Generator Outage Increases:

A Preliminary Analysis of Outage Trends in the New England Electricity Market

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1. Introduction

The deregulation of electricity markets across the United States and indeed the world has been lauded as a great success and condemned as a colossal failure. While the virtues and vices of competitive electricity supply will be debated for some time, it is undeniable that the road to competition has been anything but smooth. One of the biggest problems in the opening of electricity markets is how to guard against potential gaming and abuse of the system.

One of the most serious potential abuses of a competitive electricity market is the intentional withholding of generating capacity from the pool of available power generation resources. Generating capacity could be withheld by declaring a "forced outage" to make repairs, or by extending a planned outage for maintenance. Such capacity withholding can lead to an artificial shortage of electricity supply and produce inflated market prices or reliability problems.

Under the rules in the newly competitive electricity markets in the Northeast and California, in general, all power plants bidding electricity into the spot market are paid the same "market-clearing" price.[1] Lowest priced bids are accepted first, with increasingly more costly bids then accepted up to the point that enough power is purchased to meet overall market demand. The price paid to all bidders - called the market-clearing price – is set by the highest bid needed to meet overall market demand. In theory, this system provides an incentive to generators to keep their bids low. Bidding low increases the likelihood an electricity generator's bid will be accepted, but the generator will still receive the market-clearing price.

The withholding of lower-cost power plants from the market, however, can lead to higher market clearing prices for all generators bidding into the spot market. In some circumstances, a generating company could reap windfall profits by withholding some generating capacity, thereby increasing the market-clearing price received by its other power plants.

Such withholding of capacity has been suspected of contributing to high market prices in California. Spot prices for electricity in California have been extremely high since the summer of 2000. For at least a period in early December, nearly one third of available in-state generation was off-line.[2] At least at one point, state inspectors were turned away at plant gates when inquiring as to the validity of claims that generating units were down due to maintenance problems.[3] California is not the only state where such concerns have been raised. In December, the New York State Public Service Commission released a report stating that "strong mitigation measures need to be in place to prevent abuse of market power."[4]

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1 In some markets, the price paid to suppliers also can reflect location based issues such as transmission constraints.

2 Vogel, Nancy, "Crisis Darkens State Christmas Tree," *Los Angeles Times*, December 6, 2000.

3 McSwain, Dan, "California Investigators Inspect Power Plants to Avert Crisis," *North Country Times*, December 8, 2000.

4 New York State Department of Public Service, "Interim Pricing Report on New York State's Independent System Operator," Department of Public Service Pricing Team, December 2000.

New England's competitive wholesale electricity market opened on May 1, 1999.[5] Since that time, the region has experienced higher hourly spot prices, substantial price volatility, and higher monthly average market prices, as documented below. Although it appears that increases in oil and gas prices to electric companies have been a contributor to higher electricity prices, the Union of Concerned Scientists asked Synapse Energy Economics, Inc. (Synapse) to investigate whether there is any evidence of changes in the frequency or patterns of power plant outages in New England that may have also contributed to higher electricity prices. [6]

2. Data Sources and Limitations

Synapse based this analysis primarily on data published by the New England Independent System Operator (ISO-NE) in its monthly Load Capability Reports and its daily Morning Reports. These publications report the total megawatts (MW) of capacity out of service due to planned or forced outages and capacity reductions.[7] There were some considerations in using the published data, each of which is discussed below.

1. ISO-NE does not publish information on individual plant outages and capacity reductions. Therefore, we were unable to examine the trends in outage durations for individual generating units. This prevented us from analyzing the connection between the outages that occurred at individual generating plants and the periods of unusually high hourly spot market prices.

2. ISO-NE does not publish information that would allow us to distinguish between capacity out of service due to planned versus forced outages and capacity reductions. For this reason, we were unable to independently confirm the higher fossil plant forced outage rates that were reported by ISO-NE for the first eight months following the opening of the competitive market.[8]

3. For the first five months that the new competitive market was functioning, May through September, 1999, ISO-NE published data only for the weekdays during each month. For this reason, our analysis examines the total megawatts of capacity out of service for both planned and forced outages on an average weekday. This was not a significant problem since nearly all of the highest electricity market clearing prices have occurred on weekdays rather than on weekends. In addition, peak loads have traditionally occurred on weekdays, not weekends.

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[5] On May 1, 1999 the NEPOOL moved from a system of regulated dispatch to a competitive bid based dispatch system.

[6] This problem is distinctly different from recent "capacity market" problems in New England. The issues surrounding New England's capacity market (ICAP) were mainly concerned with bidding strategies in the ICAP market and are a separate issue not dealt with in this report.

[7] Planned outages are those outages scheduled for maintenance and other purposes; forced outages are those outages that are unplanned and due to events such as equipment failure; capacity reductions are losses of generating capacity due to equipment performance thresholds and safety standards. For the purposes of this report "out of service" will refer generically to all types of outages unless otherwise specified.

[8] See Finding Number 4 later in this Report.

4. The extended outages of the three Millstone Units increased the reported total NEPOOL megawatts of capacity that were out of service for the period May 1996 through October 1997. Since the Connecticut Department of Public Utility Control has determined that the Millstone outages were the result of mismanagement (and Northeast Utilities senior management officials have acknowledged as much), we have adjusted the historical capacity data to eliminate the effect of these outages.

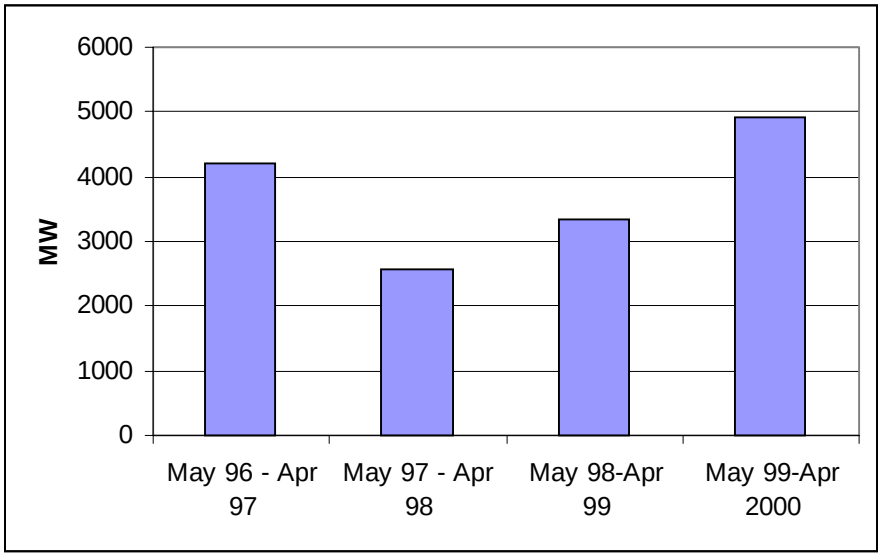
3. Findings

Synapse's five key findings are as follows:

1. The average amount of generating capacity out of service each weekday increased by 47 percent in the twelve months following the opening of the wholesale generation market (May 1, 1999 – April 30, 2000), as compared to the twelve month period ending May 1, 1999.

Figure 1 below shows that the average amount of generating capacity out of service each weekday increased dramatically during the first twelve months following the opening of the competitive market on May 1, 1999. In the 12 months beginning May 1, 1999, 47 percent more capacity was out of service (on an average weekday) during this period than had been out of service on average during the twelve months prior to the opening of the competitive market. In addition, the average amount of capacity out of service each weekday during the first twelve months following the opening of the competitive market was nearly double the amount of capacity that had been out of service during the twelve month period May 1997 through April 1998.

Figure 1: Average Megawatts of Capacity Out of Service Each Weekday for the 36 Months Prior to and the 12 Months Following May 1, 1999



Source: Calculated based on daily weekday outage data provided by ISO-NE, adjusted to eliminate the effect of the extended 1996-1998 Millstone unit outages.

2. ISO-NE data shows that New England fossil steam plant equivalent forced outage rates more than doubled from approximately 11 percent to nearly 24 percent after the New England market deregulated in May of 1999. [9]

The data presented in Table 1 and published by ISO-NE shows that fossil plant forced outage rates increased from 11.4 percent to 23.6 percent following the opening of the competitive market.[10]

Table 1: Fossil Steam Plant Equivalent Forced Outage Rates (EFOR)(Percent)

	% of Total NEPOOL Capacity	EFOR under "Markets" Environment (May 99 – Dec 99)	EFOR during 36 Months (Jan 97 – Dec 99)	EFOR during 28 Months (Jan 97 - Apr 99)
Fossil Steam	52.3	23.6	14.1	11.4

Source: ISO New England, Inc., "Review of NEPOOL Objective Capability for the Power Year 2000 – 2001," approved June 2, 2000, page 8.

This data is significant for the following two reasons:

- Fossil steam capacity, which accounts for slightly more than one-half of total NEPOOL capacity, often sets the market clearing price.
- National forced outage rates for fossil plants have declined somewhat in recent years (based upon data from the North American Electric Reliability Council's (NERC) Generator Availability Data System, through 1999. For example, NERC data shows that fossil plant (coal, oil, and gas) EFORs declined slightly from 7.90 percent during the five year period 1992-1996 to 7.72 percent for the five year period 1995-1999.[11] National oil plant EFORs similarly declined from 12.36 percent during the five year period 1992-1996 to 11.51 percent during the five year period 1995-1999. Consequently, the increased forced outage rates among New England fossil plants runs counter to national trends.

3. Wholesale electricity market clearing prices exceeded $100 per MWh for 105 individual hours on 23 weekdays during the first 16 months of the new competitive market. Eighty of these 105 hours, or 76 percent of the total, occurred on days when significantly more capacity was out of service than had historically been unavailable prior to the opening of the wholesale generation market on May 1, 1999.

In general, more capacity tends to be out of service during the spring and fall months because generators try to avoid having planned outages during the peak summer months (June, July and August) or the peak winter months (December, January, February, and March). We compared the amount of capacity out of service on each day on which the

[9] "Equivalent" refers to partial and forced outages. An equivalent forced outage rate (EFOR) thus reflects the percent of time when a power plant is completely out of service or when it remains in operation but is forced to reduce its power output.

[10] Unfortunately, as discussed in the Data Sources and Limitations section of this Report, we were unable to independently confirm these findings due to restrictions on publicly available data.

[11] North American Electric "Reliability Council Generating Availability Data System," 1997 and 1999.

market clearing price exceeded $100 per MWh with the amount of capacity, on average, that had been out of service during the same calendar month in the years preceding the restructured market opening.

For example, when looking at the largest price spikes, we found that wholesale electricity market clearing prices hit their highest value, $6,000 per MWh, on May 8, 2000. A total of 8,440 MW were out of service on that date. This was 66 percent more capacity than historically had been out of service, on average, on a weekday during the month of May prior to the opening of the new wholesale market.[12] Similarly, wholesale electricity market clearing prices reached $1,003.21 per MWh on June 8, 1999, when 5,965 MW of capacity were out of service. This was 83 percent more capacity than historically had been out of service on a weekday during the month of June before the competitive market opened.

However, dramatic price spikes have not been confined to only summer months. For example, wholesale electricity market clearing prices reached $156.56 per MWh on January 27, 2000. On that date, 5,186 MW of capacity were out of service, representing 160 percent more capacity out of service than historically had been, on average, on a weekday during the month of January prior restructuring.

Table 2 below presents the MW of capacity that were out of service on each day during the first sixteen months of the new wholesale market on those days when the wholesale electricity market clearing price exceeded $100 per MWh. The table also presents the average daily capacity that was historically out of service during this same calendar month in the three years prior to the opening of the new market.

[12] It is recognized that instance of $6,000 per MWh prices was during an unusually hot day for the month of May, which has traditionally been viewed as a "shoulder" month.

Table 2: Capacity Out of Service During Recent Price Spikes

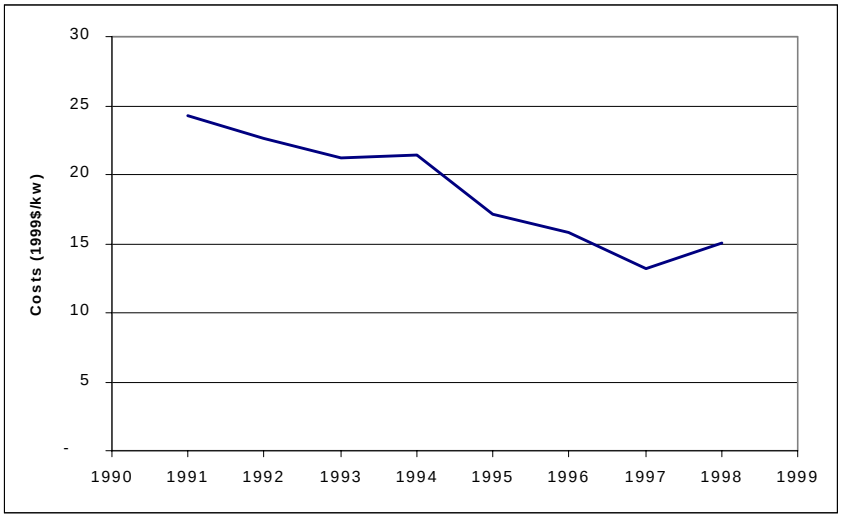
Date	Peak Market Clearing Price ($/MWh)	Total Capacity Out of Service (MW)	Increase/(Decrease) Relative to the Average Daily Capacity Out of Service During the Same Month in the Three Years Prior to Competition (%)
May 8, 2000	6,000.00	8,440	66
June 8, 1999	1,003.21	5,965	83
June 7, 1999	679.25	6,243	91
July 16, 1999	572.54	1,936	(22)
June 28, 1999	503.35	4,667	43
July 6, 1999	500.00	3,273	32
June 29, 2000	381.34	4,180	28
July 19, 1999	344.01	2,475	0
June 27, 2000	343.80	3,830	17
June 26, 2000	284.38	2,397	(27)
January 17, 2000	233.40	3,500	75
October 7, 1999	188.07	5,242	1
April 13, 2000	185.25	6,175	36
July 30, 1999	178.48	2,547	2
January 27, 2000	156.56	5,186	160
May 9, 2000	151.36	7,795	53
June 29, 1999	148.62	5,434	66
January 14, 2000	140.83	4,530	127
May 24, 2000	134.64	7,194	41
August 8, 2000	127.93	2,124	(29)
July 28, 1999	121.02	2,799	13
November 15, 1999	109.04	7,137	111
April 4, 2000	102.57	6,837	51

Source: Synapse analysis of data published by ISO-NE.

4. New England fossil steam plant O&M expenditures decreased by approximately 40 percent between 1990 and 1998 (the most recent data available).

Utility expenditures on operating and maintaining (O&M) fossil plants decreased dramatically during the 1990s. Although it is unclear from the publicly available data whether this meant that the plant owners postponed or cancelled needed plant maintenance, this decrease in spending may, in part, be responsible for the increase in fossil plant forced outage rates noted by ISO-NE. See Figure 2 below.

Figure 2: O&M Expenditures Between 1990 and 1998 for New England Fossil Steam Generating Plants



Source: Calculated based upon data reported in FERC Form No. 1 compiled by the Utility Data Institute.

5. Wholesale spot electricity market prices have increased dramatically since the new market was opened on May 1, 1999.

Electricity wholesale market prices reached or exceeded $100 per megawatt hour (MWh) during 122 hours in the new market's first 18 months of operation, and reached or exceeded $65 per megawatt hour during 401 hours. These levels had never been reached prior to restructuring. Market prices also reached or exceeded $50 per MWh for 1,346 hours in the new market's first 18 months, or approximately 24 percent of the time. This figure had only rarely been reached prior to May 1, 1999.

Since May 1, 1999, individual hourly market clearing prices have reached the previously unimaginable levels of $6,000 per MWh for 4 hours on May 8, 2000; $1,003 on June 8, 1999; and between $500 and $1,000 per MWh for another 17 hours in June and July 1999 and May 2000. Significantly higher market prices also were experienced during winter and fall months.

These higher individual hourly market clearing prices helped produce average monthly electricity wholesale spot market prices that were as high as $49.18 per MWh in June 1999 and $73.96 per MWh in May 2000. Average monthly prices rarely, if ever, had been this high during the six years preceding restructuring. At the same time that spot market clearing prices for wholesale electricity in New England have become more volatile, the amount of electricity sold in the wholesale spot market has grown significantly, increasing from 11 to 14 percent of the overall market during 1999 and rising to approximately 24 percent by August 2000.[13]

The price of oil and gas used for electricity generation has also increased significantly over the past 12 to 18 months. This has clearly been a major factor in rising electricity

[13] FERC Staff Report, "Investigation of Bulk Power Markets, Northeast Region," November 1, 2000, pages 1-41.

prices. The increased generator outages, addressed in this report have also contributed to higher electricity prices. Determining how much each factor contributed to higher electricity prices was beyond the scope of this study.

4. Conclusions

The amount of capacity out of service and fossil station forced outage rates (based on the ISO-NE study, see Table 1) rose significantly when the wholesale market moved to the bid based dispatch in May of 1999. These outages have contributed to higher hourly spot prices, substantial price volatility, and higher monthly average market prices.

One potential explanation of higher outage rates is reduced expenditures for power plant operation and maintenance costs over the last decade. Another potential explanation is that generators may be intentionally withholding capacity from the market in an effort to raise wholesale spot market prices.

Unfortunately, it is not possible at this time to definitively determine whether generators are withholding capacity to raise wholesale spot market prices due to the limitations in the data publicly published by ISO-NE. However, by analyzing plant and supplier specific data, it should be possible to determine whether suppliers have been engaging in anti-competitive withholding of capacity.

5. Recommendations

Based upon our investigation, we recommend the following:

1. ISO-NE has recently initiated a study of the reasons for increased generating plant unavailability. The ISO-NE study should be expedited. Our understanding is that the target date for reporting the findings of the analysis is March 1, 2001. While conducting a comprehensive and careful analysis will take time, it should be done as quickly as possible and key findings should be reported during the course of the analysis.

2. It is unclear from the publicly available documents whether the ISO-NE study will examine the question of whether New England suppliers have profited from potential instances of anti-competitive withholding of capacity. This analysis is especially important for the owners of those generating units that have experienced significant increases in planned and/or forced outage-rates since the opening of the deregulated market. This is a course of action that should be pursued by ISO-NE.

3. Federal and State regulators, as well as antitrust enforcement agencies should independently investigate generating unit outage trends to determine:

   - Whether plant owners are engaging in the anti-competitive withholding of capacity in order to raise market prices.

   - Whether generators have experienced increased planned and forced outage rates because the plants are deteriorating as O&M expenditures decline.

- This study should include comparative analyses of regulated and deregulated markets.

4. Market participants, generating plant owners, and regulators in New England should ensure that there is a sufficiently strong market power monitoring and mitigation mechanism that includes authority to review market participant behavior, market design, and system operation.

5. Before Federal or State regulators grant any utility retail electricity rates increases based on the higher prices that utilities may have had to pay for wholesale electricity since May 1, 1999, these regulators should investigate the following questions:

   - Whether the higher prices paid since May 1, 1999 for wholesale electricity were due to increased fossil plant forced or planned outages.

   - Whether generating plant owners caused the increased unavailability of capacity through inadequate plant maintenance during the 1990's.

   - Whether generating plant owners participated in any anti-competitive behavior since the opening of the wholesale market.