SPRING CSEM 2004
Center for the Study of Energy Markets
RESEARCH review
UNIVERSITY OF CALIFORNIA ENERGY INSTITUTE

A MESSAGE FROM THE DIRECTORS

Dear Friends and Colleagues,

With this introductory issue of the *CSEM Research Review*, we continue to expand our efforts to facilitate access to CSEM research and communicate the policy relevance of the research. We hope the *Review* will both explain the implications of CSEM research and help to refine and focus discussions at regulatory, legislative and other policy organizations in California and elsewhere. This issue of the *Review* summarizes the main policy points of three recent CSEM working papers. We hope that you will find these articles interesting and useful as you wrestle with current energy policy issues. The full papers are available on the UC Energy Institute Web site *(www.ucei.org)* under the CSEM Working Papers link.

We welcome your input regarding the effectiveness of these articles and any suggestions for improvement. We plan to publish the *CSEM Research Review* semi-annually. If you have not received this issue directly and would like to be on the distribution list, please send an email to ucei@berkeley.edu indicating whether you wish to receive it electronically or in hard copy.

Sincerely,

Severin Borenstein
Co-director

Jim Bushnell
Co-director

Can Higher Costs Lead to Higher Profits?

POLLUTION PERMITS AND ELECTRICITY PRICES

There is no shortage of finger pointing as to what caused the 2000-2001 California electricity crisis. Too few in-state generating plants, high input prices, and greed have all been blamed for the astronomical California wholesale electricity prices. New research digs into the insidious relationship between the price of pollution permits and wholesale electricity prices.

Jonathan Kolstad and Professor Frank Wolak of Stanford University, in *"Using Environmental Emissions Permit Prices to Raise Electricity Prices: Evidence from the California Electricity Market"* (CSEM Working Paper #113), explore how the price of pollution permits in the South Coast Air Quality Management District (SCAQMD) affected the wholesale electricity price in California. The authors theorize that a firm with plants both in and out of SCAQMD has an incentive to increase the cost of pollution permits as a means to increase the overall costs of its plants in SCAQMD. The higher plant costs would then serve as a justification for submitting a higher bid price, which the firm would expect to set the market-clearing price electricity for the southern zone, or perhaps for all of California. For such a strategy to work, the firm would also have to have the ability to exercise market power in the electricity market so that there would be a reasonable expectation that the high-priced plant would in fact set the market-clearing price. Kolstad and Wolak find that firms in this position behaved very differently than other firms, and that their behavior was not consistent with a competitive market.

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Regulating Competition: Structure vs. Behavior

How to regulate a competitive market may seem like an oxymoron. Yet even the most competitive market faces some form of actual or threatened regulation. As the electricity industry evolves towards competitive markets, so too must its regulatory framework. Regulators and academics alike are searching for the most effective regulation to foster a competitive electricity industry.

Dr. Jim Bushnell of the University of California Energy Institute (UCEI) begins his paper, *"Looking for Trouble: Competition Policy in the U.S. Electricity Industry"* (CSEM Working Paper #109) by describing and analyzing the evolution of the Federal Energy Regulatory Commission's (FERC) regulation of wholesale electricity. Over the last several years, FERC has moved from away from a 'structural' focus, where the intent was to establish a competitive playing field before allowing wholesale prices to be set by a market process. Instead, FERC has increasingly relied upon regulations that target firms' pricing behavior after the market is already operating.

Bushnell questions the wisdom of relying upon the micro-regulation of pricing and operational decisions of firms. There are concerns that such policies will introduce new and unforeseen regulatory distortions and yet still be relatively ineffective at curbing the exercise of market power. One of the reasons FERC has moved in this direction, however, is that their attempts at creating a competitive market structure have proven inadequate in markets such as California.

PRICE IMPACTS OF DIVESTITURE

	Mean PX Price ($/MWh)	Mean Cournot Price ($/MWh)	Mean Divest Price ($/MWh)	Mean Competitive Price ($/MWh)
June	122.29	127.93	98.40	52.67
July	108.60	131.84	102.09	60.27
August	169.16	185.02	144.18	79.14
September	116.64	116.26	91.30	75.12

Rather than abandon attempts to foster competitive market structures, Bushnell suggests FERC explore the adoption of more sophisticated tools. One such tool is the use of oligopoly models as market power screens. If a market functions as an oligopoly (i.e., where a few large firms can influence the market price), then it is crucial to address the conditions that allow the oligopoly to significantly raise prices. Bushnell then discusses a model that tests for oligopolistic behavior and simulates the impact of structural changes on firms' abilities to influence the market price.

The California electricity market was restructured in 1998. Relative to other restructured markets, California has somewhat less concentrated ownership of generation plants and the owners of the generation plants have far fewer end-use customers of their own. To test his hypothesis that an oligopoly model better describes the California electricity market than a competitive model, Bushnell models the five largest generating firms that had the ability to exercise market power during summer 2000. He assumes that each firm will choose to supply the amount of electricity that will maximize its own profits, given what the other firms are producing, known as "Cournot" strategies. These simulations result in Cournot equilibrium prices, in which no firm can improve its profits by changing its production.

Bushnell then compares the Cournot prices to the actual prices observed in the market and to a competitive benchmark price that was developed in an earlier paper. It turns out that the actual prices are much closer to the Cournot prices than they are to the benchmark competitive prices, which indicates that the firms behaved more as oligopolists than as competitive price takers in the electricity market. *(See Table.)*

Bushnell then simulates less concentrated ownership of plants by assuming additional divestiture of plants. The resulting prices were still significantly above the hypothetical competitive prices but much lower – on average $31 per MWh lower – than the Cournot prices in the more concentrated simulation. These lower prices in the less-concentrated plant ownership scenario could translate into savings of $1.8 billion over the 4-month summer period.

Bushnell argues that oligopoly simulations can be a useful tool in the assessment of the competitiveness of a given market structure. More importantly, the results indicate that structural approaches to regulating the market can significantly improve competition. With more diversified ownership of plants, firms will have less of an ability to influence the market price. Introducing real-time pricing to large customers and requiring long-term supply contracts yield similar results. His results indicate that any one of these measures — divestiture, contracts, or real-time pricing — would have reduced California wholesale prices to levels that likely would have averted the crisis of 2000-01. Thus, Bushnell concludes, policies that aggressively promote competitive market structures can be effective and merit more serious consideration at FERC.

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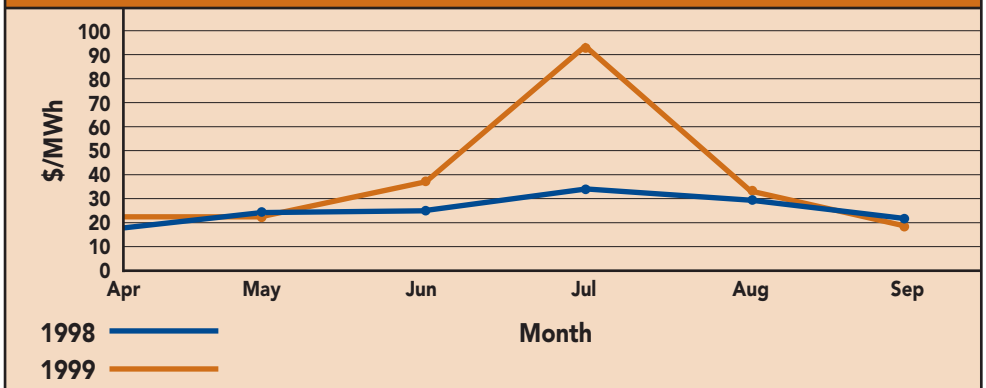
The Incentives of Vertical Integration After Restructuring

The restructuring of electricity markets has not always realized the goals of lower costs and increased efficiencies it was hoped would accompany competition. Instead, accusations of market power and market manipulation abound. Economists are trying to accurately measure market power and diagnose its causes.

In *"Vertical Integration in Restructured Electricity Markets: Measuring Market Efficiency and Firm Conduct," (CSEM Working Paper #117)* Professor Erin Mansur finds the Pennsylvania, New Jersey and Maryland *(PJM)* market to have been relatively competitive after the market restructured in early 1999. To measure the competitiveness of the PJM market after restructuring, Mansur compares the behavior of firms during the summers before and after restructuring. In this comparison, Mansur finds inefficient production in the market after restructuring and that two firms had incentives to, and did, exert market power over the wholesale electricity market.

To measure the competitiveness of the market, Mansur develops a competitive benchmark to calculate how much the market would have produced had each firm produced electricity competitively, i.e., generating whenever the wholesale price equaled or exceeded the firm's marginal cost of producing the power. Mansur calculates the generator's costs using two different models. In the "single period" model, he estimates the costs without taking into account intertemporal costs, e.g., "start-up" costs, ramping rates, "no load" costs, minimum down times and minimum operating capacity levels. The results of the "single period" model show an increase in production costs of 12.5 percent compared to a competitive market. In the second model, the intertemporal costs are included and Mansur finds that production costs increase only 3.4 percent. Although this comparison reveals that excluding intertemporal costs results in an overstatement of the production costs, and production inefficiencies, both models indicate that the market was operating less efficiently after restructuring.

PJM ACTUAL MARKET PRICES



Mansur then explores individual firms' behavior in the PJM market and tests for the exercise of market power. A firm with market power has the incentive to drive up the price by withholding cost-effective generation, which then necessitates less cost-effective generation to operate in order to meet demand. This has the simultaneous impact of increasing market production costs and the wholesale price of electricity. *(See Table.)* Many of the firms in PJM are vertically integrated: they both produce electricity to sell on the wholesale spot market and purchase electricity on the market to sell to customers. Retail customers pay a fixed rate so the firms that are net purchasers of electricity want the wholesale price of electricity to be low. Two firms in the PJM market, however, are net sellers of electricity. These firms have an incentive to increase the wholesale price of electricity, because on net they receive more revenues with a higher price. What matters for firms' incentives is their net position: PECO and PPL were the only large firms that sold more than they had to procure for their customers' needs. Mansur calculates the price markup over marginal cost for each firm in the PJM market and finds that PECO and PPL exercised market power after restructuring. These firms effectively reduced their production by 14 percent relative to the level they would have produced if they had been operating efficiently.

Mansur's conclusions lead him to advise regulators to thoroughly analyze a firm's incentives under every regulatory scheme and to create a market environment where a firm's incentives are consistent with an efficient market. These findings suggest that not all large firms inherently have an incentive to exercise market power. If a large firm also has a large retail obligation, and therefore must buy more electricity than it sells, that firm will have no incentive to raise the wholesale price of electricity. In the PJM market, it is the combination of large vertically integrated firms who are net sellers of electricity that creates the inefficiencies. In this scenario, Mansur recommends that regulators encourage these firms to sign long-term contracts to mitigate the effect of being net sellers and alter the firms' incentives enough to foster an efficient market.

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CAN HIGHER COSTS LEAD TO HIGHER PROFITS?

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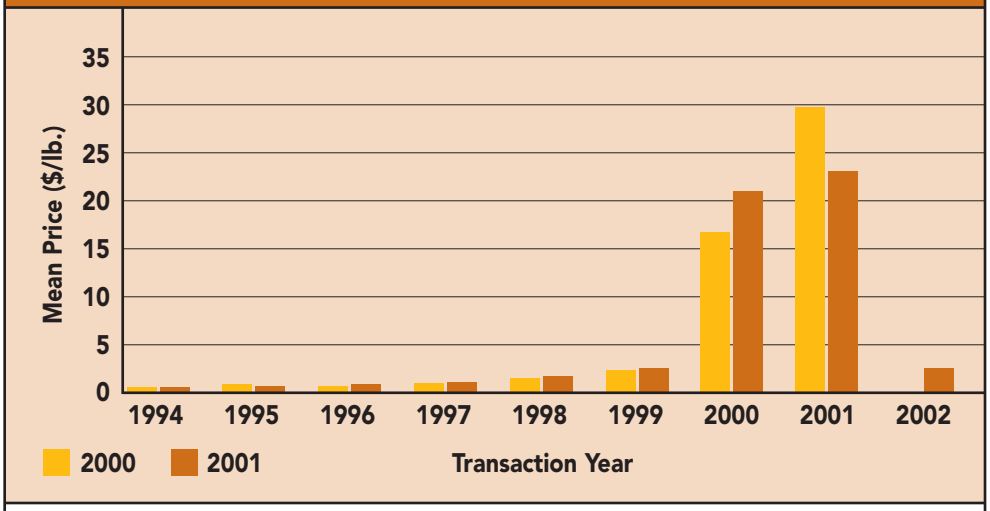
MEAN RTC PRICE FOR VINTAGE 2000 AND 2001 PERMITS BY TRANSACTION YEAR



In 1994, SCAQMD implemented the Regional Clean Air Incentive Market (RECLAIM) as a means to reduce the amount of NOx and SOx pollution. At that time, qualifying entities received an allocation of RECLAIM Trading Credits (RTCs) for each year from 1994 to 2010. RTCs could be bought and sold, either bilaterally or through a market exchange, but each year every company had to verify that it had sufficient RTCs for the amount of NOx or SOx they emitted that year. An RTC of any vintage could be traded in any year prior to its expiration, e.g., a 1999 RTC could be traded in 1996. RTC sellers received the price they bid; there was no published market-clearing price.

Kolstad and Wolak analyze RTC prices from 1997 to mid-2001, when RECLAIM was effectively suspended for generators due to the California electricity crisis. They found that a particular group of firms – those that had plants both in and out of SCAQMD – paid significantly higher average prices for the RTCs than did other firms in 2000 and 2001. These firms were also paying higher average prices in 2000 and 2001 than they had been paying in the previous years. For example, the average price for a 2000 RTC was $2.25 per pound of NOx in 1999 and jumped to $23.19 in 2001. *(See graph.)* In addition, there was a substantial increase in the variability of the prices paid in 2000 and 2001. In other words, some firms were paying high prices for a 2000 or a 2001 RTC while others were paying much lower prices for the same vintage RTCs. This divergence in prices was not evident in the years prior to 2000.

Kolstad and Wolak then compare how these firms operated their generating units in 1998 and 1999 to the dispatch order in 2000. One would expect that a firm would dispatch its plants with higher variable costs less frequently than those with lower variable costs. Instead, these firms ran plants with high RTC prices more frequently compared to low-polluting or out-of-SCAQMD plants in 2000 than they had run them in 1998 and 1999, when these same plants' RTC costs were much lower. Kolstad and Wolak also contrasted these firms' actual dispatch with an efficient dispatch benchmark and again found that the expensive plants were run far more often than an efficient dispatch would suggest.

Lastly, the authors analyze the relationship between a plant's overall marginal cost and the costs of natural gas and NOx emissions, i.e., the cost of the permit, to determine how strong an impact these two costs had on the output decisions at the plant. The standard economic assumption is that the firm's output responds similarly to all increases in marginal cost, regardless of their cause. Kolstad and Wolak find a strong relationship between the cost of natural gas and plant output decision, but a much weaker link between output decisions and the cost of emissions. This result suggests that the emissions costs were not treated in the same manner as input fuel costs by suppliers when they formulated their bids. They argue that this finding also undermines the notion that it was higher costs associated with emissions permits that contributed to the exorbitant increase in the wholesale price of electricity.

Kolstad and Wolak suggest that their findings support the theory that firms with plants both in and out of SCAQMD artificially inflated prices of RTCs in 2000 and 2001 to cost-justify higher bid prices and, thus, higher electricity prices. These firms had both the incentive and the ability to raise the price of pollution permits. The cautionary note from this analysis is that it is critical to analyze the complementarities between related markets when restructuring, so that the incentives in each market lead to the desired goal. In California, flaws in the RECLAIM market served to exacerbate the flaws in the wholesale electricity market.

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