[14]	[10]-[11]-[12]	*486*	*240*	*240*
Peak Load plus Op Reserve	[15]	[B][4]+[[B][12]	1231	1231	1231
PSI Calculation					
Market Wholesale Load	[16]	[15]-[11]-[12]	246		
Applicant Wholesale Load	[17]	[B][2]+[[B][3]-[A][2]-[A][3]	203		
Comp supplier Wholesale Load	[18]	[16]-[17]	43		
Supply Margin	[19]	[14]-[16]	240	240	240
Applicant's Uncommitted Capacity	[20]	[4]	327	124	124
Pivotal Supplier Index	[21]	[20]/[19] for [A] and [C]; [1]/[19] for [B]	**1.36**	**4.76**	**0.52**
Applicant is pivotal	[22]	If [21]>=1, YES, otherwise NO	YES	YES	NO

Table C.2
Pivotal Supplier Test: Illustrative Examples
Wholesale Load vs. Peak Load with Total Capacity and Uncommitted Capacity
Imports = 300 MW

	Line	Formula	Wholesale Load	Peak load	
			Uncommitted Capacity [A]	Total Capacity *[B]*	Uncommitted Capacity [C]
Applicant					
Generation	[1]		1140	1140	1140
Load	[2]		760	950	950
7% Op Reserves	[3]	[2]x.07	53	67	67
Uncommitted Capacity	[4]	[1]-[2]-[3]	*327*	*124*	*124*
Competing Suppliers					
Generation	[5]		230	230	230
Load	[6]		160	200	200
7% Op Reserves	[7]	[6]x.07	11	14	14
Uncommitted Capacity	[8]	[5]-[6]-[7]	*59*	*16*	*16*
Imports	[9]		*300*	*300*	*300*
Market					
Generation plus imports	[10]	[1]+[5]+[9]	1670	1670	1670
Load	[11]	[2]+[6]	920	1150	1150
7% Op Reserves	[12]	[11]x.07	64	81	81
Uncommitted Capacity	[14]	[10]-[11]-[12]	*686*	*440*	*440*
Peak Load plus Op Reserve	[15]	[B][4]+[[B][12]	1231	1231	1231
PSI Calculation					
Market Wholesale Load	[16]	[15]-[11]-[12]	246		
Applicant Wholesale Load	[17]	[B][2]+[[B][3]-[A][2]-[A][3]	203		
Comp supplier Wholesale Load	[18]	[16]-[17]	43		
Supply Margin	[19]	[14]-[16]	440	440	440
Applicant's Uncommitted Capacity	[20]	[4]	327	124	124
Pivotal Supplier Index	[21]	[20]/[19] for [A] and [C]; [1]/[19] for [B]	**0.74**	**2.59**	**0.28**
Applicant is pivotal	[22]	If [21]>=1, YES, otherwise NO	NO	YES	NO

ROMKAEW P. BROEHM

Principal

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Dr. Romkaew Broehm is an economist whose practice is focused on the electric utility industry. She specializes in the areas of market deregulation and oversight, market power analyses, studies of bulk power markets, evaluation of demand-side management, and utility cost structures. She has led numerous Brattle Group studies in competitive impact analyses for M&A, market-based rate, price forecasting, network transmission simulation, strategic bidding behavior, and generation and transmission asset valuations. Dr. Broehm has submitted testimony and comments before the Federal Energy Regulatory Commission (FERC) on market-based rates (MBR) and merger and acquisition (M&A) matters. She also has experience in analyzing potential market manipulation allegations. Recently, she co-authored comments to the Commodities Futures Trading Commission (CFTC) that proposed a practical definition of market manipulation.

Dr. Broehm also has experience analyzing and testifying on potential market manipulation allegations. She has presented to energy audiences on navigating the complexities of the Dodd–Frank Wall Street Reform and Consumer Protection Act, which focuses on how energy companies should address the economic, governance, regulatory, and transaction issues that they will face as they begin implementing the requirements of the Act.

In addition, Dr. Broehm provides to her clients analyses and litigation support on the prudence of particular investment decisions and power procurement decisions, as well as the valuation of "provider of last resort" supplies. Her experience in pricing and ratemaking includes designing and evaluating dynamic pricing programs, such as a real-time pricing programs and block rate designs. She has implemented demand simulation models to analyze changes in net economic benefits due to changes in rate design.

Before joining The Brattle Group, Dr. Broehm worked at Christenson Associates and taught economics and statistics at the University of Wisconsin-Milwaukee and Cardinal Stritch College.

EDUCATION

B.S. in Economics, Chulalongkorn University, (1983).

Ph.D. in Economics with an Industrial Organization major, University of Wisconsin-Milwaukee, (1994).

AREAS OF EXPERTISE

- *Market Monitoring and Market Power Analyses (including M&A and Market-Based Rate)*
- *Pricing and Ratemaking*
- *Valuation of Generation Assets/Contracts and Price Forecasting*
- *Resource Planning and Industry Restructuring*
- *Demand Response Bidding Strategy*

EXPERIENCE

Market Monitoring and Market Power Analyses

- Market-based rate (MBR) applications before the Federal Energy Regulatory Commission (FERC). Assisted electric utility clients in the eastern and western United States, developing expert testimonies and analyses in accordance with the FERC's final MBR rules. Her understanding of transmission networks has allowed her to work closely with the client's transmission team in preparing simultaneous import limits and determining relevant market product definitions.
- Evaluated whether a supplier's bidding behavior in the wholesale organized power market had adverse impacts on the ICE markets. Dr. Broehm assisted a regulator investigating the alleged exercise of market power by a supplier that simultaneously held related derivatives contracts that could benefit from higher prices.
- Testified on market manipulation in the Pacific Northwest bilateral power market during 2001. Dr. Broehm analyzed transmission data on major interfaces of the California ISO to assess whether a supplier manipulated transmission dominance to strengthen its bargaining power and demanded high power prices.
- Evaluated the competitiveness of ERCOT in 2011. Dr. Broehm utilized a structural-based test such as Residual Demand Index to examine competitiveness of the ERCOT zonal energy markets. The result was used to draw inferences of market conditions within defined geographic and product markets to form an understanding about the ERCOT energy markets
- Led Brattle Team to monitor Southern Company's Energy Auction. The Brattle Group was selected as the Independent Auction Monitor (IAM) for the Southern Company Energy Auction. As part of its mitigation for prospective market power, Southern Company has offered a must-offer, bid-based energy auction for day-ahead and hour-ahead "Into SoCo" products for at least three years. The auction began on April 23, 2009. Dr. Broehm developed, designed, and managed the implementation of protocols used in monitoring the auction and Southern Company's compliance to its tariff. Brattle's first report as IAM was filed at FERC on April 23, 2010.
- Evaluation of competitive impacts of utility mergers on wholesale power and gas markets in various regions, including ISO-NE, NYISO, PJM, SERC, FRCC, SPP, Entergy System, and WSCC. Dr. Broehm led the development of The Brattle Group's Delivered Price Test (DPT) model, as well as its strategic behavioral model used for analyzing potential horizontal and vertical (electricity and natural gas) market power. She led a team in examining whether a

transaction potentially created any short-term incentive to exercise vertical wholesale market power using a locational-marginal pricing simulation model. She has conducted analyses in support of an M&A application as well as provided critical studies for opposing an M&A case.

- Examination of market conditions of the Southwest Power Pool (SPP) wholesale power markets, including day-ahead and energy imbalance markets and transmission congestion management in SPP. Dr. Broehm testified that the SPP wholesale power markets did not provide Qualifying Facilities (QFs), particularly wind QFs, to have a meaningful opportunity to sell to third parties.
- Analysis for California investor-owned utilities in the competitiveness of wholesale power markets at major trading hubs in WECC. She examined liquidity of the day-ahead power markets, the CAISO real-time power market, the CAISO ancillary services markets, and the effectiveness of the CAISO market power mitigation measures.
- Investigation and evaluation of the California electric power crisis. She coordinated an extensive discovery effort and the in-depth analysis of market data and other evidence, such as trading records and compliance logs. She supervised the evaluation of numerous trading strategies and the extent to which individual market participants used those strategies to game market rules and manipulate the spot energy and ancillary service markets in California. She also provided a detailed analysis of market participants' bidding strategies, the extent of economic and physical withholding by suppliers, the potential for coordinated interaction and collusion, and the relationship between market fundamentals, market rules, and the behavior of market participants.
- Evaluation of the impacts of the California power crisis on the western forward markets. She developed the methodology to estimate artificial price inflation in forward contracts transacted during the crisis period, based on estimated implied heat rates during outside crisis periods.

Price and Ratemaking

- Estimation of the incremental costs to the utility of serving additional demand and customers by time period, sub-region, and customer class. Assisted an integrated utility in PJM in conducting marginal cost studies for the utility's transmission and distribution sectors.

- Assisted California investor-owned utilities in examining short-run and long-run avoided costs of existing qualifying facility (QF) contracts and the continuing implementation of the program under Public Utility Regulatory Policies Act of 1978 (PURPA).
- Assisted in the design of a demand simulation model used to analyze a block rate proposal in support of rate filing. Implemented the Constant Elasticity of Substitution demand model and analyzed changes in net economic benefits due to the change in rate design.
- Revision of the structure of transmission access charges in the context of membership negotiations with non-participating transmission owners for the California Independent System Operator and a working group of stakeholders. The effort involved data collection, cost-benefit analyses of various access charges and membership scenarios, and the presentation of these analyses at monthly stakeholder meetings.
- Redesigned rates of transmission and ancillary services, and drafted testimony on these issues for the rate case as well as for the restructuring plan for a cooperative utility close to bankruptcy.
- Analysis of the strategic considerations associated with various TransCo and ISO membership and design alternatives, and evaluated financial and customer rate impacts of those options.
- Preparation and the development of cost of capital, for a Canadian electric utility, using standard estimation techniques (DCF, CAPM). The project also assessed more customized models specific to the industries or lines of business in question, e.g., based on the structure and risk characteristics of cash flows, or based on multi-factor models that better characterize regulated industries.

Valuation of Generation Assets/Contracts and Price Forecasting

- Advisor to an investment firm in the valuation of the generation assets in the southeastern part of the U.S. This task involved reviewing the work done by third parties as well as the preparation of Brattle's own evaluation of the assets. She unpacked the key drivers of the assets' value and provided insights into how different variables (such as fuel prices, heat rates, early retirement option, and load growth) affect the underlying valuation. As part of the valuation, she also examined the transmission system surrounding the plants and market rules to determine whether they could diminish the value of these plants.
- Provision of a market-based revenue forecast for energy and capacity for a valuation of a power plant in a property tax dispute to a cogeneration plant in the northeastern part of the

U.S., The report prepared by The Brattle Group was used to negotiate a settlement of the plant's assessed value.

- Development of a multiple-factor price and load model which could estimate an optimal hedging strategy while recognizing limitations of the liquidity and competitiveness of the market for a utility seeking to demonstrate prudency of its forward contracts, which were used to hedge against spot market price volatility.
- Analysis and support to demonstrate a utility's prudence in procuring forward purchased contracts for both power and gas during the western crisis, even though those contract prices were high relative to actual spot prices. During the course of the project, she estimated the market-based credit-risk premium embedded on forward prices. The results of her analyses were presented before the Nevada Public Utility Commission.
- Valuation of profitability of power plants in New York City and on Long Island. Developed and simulated the New York Independent System Operator (NYISO) wholesale power market conditions in order to obtain forecasting Locational-Based Marginal Prices (LMBPs) using DAYZER, a commercial, state-of-the-art LBMP simulation model.
- Identification of components of short-run avoided costs for qualifying facilities (QFs) and assessed whether day-ahead power prices and "out-of-market" costs were a reasonable measure of the true short-run avoided costs, given QFs' attributes.
- Estimation of damages resulting from a breach of a land purchase contract on behalf of a plaintiff in a bankruptcy matter. Her work involved assessment of ability to build and finance a power plant, preparing energy price forecasts for the New York City market, and estimating associated capacity prices in accordance with the NYISO downward sloping demand curve requirement.

Resource Planning and Industry Restructuring

- Advised Thai Energy Regulatory Commission on economic and regulatory issues surrounding Third Party Open Access of Natural Gas Pipeline Industry. Her recommendations were adopted.
- Advised Thai Energy Regulatory Commission on the structure of Thai wholesale electricity market. As part of the project, Dr. Broehm assisted the regulator in issuing reporting requirements to the electric utilities.

- Advised electric power utilities on corporate strategy and structure issues in the areas of stranded costs, market power, and deregulated markets. Her project work has included development of methodology for market price forecasts, including modeling of scarcity premiums and volatility under alternative restructuring scenarios.
- Developed a resource and procurement plan for an investor-owned utility in the West. She particularly focused on the development of a set of scenarios on key issues such as potential federal climate legislation, natural gas prices, electricity demand and demand side management strategies, and the complex interplay between these factors.
- Conducted a serious of studies for an EPRI/GRI joint research venture on the impact of electric utility restructuring on fuel use. Developed a new market condition that examined impacts of simultaneous changes in market conditions (such as new generation expansion risks and changes in transmission flow patterns) on various types of fuel consumption. These assumptions were then used in a price forecasting model. The results allowed her to examine power plants' viability (particularly nuclear and old power plants) for each of the nine NERC sub-regions, their interaction with each other, and how restructuring was likely to play out in each region.
- Construction of a model that calculated the option value of offering price-capped services, given uncertainty in the prices and quantities of power needed to cover the obligation. Additionally, a logit model was applied to simulate the impact of customer switching behavior on the option value. In response to utility clients seeking to demonstrate the costs of their potential exposure associated with being the Provider of Last Resort for non-switching customers, Construction of a model that calculated the option value of offering price-capped services, given uncertainty in the prices and quantities of power needed to cover the obligation. Additionally, a logit model was applied to simulate the impact of customer switching behavior on the option value.
- Examination of potential for hydroelectric generators, for an EPRI research project, to provide a larger share of operating reserve generating capacity in a restructured electricity market. She conducted interviews with several utilities to discuss strategies that the company wanted to pursue, versus what practices they were following.
- Preparation of a marginal cost study for an integrated electric utility in PJM, studying estimated incremental costs of the utility for serving additional demand and customer by time period, sub-region, and customer class. These costs consist of marginal costs of energy,

capacity, transmission, distribution, and customer-related costs. Since the utility is operated in PJM and relies on the PJM markets to serve its customers, the study entailed projections of both the utility's costs and wholesale power prices for energy, congestion, losses and generation capacity. The results of the study were used as a basis for their rate designs.

Demand Response Bidding Strategy

- Examination of a demand response and energy efficiency programs and the ISO-New England market rules in order to develop bidding strategies that maximize the utility's demand responses and energy efficiency programs when participating in the ISO-New England's Forward Capacity Market (FCM), for a utility in the ISO-New England.
- Led a seminar on load management strategies to mid-management executives for a large southeastern utility. Examples were drawn from other utilities' strategies in other restructuring states. Evaluation of the value of the utility's existing load-management program, and advised on appropriate strategic responses to retail competition.
- Development of marginal costing procedures, for a day-ahead and week-ahead two-part real-time pricing program for various utilities, For a Real-Time Pricing Program. Application of econometric techniques to analyze the actual and expected load response of large industrial customers with on-site generation.

PROFESSIONAL AFFILIATIONS

Northeast Energy and Commerce Association
New England Women in Energy and the Environment

PRESENTATIONS AND PUBLICATIONS

Market Power and Market Manipulation in Energy Markets From the California Crisis to the Present, (with Taylor, Ledgerwood, and Fox-Penner), March 2015, Public Utilities Report, Inc., U.S.

"How to Model Demand-Side Resources in Integrated Resource Planning," (with Mariko Geronimo), presented at Demand Response Workshop, Boston, July 16, 2014.

"Is It Possible to Charge Market-Based Pricing for Ancillary Services in a Non-ISO Market?," presented at the 33rd Annual Eastern Conference of Center for Research In Regulated Industry, May 16, 2014.

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"Dodd Frank Compliance for Oil and Gas Companies," (with Julia Sullivan and Cary Oswald) *Oil and Gas Monitor,* February 6, 2012.

"Impacts of Dodd-Frank on Energy Market," presented at Akin Gump Strauss Hauer & Feld LLP, Houston, February 2012.

Comments on the FERC Notice of Inquiry on Analysis of Horizontal Market Power Under The Federal Power Act*,* (with Peter Fox-Penner, Oliver Grawe and James Reitzes), Docket No. RM11-14-000, May 24, 2011.

"Losing Money to Increase Profits: A Proposed Framework for Defining Market Manipulation," (with Shaun Ledgerwood, Gary Taylor, and Daniel Arthur), The Brattle Group Discussion Paper, March 2011.

"Energy Trading Under CFTC's Expanded Authority" presented at February 10, 2011.

Comments on the Commodity Futures Trading Commission Notice of Proposed Rulemaking on Prohibition of Market Manipulation (with Daniel Arthur, and Gary Taylor), 17 CFR Part 180 Rin No. 3038 AD27, January 3, 2011.

"Is Thailand Ready for Nuclear Power?" *Bangkok Post*, April 5, 2007.

Comments on the FERC Notice of Proposed Rulemaking on Market Based Rates for Wholesale Sales of Electric Energy, Capacity and Ancillary Services by Public Utilities (with Peter Fox-Penner), Docket No. RM04-7, August 7, 2006. Presented the comments at the FERC MBR Outreach Meeting, FERC, November 30, 2006.

"The New Art of Plant Acquisition"*, Public Utilities Fortnightly*, June 2006, pp. 68-72.

Deregulated Electricity Pricing In the U.S. – Dramatic New Rules From the FERC (with Peter Fox-Penner), April 25, 2004.

"Competition in Wholesale Electric Power Markets" (with Peter Fox-Penner, Gary Taylor, and James Bohn), *Energy Law Journal*, 2002, Volume 23, No. 2. pp. 281-348.

"Price Responsive Electric Demand: A National Necessity, Not an Option" (with Peter Fox-Penner), *Electricity Pricing in Transition*, Chapter 10, 2002, Kluwer Academic Publishers (Norwell, MA).

Impact of Changing Fuel and Power Market Structures on Price Behavior (with F. Graves, L. Borucki, S. Thumb, and M. Schaal), Technical Report, August 2001, EPRI1001197 GTI GRI-01/0163 (Palo Alto, CA: Electric Power Research Institute).

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"Retail Pricing of Reactive Power Service" (with Fernando Alvarado, Laurence Kirsch and Allen Panvini), *Proceedings: 1996 EPRI Conference on Innovative Approaches to Electricity Pricing Managing the Transition to Market-Based Pricing*, Electricity Power Research Institute, Palo Alto, California, March 1996.

"The Effects of Imports on Domestic Wages by Unions," with John Heywood revised for *Cambridge Journal of Economics*, March 1996.

TESTIMONY AND REPORT

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Affidavit on behalf of Arizona Public Service Company, Triennial Update Market-Based Rate Filing, United States of America before the Federal Energy Regulatory Commission, Docket No. ER10-2437, December 2015

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Affidavit with Dr. Fox-Penner on behalf of the MISO Transmission Owners and the Midcontinent Independent System Operator, Inc., Comment on Exemption of Multi Value Project Usage Charge for Transactions Sinking in PJM Interconnection, United States of America before the Federal Energy Regulatory Commission, Docket No. ER10-1791-003, June 22, 2015

Testimony on behalf of the California Parties, United States of America before the Federal Energy Regulatory Commission, Puget Sound Energy, Inc., Complainant, v. All Jurisdictional Sellers of Energy and/or Capacity at Wholesale into Electric Energy and/or Capacity Markets in the Pacific Northwest, Including Parties to the Western System Power Pool Agreement, Respondents., Docket No. EL01-10-085, September 2012 and March 2013.

Affidavit on behalf of El Paso Electric Company, Triennial Update Market-Based Rate Filing, United States of America before the Federal Energy Regulatory Commission, Docket No. ER99-2416-008, December, 2012 and December 2015

Affidavit on behalf of Pacific Gas and Electric Company, Triennial Market-Based Rate Update Filing, United States of America before the Federal Energy Regulatory Commission, Docket Nos. ER10-1107-002, ER03-198-018, ER01-198-018, December 2012 and December 2015

Independent Auction Monitor, "Annual Report for Southern Companies' Energy Auction April 23, 2009 to February 10, 2009," *The Brattle Group*, Federal Energy Regulatory Commission, Docket Nos. 09-88, April, 2010.

Affidavit on behalf of National Grid USA, Triennial Market-Based Rate Update Filing, Federal Energy Regulatory Commission, Docket Nos. ER96-2585-006, ER98-6-011, ER99-2387-004, ER02-1470-004, ER02-1573-004, ER05-1439, EC06-125, December 2013, December 2010 and January, 2008.

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Affidavit on behalf of El Paso Electric Company, Triennial Market-Based Rate Authority Filing, Federal Energy Regulatory Commission, Docket No. ER99-2416, March, 2010.

Affidavit on behalf of Pacific Gas & Electric Company, Triennial Market-Based Rate Authority Filing, Federal Energy Regulatory Commission, Docket No. ER03-198-012, December, 2009.

Affidavit on behalf of Southern California Edison, Triennial Market-Based Rate Authority Filing, Federal Energy Regulatory Commission, Docket Nos. ER09-712, ER06-736, ER02-2263, ER01-2217, ER08-931 and ER08-337, December, 2009.

Affidavit on behalf of NV Energy, Market Power Update to Assess Changes in Status, Federal Energy Regulatory Commission, Docket Nos. ER01-1527-10, ER01-1529, November, 2008.

Affidavit on behalf of Sierra Pacific Power Company and Nevada Power Company, Market Power Update to Assess Changes in Status, Federal Energy Regulatory Commission, Docket Nos. ER01-1527-10, ER01-1529, May, 2008 and June, 2008.

Affidavit on Behalf of Watson Cogeneration Company, Application of Watson Cogeneration Company for Order Accepting Initial Market-Based Tariff, Waving Regulations, and Granting Blanket Approvals, Federal Energy Regulatory Commission, Docket No. ER08-337, December, 2007.

Affidavit with Dr. Fox-Penner on Behalf of American Wind Energy Association, The Wind Coalition, and John Deere Renewables, LLC, Motion to Intervene and Protest Opposing SPP IOU's Request to Terminate PURPA Purchase Obligations, Federal Energy Regulatory Commission, Docket No. QM07-5, November, 2007.

Affidavit, Change In Status Filing on Behalf of El Paso Electric Company, Federal Energy Regulatory Commission, Docket Nos. ER99-2416, July, 2006.

Affidavit with Dr. Fox-Penner, Market Power Analysis for Market-based Rate Application on Behalf of Vandolah Power Company L.L.C., Front Range Power Company, LLC, and Dartmouth Power Associates Limited Partnership, Federal Energy Regulatory Commission, Docket Nos. ER02-1336, ER96-1149, and ER02-1173, July, 2005.

Affidavit with Dr. Fox-Penner, Market Power Analysis for Market-based Rate Application on Behalf of Dartmouth PPA Holdings, LLC and Dartmouth Power Associates, Federal Energy Regulatory Commission, Docket Nos. ER05-598 and ER05-559, February, 2005.

JEREMY A. VERLINDA

Senior Associate

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Dr. Verlinda specializes in competition issues in both antitrust and regulatory contexts. He has supported testifying experts in competition matters before U.S. district courts, federal regulatory agencies, and various state public utilities commissions, as well as before competition and regulatory agencies in Canada and Australia. He has also supported damages analyses in price fixing and arbitration proceedings around the world. He has particular expertise in energy markets, telecommunications, transportation, payments, and search advertising.

Dr. Verlinda has provided direct consulting services to firms around the world regarding antitrust risks associated with planned or potential acquisitions and also has assisted them with subsequent merger proceedings in front of the reviewing agencies. Dr. Verlinda has prepared white papers on vertical integration risk and co-authored a series of reports evaluating the competitiveness of the Canadian wireless telecommunications industry in joint filings with the Canadian Competition Bureau before the Canadian Radio-television and Telecommunications Commission.

Prior to joining The Brattle Group, Dr. Verlinda spent 8 years at the *Antitrust Division* of the *U.S. Department of Justice*, where his casework focused on monopolization claims in the payments and electricity industries, criminal price fixing in air cargo and financial markets, and merger analysis (including demand estimation and merger simulation) in the consumer goods, airlines, entertainment, and electricity industries. In electricity markets, Dr. Verlinda has particular expertise in merger simulation, including incorporation of system dispatch accounting for transmission grid and plant operating characteristics.

Dr. Verlinda received his Ph.D. in Economics from the University of California – Irvine, where his primary research examined the relationship between pricing dynamics and market structure in retail gasoline markets. Dr. Verlinda also specialized in econometrics, focusing in particular on the application of Bayesian methods to discrete choice analysis, panel and time series data, and demand estimation.

EDUCATION

Ph.D. Economics, University of California – Irvine, June 2005
Dissertation: Essays on Pricing Dynamics, Price Dispersion, and Nested Logit Modelling
B.S. Economics, University of Washington, March 1999
B.A. Business Administration, University of Washington Business School, March 1999

AREAS OF EXPERTISE

- Competition & Antitrust (including merger and conduct analysis)

- Econometrics and Statistics (including demand estimation, merger and entry simulation, and damages calculations)
- Industrial Organization

SELECTED EXPERIENCE

- Provide ongoing expert support on antitrust risks for potential acquisitions in various industries.
- Provide ongoing expert support for defendants facing damages claims resulting from a multinational price fixing cartel, including preparation of expert reports.
- Provide ongoing support in an antitrust litigation regarding claims of anticompetitive tying.
- Provide ongoing support in a regulatory proceeding before the Federal Communications Commission on competition issues in dedicated internet bandwidth services. Supported and oversaw preparation of multiple pieces of testimony presented to the Commission.
- Prepared a white paper (with co-authors on a framework for antitrust review of integration in network industries).
- On behalf of merging electric and gas utilities, provided direct expert support on antitrust and regulatory review risk. Prepared analyses for direct presentation before the Federal Trade Commission. Oversaw preparation of expert testimony before state utility commission regarding competitive effects of the merger.
- On behalf of merging electric utilities, supported various experts' testimonies in multiple state public utility commission proceedings, including issues of horizontal and vertical market power as well as incentives and ability to deter innovation, deter entry, or otherwise raise rivals costs.
- On behalf of an acquisition target in the aerospace industry, provided support on global antitrust risks associated with unilateral effects in bargaining markets, as well as conglomerate issues associated with bundling.
- For the Canadian Competition Bureau, provided analysis of risk of foreclosure and raising rivals costs concerns regarding vertical integration in an acquisition review in the mobile telecommunications industry.

- Provided consulting services to a third party intervener in a state public utility commission electric-utility merger review proceeding. Gave expert advice on corporate governance issues, incentives for the merged firm to raise rivals costs, and incentives to deter entry.
- For the Canadian Competition Bureau in proceedings before the Canadian Radio-television and Telecommunications Commission, co-authored a series of reports on the competitiveness of the wireless communications industry. Evaluated the structural performance of the market's pricing, concentration, and degree of wireless penetration. Conducted demand estimation and developed a model to simulate effects of de novo entry, including consumer surplus benefits, losses to incumbent carriers, and expected profits and viability of the entrant. Presented estimates of network operators' vertical incentives to raise wholesale costs of small carriers and mobile virtual network operators.
- On behalf of plaintiff-interveners in the DOJ's challenge of Texas voter ID laws, supported expert testimony that estimated racial disparity in costs and impact of obtaining an ID.
- For a private antitrust suit before a U.S. district court, supported defendants' expert testimony in support of a *Daubert* challenge of plaintiffs' expert. Evaluated complex econometric simulation models of consumer demand and entry and demonstrated the irrational behavioral assumptions for consumers and firms in plaintiffs' expert's economic model.
- For a foreign owner of a gas-fired energy facility in international arbitration proceedings, supported expert testimony calculating damages from forced early termination of a gas supply agreement. Evaluated expected economic dispatch over the life of the contract and constructed a cash flow model to predict lost profits.
- For a private antitrust suit before a U.S. district court, supported plaintiff's expert testimony regarding alleged monopolization claims. Evaluated issues of disparate pricing in two-sided markets and the potential market distortions from price discrimination and exclusive agreements.
- While at the *Department of Justice*, conducted **merger review** in the following investigations: Exelon/PSEG (energy), Delta/Northwest (airlines), LiveNation/Ticketmaster (entertainment), Mirant/RRI (energy), Allegheny/First Energy (energy), Exelon/Constellation (energy), 3M-Avery (consumer products), Flowers/Hostess Brands (consumer products).
- While at the *Department of Justice*, investigated claims of **monopolization** conduct in the following cases: Google/Yahoo (search and advertising); American Express/Visa/MasterCard

(payments), Visa (payments), Entergy (energy), BlueCross/BlueShield of Michigan (health insurance).

- While at the *Department of Justice*, evaluated claims of **price discrimination** and calculated damages and volume of commerce in the following industries and/or cases: municipal bonds, air cargo shipments, and LIBOR manipulation.

REPORTS

Canadian Wireless Market Performance and the Potential Effect of an Additional Nationwide Carrier. Prepared for Canadian Competition Bureau for CRTC Proceeding 2014-76 (May 2014; with Kevin Hearle, Giulia McHenry, James Reitzes, and Coleman Bazelon) (Available from the CRTC).

Vertical Foreclosure in Canadian Wholesale Services Markets: Supplemental Filing. Prepared for Canadian Competition Bureau for CRTC Proceeding 2014-76 (Aug 2014; with Kevin Hearle, Giulia McHenry, James Reitzes, and Coleman Bazelon) (Available from the CRTC).

Canadian Wireless Market Performance and the Potential Effect of an Additional Nationwide Carrier: Response to Intervener Filings and Oral Testimony. Prepared for Canadian Competition Bureau for CRTC Proceeding 2014-76 (Oct 2014; with Kevin Hearle, Giulia McHenry, James Reitzes, and Coleman Bazelon) (Available from the CRTC).

PUBLICATIONS

A Bayesian Analysis of Tree Structure Specification in Nested Logit Models, Economics Letters (April 2005)

A Comparison of Two Common Approaches for Estimating Marginal Effects in Binary Choice Models, Applied Economics Letters (February 2006)

Do Rockets Rise Faster and Feathers Fall Slower in an Atmosphere of Local Market Power? Evidence from the Retail Gasoline Market, Journal of Industrial Economics (September 2008)

Mimeographs

The Effect of the Internet on Pricing in the Airline Industry (with Leonard Lane) (Available on SSRN)

The Effect of Market Structure on the Empirical Distribution of Airline Fares (Available on SSRN)

Works in Progress

A review of the airline hub effects from the Delta-Northwest Merger

Accounting for strategic pricing interactions in reasonable royalties calculations in patent infringement cases

Estimating the effects of entry in the wireless telecommunications industry in Canada

Merger Analysis in Nodal-Price Electricity Markets: Residual Demand from Powerflow Models

On the Implications for Geographic Market Definition in Nodal-Price Electricity Markets

ACADEMIC HONORS AND FELLOWSHIPS

University of California Transportation Center Fellowship: Fall 2003 to Spring 2004
School of Social Sciences Predissertation Fellowship: Winter 2003
School of Social Sciences Summer Research Fellowship: Summer 2001, 2002, 2004
Institute for Mathematical Behavior Sciences Summer Fellowship: Summer 2002
Invited Panelist to the Teaching Assistant Professional Development Program, Instructional Resources Center, UC, Irvine: Summer 2003
National Scholar Fellowship: UC, Irvine: Fall 1999 to Spring 2001

OTHER HONORS AND AWARDS

"Award of Distinction" – Antitrust Division, 2010

James David Reitzes

Principal

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Dr. James D. Reitzes received his B.A. in economics and history from Stanford University, and his Ph.D. in economics from the University of Wisconsin. He specializes in providing economic analyses and expert testimony pursuant to regulatory proceedings and strategy work in the energy and transportation sectors and litigation in the areas of antitrust and competition.

Dr. Reitzes has provided expert analysis and testimony in energy-related competition and regulatory matters before the Federal Energy Regulatory Commission, state public utility commissions, and federal antitrust agencies. In the transportation sector, he has offered expert analysis and testimony in proceedings involving the U.S. Department of Transportation, U.S. Department of Justice, the European Commission, the European Court of First Instance, and national antitrust authorities. He also has provided economic consulting services to clients in the United States, Canada, the European Union, South America, and Africa.

Since joining The Brattle Group as a Principal in April 1998, Dr. Reitzes has been involved in energy regulatory, strategy, and litigation matters for utilities, RTOs, cooperatives, municipal power providers, and industrial customers. Most recently, Dr. Reitzes has been involved in formulating and managing auction and RFP processes for procuring and selling electric power supplies (including renewable power and renewable energy credits), assessing the competitive impact and efficiencies arising from integration and consolidation in natural gas transport markets, valuing investments in specified electric generation assets as well as purchases of energy and capacity (in comparison to other generation or procurement alternatives), analyzing the value and risks associated with particular features of power purchase agreements and EPC contracts, designing energy procurement strategies to support standard-offer service obligations, critiquing market-monitoring policies and market design features of electric power markets, assessing the competitive implications of mergers and acquisitions in power markets, providing analyses of alleged market manipulation and exercises of market power in the energy sector, and designing transitional regulation strategies.

Dr. Reitzes has authored several articles on firm strategies with respect to pricing, quality, R&D investment, and merger behavior, published in leading economics and legal journals. He also is an author of a book that assesses the domestic impact of U.S. international trade policies.

REPRESENTATIVE ENERGY SECTOR EXPERIENCE

Procurement (Auction) Management, Design, and Bidding Strategy

- For three utilities in Pennsylvania, designed and managed the procurement of solar photovoltaic alternative energy credits (SPAECs) on multiple occasions and submitted testimony describing the procurement process and benchmarking the results against expected market prices. Responsibilities included: (i) designing the auction rules and bid

forms; (ii) overseeing the provision of auction-related information on the procurement website; (iii) corresponding with interested bidders; (iv) interacting with company personnel regarding bidder credit issues; (v) hosting bidder information sessions; (vi) evaluating bid materials; (vii) building a financial model to determine the likely value of the solar energy credits; (viii) providing a benchmarking study to determine if the bids were reflective of market fundamentals; and (ix) drafting a report to the Pennsylvania Public Utility Commission to secure approval of the procurements.

- For utilities in Ohio, submitted testimony that described the design, management, and implementation of an auction process to serve standard service offer customers. Also participated in the development of software to implement the auction process and identify the winning bidders.
- For an owner of a merchant transmission line connecting PJM with NYISO, designed and managed an RFP process to sell transmission scheduling rights on multiple occasions. Responsibilities included: (i) designing the auction, its rules, and the bid forms; (ii) developing marketing materials and conducting various types of market analyses to assist bidders in understanding the value proposition offered by the transmission rights; (iii) identifying potentially interested bidders; (iv) assisting in the development of other auction materials including bidder participation agreements and purchase and sale contract provisions; (v) hosting a website and overseeing the provision of auction-related information through the website; (vi) communicating with potential bidders; (vii) responding to bidder questions and posting answers to those questions on the auction website; (viii) interacting with the client regarding a variety of bidder-related issues; (ix) selecting the winning bidders; and (x) preparing a report describing the auction process that was submitted to the Federal Energy Regulatory Commission.
- For an owner of another merchant transmission line connecting PJM with NYISO, designed and managed an RFP process to sell transmission scheduling rights. Responsibilities included: (i) designing the auction, its rules, and the bid forms; (ii) identifying potentially interested bidders; (iii) providing analyses to describe the value proposition offered to holders of transmission rights for the line; (iv) developing other marketing materials; (v) assisting in the development of other auction materials such as bidder qualification forms and purchase and sale agreements; (vi) hosting a website and overseeing the provision of auction-related information through the website; (vii) communicating with potential bidders; (viii) responding to bidder inquiries;

(ix) interacting with the client regarding a variety of bidder-related issues; (x) selecting the winning bidders; and (xi) assisting in the preparation of a report submitted to the Federal Energy Regulatory Commission describing the auction process.

- For a municipal power provider that was a partial owner of a power plant in Illinois, designed and managed an RFP process to either sell the ownership stake in the plant or alternatively sell the output entitlement through a long-term PPA agreement. Responsibilities included: (i) developing target sale structures; (ii) formulating a schedule for completing the sale; (iii) developing the RFP documents and bid process tools; (iv) soliciting interest for the sale; (v) managing the RFP bid process; (vi) qualifying the bids; (vii) evaluating final bids and assisting in the negotiation of final terms; and (viii) preparing a report summarizing the RFP process.
- For an unregulated trading affiliate of a regulated utility, provided strategic bidding advice and financial analysis in a multi-round ascending clock auction to acquire PPAs for virtually divested generation assets. Assisted in the development of financial models to value the various PPAs, and in formulating between-round bidding strategies, including helping with algorithms to estimate the remaining amount of eligibility of competing bidders.
- Have been part of the Brattle team serving as the Independent Auction Monitor (IAM) for the Southern Company energy auction. Southern Company must supply its excess power resources under specified terms and conditions into a day-ahead and hour-ahead energy auction that is overseen by an external monitor. Our role is to: (i) verify Southern's calculations of available capacity to offer into the auctions; (ii) confirm that any transmission service necessary to accommodate a purchase under the auction is not unreasonably withheld; (iii) verify that the auction has cleared properly; (iv) ensure that internal data control restrictions are maintained to protect bidder information; (v) report complaints to the FERC; and (vi) independently file reports with the FERC regarding the auction.
- For industrial customers and municipalities in Texas in a stranded cost proceeding, submitted testimony to the Public Utility Commission of Texas that analyzed auction design issues pertaining to the sale of generation assets, including the potential impact on sale prices of conducting an auction when an outside entity has a right-of-first-refusal (ROFR) to purchase the assets at the winning auction price.

Retail Market Design and Power Procurement for Standard-Offer Service Customers

- For a utility in Pennsylvania, submitted testimony that analyzed cost and risk differences associated with full-requirements versus block-and-spot procurements of power supplies for default service customers. Analysis included estimates of the implied price premium for covering volumetric and pricing risk that was associated with past procurements of full-requirements power supplies, showing that this premium was relatively modest in size.
- For a utility in Pennsylvania, submitted testimony that estimated the expected level and variance in procurement costs associated with different portfolio strategies for providing electric power to default service customers. Analysis showed how different portfolio combinations of spot and forward purchases were likely to perform under different assumptions regarding the timing and frequency of forward purchases.
- For a utility in Maryland, submitted testimony that assessed differences in the expected cost and risk profile of different portfolio strategies for procuring power supplies for standard offer service customers. Analyzed how the use of a fixed-price default service product without switching restrictions provides customers with a potentially valuable option that may significantly increase the cost of supplying default service customers with full-requirements power. Assessed how load uncertainty affects the cost and risk of providing default service.
- For a utility in Pennsylvania, submitted testimony that assessed methods of supplying default service customers and the relationship between various facets of default service policy and the development of increased shopping by retail, residential, and commercial customers. Testimony analyzed the impact on customer shopping rates (and the competitive retail electric market) arising from the imposition of an "adder" to the price-to-compare, as well as from holding a retail opt-in auction subsequent to the purchase of power supplies for default service customers. Testimony also analyzed the magnitude of the "risk premium" embedded in the prices of past auctions to acquire full-requirements power supplies for default service customers.
- For a utility in Ohio, assessed a utility's proposed rate plan for self-supplying generation service to standard service offer customers, and compared its costs against the costs of procuring power from market sources under full-requirements contracts.

Asset Valuation

- For the City of San Antonio, performed a valuation of a nuclear power plant, and compared its value against alternative technologies including gas-fired, wind, and solar powered generation. Our analysis included a risk assessment of how the plant's value could be affected by changes in natural gas prices, environmental policy, and construction costs. Historical volatilities and implied volatilities derived from options were used to derive a distribution of potential valuation outcomes. Our results were submitted in a public report and hearing, as well as in briefings to the Mayor, City Manager, City Council, and the public.
- For a major overseas utility and investor in generation assets, performed a valuation of a proposed nuclear power plant in ERCOT and estimated the values of different types of PPAs associated with the output of the power plant. Made recommendations as to various structures for potential PPA agreements, and performed valuations associated with changes in individual PPA features. Identified potentially interested counterparties for PPA agreements. Also, performed a valuation analysis for the power plant for the "residual" period beyond the expiration of the PPA agreements. This analysis required predicting the expected level and variance of future power prices under differing outcomes regarding the price of natural gas and greenhouse gas policy.
- For a group of municipal power providers and industrial customers, performed a valuation of various power plants for a stranded cost proceeding. Built a financial model to estimate the assets' values at the time as sale, as well as analyzed comparable transactions to form an alternative valuation estimate.
- Built financial model to perform valuation analysis of renewable energy credits. This model was used to evaluate the results of several procurements of solar renewable energy credits conducted by Pennsylvania utilities, and the results of the model were presented to the Pennsylvania Public Utility Commission.
- On several occasions for utilities in the Mid-Atlantic and Midwest regions, have used multi-factor risk models to estimate the expected cost and cost distribution associated with different portfolio strategies for procuring power supplies for default service customers.

Competition Analysis

- For a merger of two major utilities in the western United States, estimated the pricing impacts associated with alternative generation divestiture scenarios through the use of a Cournot oligopoly simulation model. Assisted in the drafting of testimony related to the merger's impact on competition and other issues.
- For an independent power producer, submitted testimony to FERC assessing the competitive impacts of a high-profile merger involving two major utilities and generation owners within PJM, as well as the competitive effects associated with specific proposed market power mitigation measures.
- For a group of municipal power companies, analyzed a proposed merger involving two major utilities with generation supplies in the mid-atlantic and midwest regions. Reviewed the Delivered Price Test (DPT) analysis conducted on behalf of the merger applicants, and analyzed the sensitivity of applicants' results to changes in assumptions regarding power prices, gas prices, and available suppliers of imported power into the geographic area of interest.
- For two merging utilities in New York, analyzed vertical market power issues related to the merged entities' ownership of both transmission and generation assets, including the strategic use of transmission outages and other forms of transmission withholding to induce increases in power prices. Examined potential pricing impacts with the aid of security-constrained, least-cost dispatch generation model.
- For PJM, served as the lead author of a Brattle study that analyzed PJM's protocols for mitigating market power, comparing those protocols to the ones used in other major RTO markets and internationally (e.g., the United Kingdom, Australia, and Nordpool). Made recommendations for potential changes to PJM's market power mitigation practices, and presented findings to various PJM member committees.
- For two merging electric and gas utilities with overlapping service territories in New England, analyzed the competitive impacts of their merger, specifically as it related to market power concerns arising from the supply of gas to dual-fuel industrial customers, interconnection policy with respect to industrial customers, and vertical market power issues related to supplying gas to competitive generation suppliers. Presented analysis to Federal Trade Commission attorneys and economists.

- For two merging electric and gas utilities in North Carolina, analyzed the competitive impact of the merger on gas transport markets and the price of delivered gas to North Carolina customers, including competing generation suppliers. Submitted analysis to the North Carolina Utilities Commission along with an expert report.
- For an owner and operator of natural gas pipelines, provided a white paper to the competition authorities that presented a framework for analyzing the cost and benefits of further consolidation of pipeline ownership, and assessed the efficiencies that have arisen from prior consolidations of complementary pipeline assets.
- For the U.S. government, analyzed the pricing impacts arising from an alleged cornering of a major commodity market for an oil and gas derivative product. Formulated and estimated an econometric model to identify whether an "artificial price" had resulted from the alleged behavior consistent with the exercise of significant market power. Also provided estimates of damages attributable to the price overcharges stemming from the alleged manipulation.

PUBLICATIONS

Journals

"Domestic Versus International Capital Mobility: Some Empirical Evidence," with Donald J. Rousslang, *Canadian Journal of Economics*, Vol. 21, No. 2 (May 1988): 312-323.

"The Impact of Quotas and Tariffs on Strategic R&D Behavior," *International Economic Review*, Vol. 32, No. 4 (November 1991): 985-1007.

"Anticompetitive Effects of Mergers in Markets with Localized Competition," with David T. Levy, *Journal of Law, Economics, and Organization*, Vol. 8, No. 2 (April 1992): 427-440.

"Quality Choice, Trade Policy, and Firm Incentives," *International Economic Review*, Vol. 33, No. 4 (November 1992): 817-835.

"Basing-Point Pricing and Incomplete Collusion," with David T. Levy, *Journal of Regional Science*, Vol. 33. No. 1 (February 1993): 27-35.

"Ocean Shipping Economics: Comment," *Contemporary Policy Issues*, Vol. 11, No. 3 (July 1993): 81-85.

"Product Differentiation and the Ability to Collude: Where Being Different Can Be an Advantage," with David T. Levy, *Antitrust Bulletin*, Vol. 38, No. 2 (Summer 1993): 349-368.

"Antidumping Policy," *International Economic Review*, Vol. 34, No. 4 (November 1993): 745-763 [reprinted in Douglas R. Nelson and Hylke Vandenbussche editors, *The WTO and Anti-Dumping: Volume 1* (Cheltenham, UK: Edward Elgar Publishers, 2005): 392-410].

"The Importance of Localized Competition in the 1992 Merger Guidelines: How Closely Do Merging Firms Compete?" with David T. Levy, *ABA Antitrust Law Journal*, Vol. 62, No. 3 (Spring 1994): 695-716.

"Market-Share Quotas," with Oliver R. Grawe, *Journal of International Economics*, Vol. 36, No. 3/4 (May 1994): 431-447.

"Price Discrimination and Mergers," with David T. Levy, *Canadian Journal of Economics*, Vol. 28, No. 2 (May 1995): 427-436.

"In the Matter of Weyerhaeuser Company: The Use of the Hold-Separate Order in a Merger with Horizontal and Vertical Effects," with Robert P. Rogers and Laurence Schumann, *Journal of Regulatory Economics*, Vol. 11, No. 3 (May 1997): 271-289.

"Market Power and Collusion in the Ocean Shipping Industry: Is a Bigger Cartel a Better Cartel?" with Paul S. Clyde, *Economic Inquiry*, Vol. 36, No. 2 (April 1998): 292-304.

"Is it Efficient to Impose Costs on Small-Volume Equity Traders?" with Paul S. Clyde, *International Journal of the Economics of Business*, Vol. 6, No. 1 (April 1999): 81-92.

"Lessons from the First Year of Competition in the California Electricity Markets," with Robert Earle, Philip Hanser, and Weldon Johnson, *The Electricity Journal*, Vol. 12, No. 8 (October 1999): 57-76.

"Entry Policy and Entry Subsidies," with Oliver R. Grawe, *Review of International Economics,* Vol. 7, No. 4 (November 1999): 715-731.

"Deregulation and Monitoring of Electric Power Markets," with Robert L. Earle and Philip Q Hanser, *The Electricity Journal*, Vol. 13, No. 8 (October 2000): 11-25.

"Strategic Pricing When Electricity Is Storable," with Alfredo Garcia and Ennio Stachetti, *Journal of Regulatory Economics*, Vol. 20, No. 3 (November 2001): 223-247.

"Rolling Seas in Liner Shipping," with Kelli L. Sheran, *Review of Industrial Organization*, Vol. 20, No. 1 (February 2002): 51-59.

"Regional Interactions in Electricity Prices in the Eastern United States," with Gregory R. Leonard, Adam C. Schumacher, and James G. Bohn, in Michael A. Crew and Joseph C. Schuh editors, *Markets, Pricing, and Deregulation of Utilitie*s (Boston: Kluwer Academic Publishers, 2002): 109-142.

"Designing Standard-Offer Service to Facilitate Electric Retail Restructuring," with Lisa V. Wood, J. Arnold Quinn, and Kelli L. Sheran, *The Electricity Journal*, Vol. 15, No. 9 (November 2002): 34-51.

"Can Mergers to Monopoly, Price Fixing, and Market-Division Agreements Raise Welfare?" with Paul S. Clyde, *International Journal of the Economics of Business*, Vol. 11, No. 1 (February 2004): 69-90.

"Forward and Spot Prices in Electricity and Gas Markets: Does 'Storability' Matter?" with J. Arnold Quinn and Adam C. Schumacher, in Michael A. Crew and Menahem Spiegel editors, *Obtaining the Best from Regulation and Competition* (Boston: Kluwer Academic Publishers, 2005): 109-135.

"Incentive Contracts for Infrastructure, Litigation and Weak Institutions," with Alfredo Garcia and Juan Benavides, *Journal of Regulatory Economics*, Vol. 27, No. 1 (January 2005): 5-24.

"Dynamic Pricing & Learning in Electricity Markets," with Alfredo Garcia and Enrique Campos, *Operations Research*, Vol. 53, No. 2 (March-April 2005): 231-241.

"Estimating the Economic 'Trade' Value of Increased Transmission Capability," with Andrew N. Kleit, *The Electricity Journal*, Vol. 19, No. 2 (March 2006): 69-78.

"International Perspectives on Electricity Market Monitoring and Market Power Mitigation," with Jose A. Garcia, *Review of Network Economics*, Vol. 6, No. 3 (September 2007): 397-424.

"Downstream Price-Cap Regulation and Upstream Market Power," *Journal of Regulatory Economics*, Vol. 33, No. 2 (April 2008): 179-200.

"Airline Alliances and Systems Competition," with Diana Moss, *Houston Law Review*, Vol. 45, No. 2 (Summer 2008): 293-332.

"The Effectiveness of FERC's Transmission Policy: Is Transmission Used Efficiently and When Is It Scarce?" with Andrew N. Kleit, *Journal of Regulatory Economics*, Vol. 34, No. 1 (August 2008): 1-26.

"Competition for Exclusive Customers: Comparing Equilibrium and Welfare under One-Part and Two-Part Pricing," with Glenn A. Woroch, *Canadian Journal of Economics*, Vol. 41, No. 3 (August 2008): 1046-1086.

"Competitive Effects of Exchanges or Sales of Airport Landing Slots," with Brendan McVeigh, Nicholas Powers, and Samuel Moy, *Review of Industrial Organization*, Vol. 46, No. 2 (March 2015): 95-125.

Books

The Regional Welfare Effects of U.S. Import Restraints on Apparel, Petroleum, Steel and Textiles, with Randi Boorstein, Michael Metzger, and Morris Morkre, Avebury Press, 1996.

Completed Studies

"Case Studies of the Price Effects of Horizontal Mergers," *Staff Report of the Federal Trade Commission,* April 1992, with coauthors.

"The Effectiveness of Collusion under Antitrust Immunity - The Case of Liner Shipping Conferences," *Staff Report of the Federal Trade Commission*, December 1995, with coauthor.

"The Effectiveness of Dutch Airport Transport Policy," study prepared for the Dutch Ministry of Transport, December 2002, with coauthors.

"The Economic Impact of an EU-US Open Aviation Area," study prepared for the European Commission - Directorate-General for Energy and Transport, December 2002, with coauthors.

"Study to Assess the Potential Impact of Proposed Amendments to Council Regulation 2299/89 with regard to Computerised Reservation Systems," study prepared for the European Commission - Directorate-General for Energy and Transport, October 2003, with coauthors.

PRESENTATIONS

"Genco Pricing & Genco Asset Values under Deregulation," presented to the Center for Business Intelligence Conference, Chicago, IL, September 18, 1998.

"Ancillary Services: New Business Opportunities in Competitive Ancillary Services Markets," presented at Electric Utility Consultants Workshop on Strategies for Pricing and Selling Ancillary Services, Denver, CO, September 9, 1999.

"Profit-Maximizing Strategies and Gaming: Market Power and Power Markets," presented to the Center for Business Intelligence Conference on Pricing Power Products and Services, Chicago, IL, October 14, 1999.

"Strategic Behavior and Power Market Prices," presented to the EPRI Asset &Risk Management Group, Washington, DC, June 23, 2000.

"Regional Interactions in Electricity Prices in the United States," presented to the CRRI Research Seminar, Newark, NJ, May 3, 2002.

"Standard-Offer Service and Retail Restructuring of Electric Markets," presented to the CRRI Eastern Conference, Newport, RI, May 23, 2002.

"The Economic Impact of an EU-US Open Aviation Area," presented to the U.S. Department of State, the European Commission (US office), and the Heritage Foundation, Washington, DC in 2002 and 2003 , and the Association of European Airlines, Brussels, Belgium, 2003.

"Transactions Costs Across Electricity Markets: Does Restructuring Matter?" presented to the CRRI Eastern Conference, Skytop, PA, May 22, 2003.

"Identifying the Relationship between Spot and Futures Prices for Electricity and Natural Gas," presented to the Center for Research in Regulated Industries (CRRI) Research Seminar, Newark, NJ, May 7, 2004, and the CRRI Eastern Conference, Skytop, PA, May 21, 2004.

"Geographic Integration, Transmission Constraints, and Electricity Restructuring," presented to the Federal Energy Regulatory Commission, Federal Trade Commission, Energy Information Administration, in Washington, DC, in 2004 and 2005, and the 10th Annual POWER Research Conference on Electricity Industry Restructuring of the University of California Energy Institute, Berkeley, CA, March 18, 2005.

TESTIMONY/EXPERT REPORTS

Testimony before the Advisory Commission on Conferences in Ocean Shipping, 1991, relating to an econometric analysis of the determinants of ocean freight rates, and the conclusions of that study with respect to the existence of market power in ocean shipping.

Expert Submission - Appendix J, Volume 1, Prehearing Brief on Behalf of Petitioner, Certain Flat Rolled Carbon Steel Products, June 21, 1993, U.S. International Trade Commission Investigation Nos. 701-TA-319-332, 334, 336-342, 344, and 347-353 (final); 731-TA-573-579, 581-592, 594-597, 599-609, and 612-619 (final). Analysis included a critique of methods used to evaluate domestic injury in trade cases. Also authored part of submission for post-hearing brief.

Expert Report Submitted to the European Court of First Instance on Behalf of the European Commission relating to the Petition of the Transatlantic Agreement to Annul the Commission's Decision of October 19, 1994, including a rebuttal of the expert economic analysis offered by the members of the Transatlantic Agreement in support of their collective restrictions on capacity utilization and their coordinated activity in setting certain types of freight rates.

Testimony in the Matter of Henry H. Godfrey v. Benjamin F. Hofheimer, III, *et. al.*, 1995, on behalf of defendant relating to the appropriate calculation of damages in a breach-of-contract dispute.

Expert Report Submitted to the Environmental Protection Agency, 2000, on behalf of a trade group of aluminum smelters assessing the economic costs of revised land-disposal restriction standards for spent aluminum potliners (K088), 2000.

Two Expert Reports Submitted to the U.S. District Court for the District of Maryland, 2001, in the matter of Charles River Associates Inc. v. Hale Trans, Inc., assessing the quality and cost effectiveness of economic expertise provided in a predatory-pricing matter.

Expert Report Submitted to the U.S. District Court for the District of Columbia in the Matter of DAG Enterprises Inc. v. Exxon Mobil Corporation, 2003, regarding the suitability of a prospective purchaser as an acquirer of Mobil assets under the antitrust standards used by the Federal Trade Commission.

Expert Report Submitted to the Federal Energy Regulatory Commission (Docket No. EC05-43-000) 2005 on behalf of Midwest Generation, regarding the competitive impact of the proposed merger of Exelon Corporation and Public Service Enterprise Group and the mitigation measures offered by the parties.

Expert Reports submitted to the U.S. Department of Transportation (Docket No. OST-2004-19214), 2005, on behalf of American Airlines, regarding the competitive impact of the proposed application for antitrust immunity of an airline alliance consisting of Delta, Northwest, KLM, Air France, Alitalia, and Czech Airlines.

Expert Report and Testimony before the Public Utility Commission of Texas (Docket No. 31056), 2005, on behalf of the Cities served by AEP Texas Central Company, the Texas Industrial Energy Consumers, and the Alliance for Valley Healthcare, regarding the competitiveness of an auction held to sell an ownership share in a nuclear power plant and the commercial reasonableness of the actions taken by the seller.

Expert Reports submitted to the U.S. Department of Transportation (Docket No. OST-2005-22922), 2006, on behalf of American Airlines, regarding the competitive impact of the proposed Star Alliance expansion to include LOT and Swiss airlines and expand antitrust immunity between Air Canada and United Airlines.

Expert Report and Testimony before the Public Service Commission of Maryland, (Case No. 9117, Phase 1), 2007 on behalf of Potomac Electric Power Company and Delmarva Power & Light Company, regarding the risks and costs associated with portfolio procurement of electric power supplies as opposed to relying on a full-requirements auction-based procurement method.

Expert Report submitted to the Pennsylvania Public Utility Commission (Docket No. P-0072305), 2008, on behalf of Pennsylvania Power Company, regarding the risks and costs associated with different procurement methods for obtaining electric power supplies to serve default-service customers.

Expert Report and Testimony before the Public Utility Commission of Ohio (Case No. 08-936-EL-SSO), 2008, on behalf of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, regarding the rationale for using an auction process to procure full-requirements electric power supplies for standard-service-offer customers, as well as a description of the responsibilities undertaken by myself and The Brattle Group as manager of that procurement.

Expert Report submitted to the Pennsylvania Public Utility Commission (Docket Nos. P-2009-2093053 and P-2009-2093054), 2009, on behalf of Metropolitan Edison Company and Pennsylvania Electric Company, describing the design of an RFP process for procuring solar photovoltaic alternative energy credits and the management of that process by myself and The Brattle Group, as well as an analysis of

the desirability of meeting default service obligations through the auction-based procurement of full-requirements power supplies.

Various Expert Reports submitted between 2008 and 2010 to the U.S. Department of Transportation (Docket No. OST-2008-0252) and the European Commission describing the competitive impact of the proposal by the oneworld alliance to receive antitrust immunity, including various assessments of the impact on non-stop and connecting passengers that relied on econometric analysis of airline fare data and other empirical methods.

Reports submitted to the Pennsylvania Public Utility Commission, 2010, 2011, 2012, and 2013 as the Independent Procurement Manager for the procurement of Solar Photovoltaic Alternative Energy Credits by Metropolitan Edison Company, Pennsylvania Electric Company, and Pennsylvania Power Company including a description of the RFP process, a benchmarking of procurement prices against both current short-term prices and expected long-term prices for solar credits (based on a proprietary financial model), and the conformity of the procurement to the standards of least-cost procurement provided under Pennsylvania law.

Expert Reports (and Deposition) submitted to the U.S. District Court for the Middle District of Tennessee, 2012, in the matter of Watson Carpet & Floor Covering Inc. v. Mohawk Industries Inc., regarding the competitive effects of a carpet manufacturer's alleged refusal to sell its products to a carpet dealer serving production homebuilders in Nashville and surrounding counties.

Expert Reports and Testimony before the Pennsylvania Public Utility Commission (Docket Nos. P 2011-2273650, P-2011-2273668, P-2011-2273669, and P-2011-2273670), 2011 and 2012, on behalf of Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, and West Penn Power Company, analyzing the Companies' procurement strategies for supplying default service customers, describing the design of an RFP process for procuring solar photovoltaic alternative energy credits (and the management of that process by myself and The Brattle Group), proposing an auction process for outsourcing the provision of generation service for time-of-use customers, describing an "opt-in" auction process to promote the switching of default service customers to competitive retail supply, and describing a customer referral program that is also designed to promote retail competition.

Expert Reports before the Pennsylvania Public Utility Commission (Docket Nos. P-2013-2391368, P-2013-2391372, P-2013-2391375, P-2013-2391378), 2013 and 2014, on behalf of Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, and West Penn Power Company, analyzing the Companies' procurement strategies for supplying default service customers.

Report submitted and Testimony provided to the Canadian Radio-television and Telecommunications Commission (CRTC Docket No. 2014-76-1), 2014, on behalf of the Canadian Competition Bureau analyzing market power in the wireless market, including an analysis of industry profitability, an assessment of the impact on prices, market shares, profits, consumer surplus, and market penetration arising from the entry of an additional nationwide carrier, and an analysis of the cost impact for incumbent carriers arising from changes in spectrum availability used to accommodate additional entry.

Expert Reports before the Pennsylvania Public Utility Commission (Docket Nos. P-2015-2511333, P-2015-2511351, P-2015-2511355, and P-2015-2511356), 2015, on behalf of Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, and West Penn Power Company, analyzing the Companies' procurement strategies for supplying default service customers and the competitiveness of the proposed procurement process, and estimating the pricing and volumetric risk premium associated with past procurements.

Expert Report before the North Carolina Utilities Commission (Docket. Nos. E-2 Sub 1095, E-7 Sub 1100, and G-9 Sub 682), 2016, on behalf of Duke Energy, relating to an analysis of potential market power issues and the potential for competitive harm associated with the acquisition by Duke Energy of Piedmont Natural Gas, as it applies to the combination of electric and retail gas activities and the transport and delivery of natural gas.

PROFESSIONAL ACTIVITIES

Consultant to the *World Bank* on the formation of regional trading blocs, the *European Community* (DG IV) on antitrust and transportation issues, and the *Government of Canada* (Competition Bureau) on antitrust and transportation issues.

Advisory Board Member of the Center for Research in Regulated Industries

Member of the Atlantic Energy Group

Referee for the following journals: *American Economic Review, Canadian Journal of Economics, Contemporary Policy Issues, European Economic Review, International Economic Review, International Journal of the Economics of Business, Journal of Economics, Journal of Economics and Business, Journal of Economic Integration, Journal of Industrial Economics, Journal of International Economics, Journal of Regulatory Economics, Oxford Economic Papers, and Review of International Economics*.

Teaching Experience: Introductory Macroeconomics; Introductory Microeconomics

June 30, 2016