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"Electricity and Ancillary Services Markets in New York State: Market Power in Theory and Practice"

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Abstract

Since electricity, and its reliable provision on command, is a multi-attribute commodity, it should be priced over multiple dimensions if it is to be provided efficiently, and that requires multiple but related markets. So far New York is the only domestic electricity market that has introduced separate segments for ancillary services, together with eleven locationally defined markets for energy. By fragmenting the market over dimensions of space, time, and various contributing factors to reliability, the chances for greater efficiency are available in theory, but by spreading the market out, the possibility also exists of having fewer potential suppliers for each segment, thereby increasing opportunities to exercise market power at particular times and places. In fact several instances of market power have been observed that are not surprising with the benefit of perfect hindsight, and the lessons learned are combined with theoretical principles to establish guidelines for future electricity market design and operation.

I. New York State Market Structure

The Independent System Operator in New York (ISO) is charged with operating the bulk power system (generation and transmission) reliably, while developing and maintaining efficient wholesale markets for electricity. As a prelude to deregulation, each of the state's six utilities sold its generating facilities (except for nuclear plants) to independent companies; although these utilities continue to own both the transmission lines, that however are controlled by the ISO, plus their distribution system. In addition, the New York Power Authority (NYPA) is a public generation and transmission company, and the Long Island Power Authority (LIPA) serves customers on the island through its transmission and distribution system and long term contracts for its former generation. These two authorities collaborate with the ISO and participate in its wholesale markets.

Because of the potential for transmission line congestion limiting, at times, the statewide flow of power, New York has been divided into eleven separate geographic markets for electric energy, as illustrated in Figure 1, whose prices can differ when transmission lines crossing zonal borders are congested. Furthermore, each location has three temporal markets: day ahead, hour ahead balancing, and real time. While bi-lateral contracts operate outside the ISO's wholesale markets, the power flows are scheduled through the ISO and bi-lateral suppliers are afforded the opportunity to furnish "decremental bids", e.g. prices at which they would substitute purchases from the wholesale market at their supply location for their own supplies.

Capacity and/or reliability related markets include

transmission congestion contracts (TCCs) which essentially are purchased as hedges against price differences that may emerge across the boundaries of the eleven energy pricing zones, and mandatory purchases of rights to installed capacity (ICAP), which must be secured by load serving entities to meet their area's estimated peak load plus its required reserve margin, as computed for six month summer and winter periods. Providers of ICAP must offer into the day ahead energy market in order to demonstrate the availability of their units. Voltage support (VARs) are arranged for separately by the ISO and the costs are spread over all use through a separate tariff.

In addition, there are four active markets for reserves, both day and hour ahead, regulation, ten minute spinning reserves, ten minute non-synchronized reserves and thirty minute reserves – each successively less spontaneous in response to calls to action by the ISO. Regulation reserves are provided by units already operating and serving substantial loads, but that can pick up small amounts of additional load at almost a moment's notice. Typically, units selected for regulation reserves will back-down their energy supplies by an equivalent amount, and so suppliers that have been selected to serve this market will be paid the market-clearing price for regulation plus the lost opportunity cost (determined in the energy market) for the amount of energy withheld. Ten minute spinning reserves are facilities that can meet their obligations within ten minutes of notification, as assured by the fact that the units are running and synchronized with the system. Ten minute non-synchronized reserves are provided by fast-starting units, primarily gas turbines and hydro-electric facilities. Thirty minute reserves require longer ramp-ups, and therefore are in that sense less certain.

When suppliers offer into the energy markets, not only do they provide hour by hour energy supply offers, they also specify start-up costs and minimum generation times. Thus, the unit commitment problem is still solved by the ISO's system-cost-minimizing algorithm, but instead of using cost and capability data reported by the utilities, as under the previous regulated power regime, the ISO bases its optimization computations and calculates market clearing prices using offers form all vendors that can vary widely over time.

II. Chronology of Market experience

The New York ISO began trial generations on November 18, 1999 and officially took over the former power pool's responsibilities on December 1, 1999.

A. Regulation Markets

Almost immediately, the amount of regulation service offered was inadequate, market-clearing prices soared, and the ISO operators contacted numerous generators calling their attention to the commercial opportunities available to them were they to offer their units into the regulation market. Gradually, their capacity offered increased over the next two or three weeks and prices drifted down to the $20-$30/mW range within a month, (see Figure 2) and to the $15/mW level by spring where they have remained every since.

For the first time, experienced power system operators claim, there is some evidence of the true cost of providing regulation. Under regulated power pool operation, particular units were assigned the responsibility of providing regulation on a rotating mandatory basis, with small, pre-determined compensation. Plant operators grumbled when assigned the duty because of the wear and tear imposed on equipment as a result of the rapid ramp-ups in generation. Perhaps this explains the initial reluctance of the operators of generation to offer their units into regulation markets.

Lesson # 1: The transition from regulated to market-allocations requires ongoing real-time education, since many of the same people who were trained under one regime will continue to influence decisons in the market environment. By closely monitoring markets in transition periods and offering market participants "hints" on how they may perform better, so long as fairly provided, the costs born by customers may be reduced as the participants learn how to function under the new regime.

B. Ten Minute Non-Synchronized Reserves

In late January, the prices in the ten minute non-synchronized reserve markets rose sharply, as shown in Figure 3, from the $2-3/mW, range to spikes of $140/m, in large part because the capacity offered into the market was diminished. Although a single statewide clearing price is established for these reserve markets, because of congestion of transmission lines linking downstate (New York City and Long Island) with the rest of the market, ISO reliability requirements mandate that adequate downstate reserve be available to meet the downstate demands during

these congested periods. Because of unusual winter weather, line congestion was experienced in January and February 2000, and downstate supply-demand conditions set the statewide market prices, an unfortunate market design flaw since there were plentiful reserves upstate to meet upstate demand.

Compounding factors were the downstate market composition and yet-to-be-resolved problems with the market-clearing software and rules that prohibited large hydro-units located downstate from offering into the ten minute reserve markets. Together these factors limited the number of generation suppliers offering into the ten minute non-synchronized reserves market to four, with two accounting for nearly seventy percent of the supplies (see the NYISO filing before FERC, 2000, [1]). As suggested by experimental results (see Bernard, et.al, 1998 [2]), in markets that are repeated many times with similar supply and demand characteristics, after 40-50 repetitions, four suppliers might be expected to begin to exercise market power without any explicit collusion. By the end of January 2000, New York markets had been in operation for over eight weeks with approximately forty repetitions of each weekday hour, so in this case the practice was consistent with the experimental results. Despite these high prices for reserves, where in many circumstances the higher-valued ten minute spinning reserves had market prices lower than did ten minute non-synchronous reserves (see Figure 4), many suppliers were slow in reallocating their offers to the higher priced markets. Also, some suppliers who did not have all their offers filled in the energy market failed to shift their offers into the high-priced reserve markets. Once again, the ISO operators engaged in substantial "educational contact" with the generators, but as illustrated in Figure 3, little reallocation of offers took place in this case, and high prices persisted on and off again for almost eight weeks until the ISO announced its intention of filing a request for investigation with the Federal Energy Commision (FERC) and capped the offers into the reserves markets at their levels over the two months prior to the run-up in prices [1].

With the benefit of perfect hindsight, virtually everything that could be done wrong was done wrong in the original structuring of the market for reserves downstate by the market participants:

Lesson #2: It takes more than four suppliers to create a workably competitive electric market, particularly where two suppliers account for more than 70 percent of the market share. Here Hirshman-Hirfindah[1] Indices (HHI) may be useful gauges of the potential for exercising market power if the effective market area is properly defined in light of likely congestion constraints.

Lesson # 3: Apparently the designers of the market relied on the fact that public authorities comprise a substantial portion of the potential supplies of reserves to downstate markets, but it appears that any entity with market power might be expected to exercise it, regardless of their corporate structure. One view of the public interest is to keep prices as low as possible to all customers; apparently this was the behavior assumed by the market participants who designed the downstate reserves markets when they saw the potential dominant market shares controlled by public authorities. But another view of the public interest, if defined only over the customers served by the authority, would be to optimize revenues from wholesale markets for sales to both their own and outside customers so that the gains could offset other costs in setting prices to their own customers.

Lesson # 4: Congestion possibilities must be recognized in defining market areas where the same clearing price will be applied; otherwise, tremendous incentives are provided to generate profits for suppliers (particularly if commonly-owned) on both sides of the congestion. The cure for New York Reserve markets is to allow separate reserve prices up -and downstate, just as there may be as many as eleven different locationally-based energy prices in New York. Question: might some of California's high average summer prices be due to gaming for the benefit of units across congested boundaries?

Lesson # 5: Some suppliers may be slow to integrate market-clearing prices in multiple markets into their decision-making processes. In this case of downstate reserve markets, even after informational conversations with ISO operators, suppliers who offered into the area's energy or ten minute spinning reserve markets were extremely slow to redirect their offers into the seemingly more profitable ten minute non-synchronzied reserve markets. Is there a parallel to a previous conceptual analysis where dominant suppliers recognizing lagged customer response to price differences continue to find it profitable to charge high prices(see Schuler, 1998 [3]) ? In this case, the dominant suppliers might behave similarly, recognizing how slowly potential competitors are likely to respond by shifting their market focus.

Lesson # 6: It isn't the market-share of ownership that matters; it is the share of the available supplies whose offer strategies are determined by a single operator that counts. In the case of the downstate reserve markets, the public authority contracted the operation and marketing strategies for its generation to the operator of competing facilities, thereby further concentrating the market.

By summer's end, downstate reserves markets may once again be opened with caps on their offers eliminated. Important corrections to the market structures will have been made allowing for separate downstate and upstate markets and different prices, in congested periods plus market clearing software has been improved both to allow hydro-electric units to offer into reserve markets and to consider gas-turbine offers in smaller increments of supply that are consistent with their control capabilities. All of these factors should enhance the number of suppliers of reserves to the downstate region.

C. Energy Markets

There has been occasional evidence of behavior that could influence day-ahead and real time locationality based marginal cost prices (LBMP) by market participants in New York, both by some suppliers withholding portions of their units from the market in peak periods, and by buyers (load serving entities and marketing agents) in underestimating their demands in the day ahead markets. Currently all suppliers of ICAP must make offers into the day-ahead energy market; however, during this summer, increasing numbers of ICAP suppliers failed to do so. Because the ISO does not have blanket sanction and penalty impositions authority, this type of withholding must be addressed on a case-by-case basis through appeals to FERC. However, in order to enhance supplier flexibility in entering the most advantageous markets, the ISO is proposing rule changes that would allow successful suppliers of ICAP to demonstrate their availability by offering into any of the day ahead markets, either energy or reserves.

A particularly anomalous intertemporal result emerged in May when a number of buyers substantially under-bid the quantities they would need in the day ahead market, thereby depressing day-ahead prices. While the shortages had to be made up in the real time market, through July the ISO was required by the rules developed by the market participants to pass on those higher prices (so- called uplift charges) to all buyers in the market through the ISO's tariff for services (Rate Schedule 1). These rules allowed individual buyers to impose part of the cost of their bidding for inadequate supplies, regardless whether the cause was poor forecasting capability or intentional gaming, to all buyers throughout New York. These rules have now been changed so that buyers who bid for too little energy must bear the cost.

Lesson # 7: Sooner or later market participants will find a way to take advantage of any market structure that averages prices over space or time; that's the bad news. The good news is that in a market, sooner or later the exercise of that strategic behavior will highlight the deficiency in market structure, thereby signaling the need to change. By comparison, under regulation where averaging was endemic, perverse behavior was encouraged and persisted through the opportunities for cross subsidization across space and time.

However, by far the greatest problem in energy markets, both in New York and across the nation, is that energy demands are stretching existing generation capabilities, leading to an increasing number of price spikes in peak load periods. Most spikes occur in the real time market and are due in large part to the demand curve established by the ISO through its load forecast that is effectively vertical. Were there any elasticity to the short run demand curve, many of those spikes would be moderated (for example see Mount, 1999 [4] and 2000 [5]). This is particularly the case in New York where an analysis of the price composition of supply offers into energy markets during a heat wave in early May indicated that the spikes were set by a very small fraction of offered supplies (2-3 percent). The long term solution is to have greater supplies available since the competitiveness of any market is determined by the number of suppliers who could have produced profitably at the market-clearing price but were not selected. In fact, New York now has a backlog of 67 proposed facilities that would add nearly 80 percent of currently available capacity to the system, and a majority of those facilities are proposed for downstate where the prices are highest. So even if a fraction of these facilities are completed, New York markets should become more competitive in several years.

However, the immediate question is how much of a price premium should customers pay, for how long, to encourage those new supplies to be developed? The price spike experienced in May was $1,300/mWh, which is certainly well above the average running and capital costs for a combined cycle gas turbine of approximately $45/mWh. Furthermore, no one has asked retail customers if they are really willing to pay $1,300/mWh, e.g. what is their short-run price elasticity? In response to this asymmetry in market structure, the ISO reluctantly proposed a cap on offers of $1,300/mWh to last through the summer, and instructed all market participants to have price-responsive demand-side procedures in place for summer 2001. (In fact, FERC lowered the cap to $1,000/mWh, consistent with the caps in the neighboring ISOs). Despite the historic reluctance of many customers to adopt interruptible rates or demand

management protocols, never were they offered benefits much in excess of several cents per kWh; yet, the current market cost savings could amount to $1.00/kWh, even with offer caps in place. At ten to twenty times the historic incentives it will be interesting to see the customer's response. Futhermore, only a two to three percent demand response may be needed to reduce the price spikes substantially.

Therein lies the dilemma: if high prices are the spur to both capacity additions by suppliers and customer investments to shape their demands, then the success of those ventures will reduce their profitability. That is why the New York ISO was reluctant to cap offers below $1,300/mWh. Furthermore, as shown in figure 4, average wholesale market prices in New York that include these price spikes remain between 4-4.5 cents / kWh, just sufficient to cover the full cost of a new combined cycle gas turbine. And despite the periodic evidence of market power, with the exception of the February - March period, the cost of ancillary services provided through markets averaged about one percent of total average wholesale energy prices, as shown in Figure 5. So while price spikes capture headlines, if given the chance some customers may find it profitable to act in ways that might mitigate those spikes. If not generated by substantial exercises in market power, occasional price spikes should be allowed to perform their normal economic function; otherwise lesson # 7 will be ignored.

Lesson # 8 : Provide effective options to customers to determine at what price they are willing to take steps to adjust their demands in response to spiking prices.

III. Broader Economic Lessons

Several important cost lessons do emerge from this early experience with New York ISO markets. First, having workably competitive markets requires that some cost-effective suppliers be frustrated. It is the risk of not being selected that coerces a supplier to lower their offering price. But translate that principle to markets for reserves. If systems engineers determine that an eighteen percent margin of excess capacity must be maintained in order to ensure reliable system operation, then in order to secure that margin through a workably competitive market, a larger amount of capacity must be available and capable of reaching the designated areas during peak loads. Ensuring an effective market for ancillary services, particularly ICAP, therefore requires available capacity substantially in excess of the reliability required reserve margin. If that spare capacity that is needed to make the market function well must be continuously available, average prices must rise in the long-run to a level high enough to support that additional, efficient-market- required increment. In effect, an eighteen percent required reserve margin may require twenty-two percent total extra capacity to sustain an efficient market. And since generation capacity is sunk in the ground, if offered unsuccessfully into its home ICAP market, it may be unable to offer into other markets because of transmission constraints. In theory, this extra margin of capacity to make the market perform efficiently would not have been required under the former centrally-planned, regulated system. However, history suggests otherwise since customers in New York were burdened over the past twenty years to pay for reserve margins as high as forty percent because of incorrect load forecasts. Note, in a market forty percent excess capacity should induce intense competition for the eighteen percent requirement, leading to much lower ICAP prices, not the high costs borne by customers under regulation.

The second important lesson derived from these experiences is that energy and the various components of reserves comprising ancillary services do have many common costs, and suppliers are free to alter the composition of services offered in response to their relative prices. Therefore, it is extremely important to establish effective workably-competitive markets for all of these components of reserves, simultaneously, or else suppliers will seek opportunities to exploit the system where costs are averaged. So while developing effective markets for some components of reserves is an ongoing challenge in New York, at least the strategic behavior by market participants becomes transparent, and therefore may be corrected. By comparison, in neighboring ISO's where ancillary services are still provided by administrative fiat and the costs averaged across all customers, insidious strategic behavior leading to uneconomic results may be widespread, but few people know about it because it is submerged and its consequences averaged.

The third lesson is that human instincts, habits, foibles and frailties play a large role in determining market performance, and therefore particularly in the introductory stage of a new market, substantial education and personal intervention by the market operator may be required to facilitate the transition to smooth operation. This should not be surprising since continuous monitoring information requests and personal inquiries about apparent strategic behavior are commonplace in the operation of securities

markets. These are well-established markets that are thought to be extremely competitive; yet, if their efficient functioning requires continuous personal monitoring and regular inquires about behavior, then certainly a new complex market like electricity should be expected to require this type of extensive personal attention. Laissez-faire does not mean hands off! And if even after extensive prodding by the market operators, many participants are slow to respond to apparent profitable opportunities, thereby leading to strategic behavior by the remaining participants, what further steps should be taken if the pricing results, on average, are no worse than they might be under regulation?

The real challenge is to recognize that all aspects of electricity supply are related, and therefore it is important to open markets over as many dimensions as possible as soon as possible. Otherwise, market participants will learn how to take advantage of the inevitable averaging that arises when important components of supply, and therefore of their costs, are allocated administratively. Those who learn how to benefit from this process will have a large stake in its perpetuation, thereby making the transition to multiple markets more difficult in the future. So, the tradeoff seems to be either to open multiple markets simultaneously and face the many surprises that result from not perfectly foreseen behavior, like the NYISO, or to open a single energy market and learn how to do that very well, like PJM. But in that case the risk that market participants will grow so accustomed to those mixed market / administrative operations, with the associated profit niches exploited privately, that enormous resistance will develop to moving on to more efficient multiple markets.

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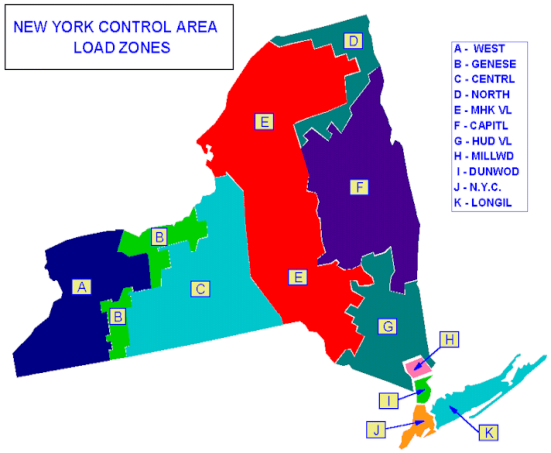

Figure 1. Eleven Pricing Zones in New York
Source : NYISO

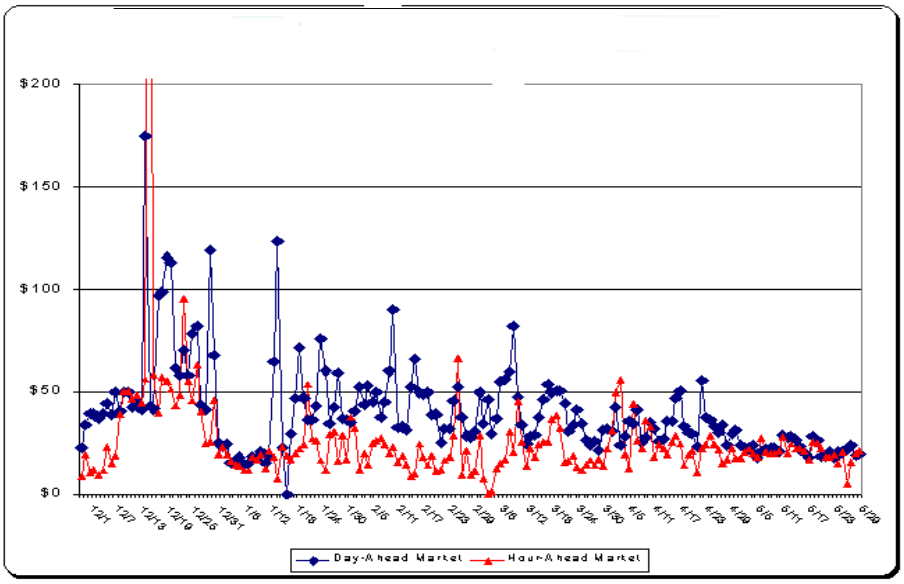

Figure 2. Avg. Daily Prices for Regulation (12/1/99 - 2/29/00) in $/mW
Source : NYISO

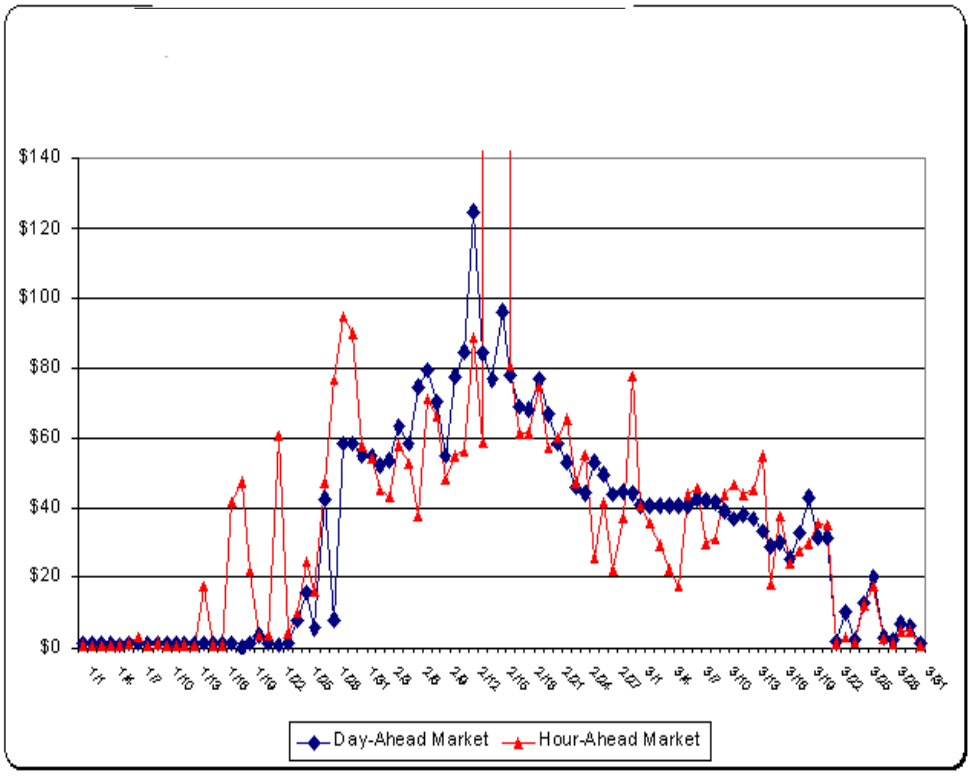

Figure 3. Avg. Daily Prices for 10 Minute Non-Synchronized Reserves (1/1/00 - 3/31/00) in $/mW
Source : NYISO

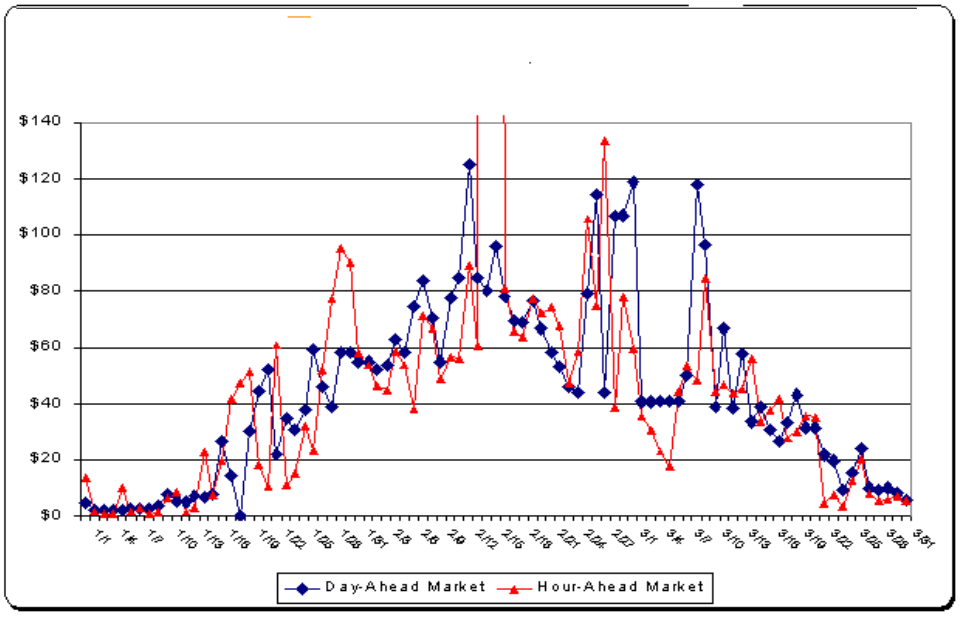

Figure 4. Avg. Daily Prices for 10 Minute Spinning Reserves (1/100 - 3/31/00) in $/mW
Source : NYISO

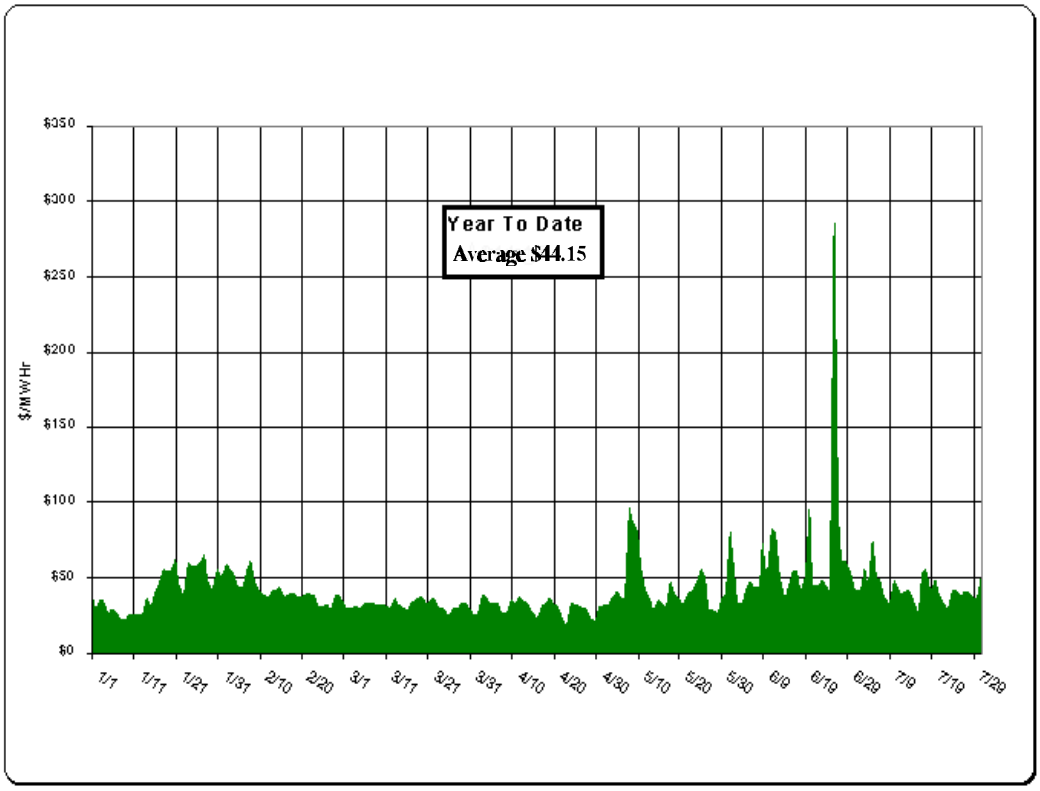

Figure 5. NYISO Daily Wholesale Electricity Price (1/1/00 - 7/31/00) in $ /mWh
Source : NYISO

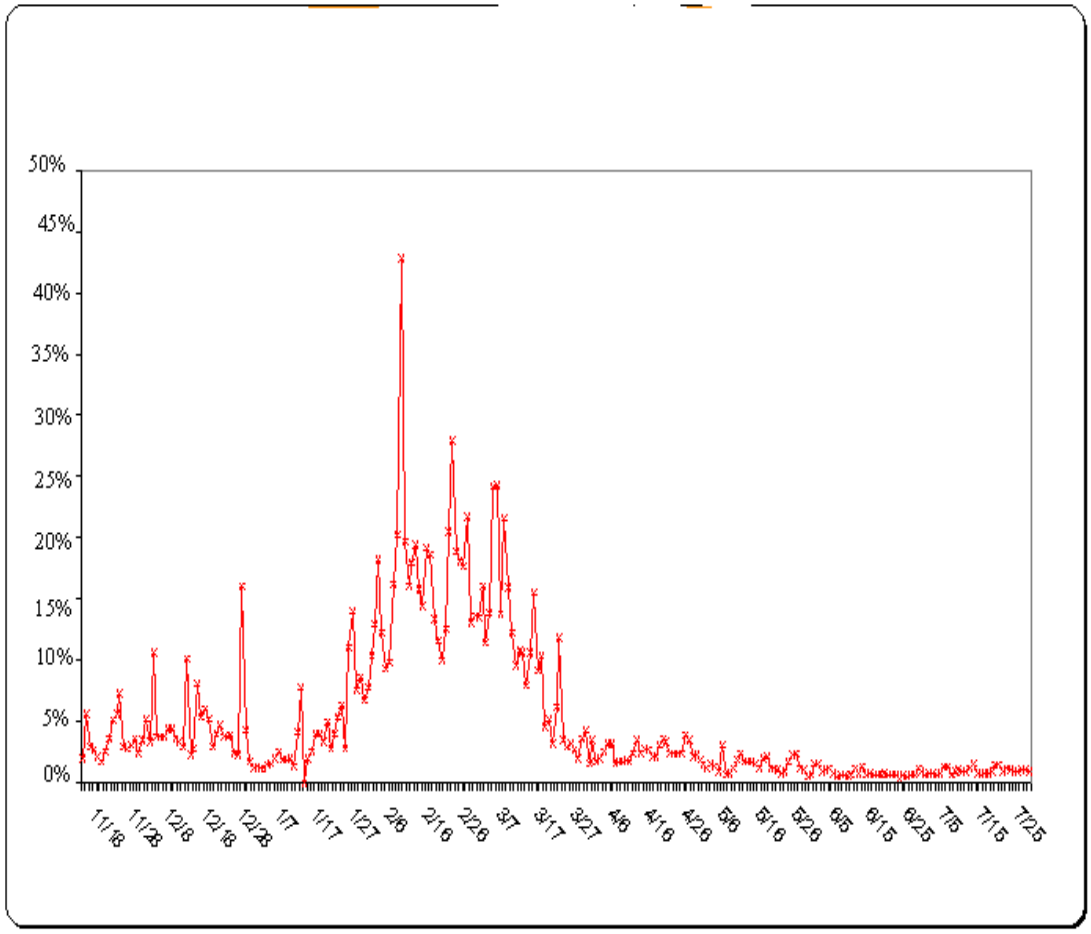

Figure 6. Ancillary Service for Day Ahead Market)11/18/99 - 7/31/00) as of % of Wholesale Prices
Source : NYISO