

June 2001

# ENERGY MARKETS

## Results of Studies Assessing High Electricity Prices in California



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United States General Accounting Office  
Washington, DC 20548

June 29, 2001

The Honorable Jay Inslee  
The Honorable Peter A. DeFazio  
House of Representatives

Wholesale electricity prices in California rose sharply in May 2000 and have remained high. In addition, there were disruptions in service—blackouts—this winter and spring. The California Independent System Operator, the state agency in charge of balancing electricity supply with demand, expects high prices and service disruptions to continue and perhaps worsen this summer. Some other western states, including Oregon and Washington, have also experienced increases in their wholesale electricity prices since the summer of 2000.

A number of factors have likely contributed to these high wholesale electricity prices and service disruptions, including rapid demand growth since 1995 accompanied by slow growth in supply, higher-than-normal natural gas prices, and flaws in the design and structure of California's electricity market. In addition to these factors, state officials and others have attributed the problems, at least in part, to market power, exercised by individual electricity-generating companies. Some have argued that generating companies have staged outages of generating units to reduce supply and drive up prices. As evidence, they point to a higher-than-normal level of such outages since the summer of 2000.

In response to concerns about high prices and generator outages in California, the Federal Energy Regulatory Commission (FERC) undertook a study, released in February 2001, to determine whether outages were being used to physically withhold power and drive up prices of electricity in California. Other studies of the electricity market in California have been conducted by economists and industry experts. One study, conducted by three economists from Stanford University, the University of California at Berkeley, and the University of California Energy Institute examined whether market prices of electricity in California in 1998 and 1999 were higher than competitive levels. A second, similar study by two economists—one from the Massachusetts Institute of Technology and one from a private consulting firm—examined the California market during 2000.

Concerned about the potential use of market power to drive up electricity prices, you asked us to evaluate the FERC study, as well as the two studies

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on the California electricity market.<sup>1</sup> As agreed with your offices, this report addresses two questions: (1) How do the methodologies and results of the three studies compare? (2) Was FERC's study thorough enough to support its conclusions?

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## Results in Brief

FERC's study used a very different methodological approach from the approach used by the other two studies and reached different conclusions. FERC used a case-study methodology analyzing a number of specific generating plant outages to determine whether they were used strategically by generating companies to push up prices of electricity or whether they resulted from unavoidable or routine repairs or maintenance. As part of this methodology, FERC conducted telephone interviews with generating companies to verify the reasons for outages. It also visited the headquarters of two companies and performed on-site inspections at three generator plant sites. In every case, FERC found that legitimate repairs or maintenance was performed on the downed generating plants and on this basis, found that there was no evidence these companies were using outages strategically to withhold power and influence prices. However, FERC pointed out that its report did not analyze whether companies were using other techniques to influence prices, such as not offering bids to sell capacity at certain times, or bidding at prices high enough to practically ensure that their supply would be excluded from the market. The other two studies looked for evidence of the existence and exercise of market power in the entire market, rather than focusing on particular instances of generator outages. They compared wholesale market prices with the costs to generate electricity to determine if prices were significantly higher than would be expected if generators were acting competitively. The authors of both studies concluded that prices were higher than competitive levels, strongly suggesting that market power has been used in California to increase prices of electricity.

FERC's study was not thorough enough to support its overall conclusion that audited companies were not physically withholding electricity supply to influence prices. FERC's study was largely focused on determining whether or not there were actual physical problems—such as leaks in cooling tubes—in generating plants experiencing outages. However, industry experts we spoke with generally agree that it is practically impossible to accurately determine whether such physical outages are

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<sup>1</sup> See appendix I for bibliographic information about the studies.

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legitimate or not because plants frequently run with physical problems, and the timing of maintenance or repairs is often a judgment call on the part of plant owners or operators. In discussions with FERC, officials acknowledged that simply looking at outages and maintenance records of generators is not sufficient to determine whether generating companies are exercising market power to increase prices. A thorough study of market power would combine the market-wide approach of the other two studies with a quantification of the extent to which outages, or other supply disruptions, were caused by factors other than companies' attempts to drive up prices. Because the other two studies did not evaluate all the factors that could have led to an abnormally high level of generator outages, their results are not conclusive with regard to the precise extent that market power caused the observed high prices. To improve on its market monitoring, FERC officials told us that the agency has recently implemented a more comprehensive plan for detecting the exercise of market power.

We provided the Chairman of FERC with a draft of this report for review and comment. FERC agreed with the basic findings in the report but took issue with our characterization of its conclusion, saying that FERC had only concluded the absence of evidence of withholding electric power, rather than the absence of withholding to influence prices. In addition, FERC pointed out that it is important to make a distinction between its study, which focused on engineering reasons for outages, and the other two studies, which focused on economic reasons for withholding electric power.

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## Background

California moved to a deregulated electricity market in April 1998. For roughly 2 years, wholesale prices were fairly low on average. However, the state experienced periods of higher prices, especially during peak summer hours. Average prices rose dramatically in May 2000 and remained high. For example, average prices of electricity sold in the California Power Exchange during the months of May through December 2000 were between 2 and 13 times higher than in the same months of the previous year. In addition to higher prices, the frequency and duration of periods when the system is in danger of service disruptions have increased. Actual rolling blackouts occurred on 6 separate days in winter and spring 2001, for a total of 16 hours with shortfalls ranging from 400 to 1,000 MW. Blackouts adversely affected consumers and caused business and traffic disruptions.

The California electricity market operates within a larger western system consisting roughly of 11 states, and while California relies on imports for

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about 20 percent of its supplies, it also exports power at times to other states. As a result of this interconnectedness, the price and availability of power in California influence markets in other western states and vice versa.

Industry experts and academics generally agree that a tight power supply in California and other western states is one reason why prices increased and service reliability deteriorated starting in May 2000. The demand for electricity in California has grown rapidly since 1995, while very little new generating capacity has been added. For example, from 1995 through 2000, total electricity consumption grew by about 13 percent, compared with about 2-percent growth in electricity generating capacity in the state. In addition, last summer saw an increase in the price of natural gas—used to produce about 40 percent of California’s electricity supply—and in the price of emissions permits that are required to operate certain generators in California. Lower levels of available hydroelectricity during summer 2000 in the Pacific Northwest reduced California’s access to imports of hydroelectricity. Rapid demand growth in other states has also reduced California’s ability to import electricity from those states. Finally, flaws in market design in California are widely believed to have contributed to California’s problems. For example restrictions on the use of long-term contracts to purchase electricity increased the reliance of California’s three investor-owned utilities on spot markets and left them substantially exposed to market risks.

While these factors contributed to California’s electricity problems, a number of state officials, economists, and industry experts now believe that the market design adopted by California has enabled individual electricity-generating companies to exercise market power by withholding capacity when supplies are tight in order to drive up prices. They argue that generating firms have withheld supplies of electricity by staging outages in order to drive up prices, and point to higher-than-normal levels of outages since summer 2000.

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## Studies Used Differing Methodologies and Reached Different Conclusions

FERC’s study differed from the other two in its methodological approach and reached different conclusions. In addition, all three studies covered different time periods, so their results are not entirely comparable. FERC performed an audit of specific generating plants and companies that had experienced outages during December 2000. On the basis of these audits, FERC found that there was no evidence that the audited companies were incurring physical outages in an effort to drive up prices. The other two studies examined market prices and compared them with estimates of the costs of producing electricity to determine if prices were consistent with

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generating companies' exercising market power. Both of these studies, conducted during different time periods, concluded that there was evidence of market power used to increase electricity prices.

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### FERC's February Review of Outages Found No Evidence of Supply Withholding

FERC followed a case-study methodology, analyzing generating plant outages to determine if generating companies used them strategically to push up electricity prices or if they resulted from unavoidable or routine repairs or maintenance. FERC analysts conducted telephone interviews with generating companies to verify the reasons for outages. These telephone interviews covered about 60 percent of the reported outages. In addition, they visited the headquarters of two companies whose generating plants were down for maintenance or repairs to discuss in more detail the companies' repair policies, maintenance schedules, and operating practices. They also performed on-site inspections of generators at three plant sites and observed maintenance and repairs. In order to evaluate the legitimacy of the repairs or maintenance being performed, FERC employed private-sector consultants familiar with plant operations to accompany FERC analysts during the on-site visits. In addition to the audits, FERC examined market prices, levels of demand, and generator outages for the month of December 2000 to determine whether high levels of outages were correlated with higher prices of power.

Based on the results of its audits, FERC found that there was no evidence that the audited generating companies were withholding power in an attempt to influence prices. On the contrary, in every case, FERC found that legitimate repairs or maintenance was performed on the downed generating plants. Moreover, it found that these plants were typically older—30 to 40 years old—and had been used more intensively than usual during the summer and fall of 2000. In addition, FERC found that prices in the month of December were not strongly correlated with levels of outages. In fact, it found that the highest prices occurred during periods with relatively lower levels of generator outages.

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### Two Studies Comparing Costs and Prices Suggest That Market Power Exists

The other two studies looked for evidence of the existence and exercise of market power in the entire market, rather than focusing on particular instances of generator outages. They employed a methodology that compared market prices with estimates of the marginal costs of producing additional electricity. Marginal cost is the additional cost incurred to produce one more unit of electricity. Prices close to the marginal cost are consistent with a competitive market. High prices, however, may suggest that the market is not competitive and that individual electricity-generating companies can manipulate prices.

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The first study we examined, by Borenstein, Bushnell, and Wolak, compared prices with estimated costs of producing electricity in the period from June 1998 through September 1999. The authors constructed the market supply of electricity by estimating the cost of generating each additional unit of electricity, starting with the lowest-cost generating plants and adding increasingly costly plants. They used statistical simulation methods to take account of random generator outages, which decrease the electricity supply as units go off-line for repairs or maintenance and increase it as generating plants come back on-line. By matching actual demand at any point in time with their simulated supply of electricity, the authors were able to estimate the competitive price of electricity—that is, the price equal to the marginal cost incurred to supply the last unit of electricity demand. Then they compared the estimated competitive price with the actual price.

Based on their analysis, Borenstein, Bushnell, and Wolak concluded that there were periods of high prices and high demand from June 1998 to September 1999, which they attribute to the exercise of market power. The authors found that on average, the prices during this period were 16 percent higher than they would have been had generators behaved competitively. In discussion with one of the authors, we were told that while their study provides strong evidence of market power, it does not suggest any illegal activity on the part of electricity-generating companies. On the contrary, he believes that individual companies are sometimes able to exercise unilateral market power to raise prices without violating antitrust laws. The authors did not examine outages to try to determine whether the level or pattern was consistent with companies' withholding power, nor did they seek to determine precisely how generating companies exercised market power. In discussions with one of the authors, we were told that it is not possible to tell the difference between an unavoidable outage and a strategic outage designed simply to drive up prices. Moreover, a generating company might exercise market power in other ways. For example, a company can simply submit selling bids that are so high that all of its power will not be purchased, thus effectively reducing the volume of electricity sold in the market and causing prices to rise.

The second study, by Joskow and Kahn, examined electricity prices during summer 2000. The authors conducted a similar study to that of Borenstein, Bushnell, and Wolak, but their access to data was more limited. As a result, Joskow and Kahn relied on publicly available data for some key variables rather than the confidential and proprietary data used in the other study. Their study also differed from the first in that Joskow and

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Kahn analyzed outages during June 2000 to determine the extent to which withheld generating capacity was a factor in explaining high electricity prices. In doing so, they compared the volume of electricity generated at specific prices with their estimates of how much electricity could have been produced profitably at those prices, taking into account normal levels of unplanned outages and capacity held in reserve for system reliability reasons.

Based on their analysis, Joskow and Kahn concluded that there was strong evidence that market power was exercised to raise prices in summer 2000. They found that higher prices of electricity were caused in part by higher natural gas prices, increased demand, reduced availability of imports and higher prices for air emissions permits. However, they also found that prices in summer 2000 were greater than they would have been had the market behaved competitively. In addition, they concluded that the level of outages experienced during June 2000 cannot be explained by reasonable expectations about repairs or maintenance requirements, or by the need to hold power in reserve for system reliability reasons. However, the authors acknowledge that data limitations make their analysis of withheld generating capacity somewhat rough. Specifically, they lacked data on generating units outside of but selling power in California and contractual arrangements by electricity power marketers doing business in the state. Therefore, they were unable to measure generator outages outside of California.

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## FERC's Study Not Thorough Enough to Support Its Conclusion

FERC's study of electricity generator outages was not thorough enough to support its overall conclusion that the audited companies did not physically withhold electricity supplies to influence prices. FERC's study was largely focused on determining whether or not there were actual physical problems—such as leaks in cooling tubes—in generating units experiencing outages. Under this approach, if FERC found that there were physical problems with downed generating plants and that repairs or maintenance were performed, then it concluded that the outage was legitimate and not designed to simply reduce supply and push up prices. In fact, FERC determined that most of one company's generating plants were old and suffered from mechanical problems. In addition, FERC found that many of these plants had run at higher-than-usual rates in the summer and fall of 2000, prior to their shutting down for repairs or maintenance. These facts do suggest that a higher level of outages than normal should be expected. However, the industry experts we spoke with generally agree that it is practically impossible to accurately determine whether such outages are legitimate or not because plants frequently run with physical



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problems, and the timing of maintenance or repairs is often a judgment call on the part of plant owners or operators.

Another weakness in the FERC study—or any study that seeks to determine whether specific outages are legitimate—is the lack of data for past outages to use as a benchmark with which to compare the number, type, and duration of outages during the study period. In discussions with FERC, officials told us that accurate outage data do not exist for the years prior to their study.<sup>2</sup> Without a baseline comparison, it is not possible to conclude that observed outages are above normal in number, type, and duration. Finally, strategic use of plant outages is not the only way that a generating company could exercise market power, and FERC’s methodology did not look at other ways. As FERC acknowledged in its report, the agency did not analyze whether companies were using other techniques to influence prices, such as not offering bids to sell some capacity, or bidding at prices high enough to practically ensure exclusion from the market.

A thorough and conclusive study of market power in California since May 2000 would combine the market-wide approach of the other two studies, with a quantification of the extent to which outages or other supply disruptions were caused by factors other than companies’ attempts to drive up prices. In its study, FERC pointed out two such factors that could lead to higher-than-normal levels of outages: (1) some plants had been run at above-normal rates prior to being shut down for repairs or maintenance, and (2) many plants that were shut down were older. A third factor, suggested by other industry sources, is that a number of companies were simply refusing to operate their generators at various times during 2000 because they had not been paid for electricity they had previously sold to California’s utilities. None of the studies covered the entire period of high prices, nor did they evaluate all the factors that could have led to greater-than-normal levels of generator outages. Therefore, their results are inconclusive about the precise extent to which market power versus these other factors explains high electricity prices in California since May 2000. However, the authors of the two market power studies believe, based on their results and on results of other studies, that the case for the existence

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<sup>2</sup> In discussions with the California Independent System Operator, the body that collects outage data, we were told that prior to the FERC study, outage data had not been systematically reported by companies but that this information was now being collected.

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of market power has been conclusively made and that this is enough to warrant a policy response from FERC and the state of California.

FERC officials acknowledge that simply looking at outages and maintenance records of generators is not sufficient to determine whether generating companies are exercising market power. Accordingly, they told us that FERC has recently implemented a more comprehensive plan for monitoring the exercise of market power. Under this plan, FERC will continue to look at outages and to determine if the number, type and duration of outages are warranted. In addition, FERC will monitor generators' bids to try to detect bidding behavior designed to exclude generating capacity from the market. FERC officials also said they have notified electricity generators that their ability to earn unregulated market prices for electricity will be in jeopardy if they are found to be withholding power in order to drive up prices. We did not evaluate FERC's current plan for monitoring generators' behavior.

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## Agency Comments

We provided the Chairman of FERC with a draft of this report for review and comment. We also discussed the findings in our report with authors of the other two studies. Generally, FERC and the academic authors agreed with the basic findings in the report. However, FERC took issue with our characterization of its conclusion, saying that FERC had only concluded the absence of evidence of withholding electric power, rather than the absence of withholding to influence prices. In addition, FERC pointed out that it is important to make a distinction between its study, which focused on engineering reasons for outages, and the other two studies, which focused on economic reasons for withholding electric power (see appendix II for a copy of the FERC's comments). In addition, two of the authors of the other studies added several clarifying points that we have incorporated into the report.

In responding to FERC's first comment, we believe that our characterization of their overall conclusion is correct. In the conclusion section of its report, FERC made several statements. First of all, FERC stated that its "staff did not discover any evidence suggesting that the audited companies were scheduling maintenance or incurring outages in an effort to influence prices." On the contrary, FERC stated that "it appears that these companies accelerated maintenance and incurred additional expense to accommodate the ISO's [Independent System Operator] operating needs." FERC also pointed out the age and higher-than-normal usage of generating units as mitigating factors in explaining outages. Finally, FERC stated that its detailed site reviews are consistent

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with a finding that “prices are driven by demand, not the companies’ maintenance practices.” On the basis of these statements, we believe the report concludes that the companies they audited were not physically withholding electricity in an effort to influence prices. From a practical standpoint, a public statement, made shortly after the FERC’s outage report was released indicates that others felt the FERC was reaching such conclusions. For example, an article in the Los Angeles *Times* on February 3, 2001 quoted a spokesman for one of the generating companies as saying that the FERC report affirms the company’s operating procedures in the face of “incorrect and inflammatory allegations that we have somehow been withholding power from our four plants in California.”

The distinction between physical and economic withholding was pointed out by FERC in its second comment. We agree with FERC that the other two studies were wider in scope than its review of generator outages. As we pointed out in our report, a thorough and conclusive study of market power in California would combine the market wide approach of the other two studies, with a quantification of the extent to which outages or other supply disruptions were caused by factors other than companies’ attempts to drive up prices. We have added clarifying language in the body of the report that makes the distinction between the FERC report on physical outages and the other two, which looked more broadly for evidence of market power.

FERC’s report comes on the heels of some of the most dramatic electricity price increases in history. These price increases caused consumers, other market participants, and members of Congress to question whether electricity-generating companies have been charging unfair prices and making very large profits at their expense. In short, the public and others were looking for clear answers as to whether sellers of electricity in California were withholding power in an effort to raise prices. In this environment, FERC’s report—“focusing on whether unplanned maintenance or outages occurred to raise prices”—was important. In addition, as the federal government’s market monitoring entity, FERC’s views, opinions, and orders clearly send important signals to the marketplace, including the investment community, and influence public confidence. We believe that, as the federal government’s market-monitoring entity, FERC has an important responsibility to fully investigate potential market power and clearly report its results. In light of changes in the electricity industry as it undergoes restructuring, and the changing role of FERC in overseeing this industry, we recognize that

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FERC's monitoring role is evolving and that its outage report was simply one part of its ongoing effort.

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## Scope and Methodology

To develop an understanding of the issues surrounding market power in the electricity industry, we interviewed numerous economists from Stanford University, the University of California, Berkeley, and the University of California, Irvine, and reviewed written studies of market power and related issues. We also interviewed officials from state and federal energy agencies, including the California Public Utilities Commission, the California Independent System Operator, and FERC.

To compare the FERC outage study and the other two studies on market power, we reviewed the three studies, evaluating the methodologies used and the results. After our initial review, we discussed our findings with FERC officials and authors of the other studies. We also reviewed related studies of market power.

To determine whether FERC's methodology was thorough enough to support its conclusion that generating capacity has not been withheld without legitimate reason, we evaluated their methodology and results. We also discussed our findings with state and federal energy officials and an economist at the University of California, at Irvine who was familiar with all three studies.

We performed our work from May through June 2001 in accordance with generally accepted government auditing standards.

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Unless you publicly announce its contents earlier, we plan no further distribution of the report until 14 days after the date of the letter. At that time, we will send copies of this report to FERC and the authors of the two studies. We will also provide copies to others on request.

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If you or your staff have any questions about this report, please call me on (202) 512-3841 or Dan Haas on (202) 512-9828. Other key contributors to this report were Jon Ludwigson and Frank Rusco.

A handwritten signature in black ink that reads "Jim Wells". The signature is written in a cursive, flowing style.

Jim Wells  
Director, Natural Resources  
and Environment

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# Appendix I: Study Titles and Author Information

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“Report on Plant Outages in the State of California,” prepared by the Office of the General Counsel, Market Oversight & Enforcement and the Office of Markets, Tariffs and Rates, Division of Energy Markets, Federal Energy Regulatory Commission, February 1, 2001.

“Diagnosing Market Power in California’s Restructured Wholesale Electricity Market,” Severin Borenstein, James Bushnell, and Frank Wolak, August 2000 [unpublished]. Severin Borenstein is a professor of business economics in the Haas School of Business, University of California, and Director of the University of California Energy Institute. James Bushnell is a lecturer in the Haas School of Business, University of California, and a Research Associate at the University of California Energy Institute. Frank Wolak is a professor of economics at Stanford University and chairman of the Market Surveillance Committee of the California Independent System Operator.

“A Quantitative Analysis of Pricing Behavior in California’s Wholesale Electricity Market During Summer 2000,” Paul Joskow and Edward Kahn, January 2001 [unpublished]. Paul Joskow is the Elizabeth and James Killian Professor of Economics and Management at the Massachusetts Institute of Technology (MIT) and Director of the MIT Center for Energy and Environmental Policy Research. Edward Kahn is a principal at Analysis Group/Economics, a private consulting firm.

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# Appendix II: Comments From the Federal Energy Regulatory Commission

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FEDERAL ENERGY REGULATORY COMMISSION  
WASHINGTON, DC 20426

OFFICE OF THE CHAIRMAN

June 21, 2001

Mr. Jim Wells  
Director, Natural Resources and Environment  
United States General Accounting Office  
Room 2T23  
441 G Street, NW  
Washington, DC 20548

Dear Mr. Wells:

Thank you for your letter of June 15, 2001, enclosing your draft report of *Energy Markets: Results of Studies Assessing High Electricity Prices in California*. I appreciate the opportunity to comment on this report.

Generally speaking, I agree with the basic findings of this report. Plant operators have considerable discretion in performing maintenance which, in turn, makes it difficult to prove a generator outage is an attempt to withhold. I would note that the Commission's study found that there was no evidence that maintenance schedules had been changed, that the outages appeared to be justified and that "the outages did not necessarily correlate to the movement of prices on a given day."

I would like to comment on the report's assessment that "FERC's study was not thorough enough to support its conclusion that audited companies were not withholding electricity supply to influence prices." The Commission's outage study did not make this conclusion. As I mentioned, it concluded that staff found no evidence that the companies we examined changed maintenance schedules or incurred false generator breakdowns to influence prices. Although we found no evidence of this behavior in these instances, the public expects us to be vigilant and we believe that outage audits can only have a positive effect on generator behavior.

Further, it is important to make the distinction between the Commission's study, which examined the legitimacy from an engineering perspective of planned and unplanned generator outages (physical withholding), and studies which look for economic withholding. Economic withholding involves withholding generators from the market by refusing to bid into the market, or by offering bids at a high price that would not be accepted by buyers. The other two studies examined in GAO's report covered the

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potential for economic withholding and were wider in scope than FERC's report on generator outages. It is difficult to compare an engineering study of shut downs to an economic study of bidding patterns.

As your report notes, the Commission's outage study is not all we are doing to examine outages, withholding, and the western markets. In addition to its generator outage study, the Commission has taken numerous actions to investigate and remedy the problems in western electricity markets. For example, we imposed new pricing rules that we expect will deter withholding, imposed new conditions on market-based rates that will deter economic withholding, initiated a formal investigation of specific companies that may have engaged in physical withholding, and we have also intensified our monitoring of current outages. Further, we are now gathering new data that will permit greater scrutiny of historical outages.

I appreciate the hard work your staff put into this report and am sure it will help to further the understanding of the problems in California and the West. Thank you again for the opportunity to comment on your report.

Sincerely,



Curt Hebert, Jr.  
Chairman





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