The History of LMP Pricing Development and the Origins of Fixed Block Pricing

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TOPICS

- Goals in Implementing LMP Pricing in the 1990s
- Constraints on Initial LMP Design and Implementation
- Origins of Fixed Block Pricing In NYISO
- Evolution and Lessons from Fixed Block Pricing in NYISO
- Fixed Block Pricing in MISO, ISO New England and PJM

GOALS IN IMPLEMENTING LMP PRICING

The development of LMP pricing designs by the PJM Supporting Companies, the Member Systems of the New York Power Pool, and San Diego Gas and Electric in the mid 1990s was driven by several goals:

- Provide open access to the transmission system based on prices that reflected the actual cost of meeting load so as to avoid cost shifting;
- Provide a pricing system that would support reliability with financial incentives that were consistent with the system operators dispatch instructions;
- Provide an efficient price signal for actions by consumers and suppliers that would be consistent with system conditions.

GOALS IN IMPLEMENTING LMP PRICING

Open Access to the Transmission System

- Order 888 required that transmission owners and the tight power pools provide open access to the transmission system.
- An important goal of implementing LMP pricing in PJM and New York was to provide open access to the transmission system without cost shifting by reflecting congestion costs in energy prices and charges for transmission usage.
- LMP pricing enabled transmission owners and power pools to provide non-discriminatory spot market access to the transmission system while avoiding the need to impose restrictions on bilateral transactions and limiting the need for constrained on and off payments.

GOALS IN IMPLEMENTING LMP PRICING

Open Access to the Transmission System: William Hogan stated in his December 31, 1966 testimony accompanying the PJM Supporting Companies Order 888 Compliance Filing, observed that the proposal:

- "Provides comparable and non-discriminatory access to the transmission grid;
- Provides efficient market based price signals for generation and consumption, and transmission use and investment."

William W. Hogan, Report on PJM Market Structure and Pricing Rules,, Compliance Filing of the Pennsylvania-New Jersey-Maryland Interconnection with Order No. 888, Docket OA97- December 31, 1996 pp. 1-2

GOALS IN IMPLEMENTING LMP PRICING

Open Access to the Transmission System: William Hogan further stated in his December 31, 1966 testimony accompanying the PJM Supporting Companies Order 888 Compliance Filing, observed that the proposed pricing mechanism:

- "Ensures that energy and transmission services are priced consistently and are available at cost-based offer prices to all traders, including small undiversified ones
- Provides all energy sellers and consumers with efficient marginal incentives;
- Efficiently allocates use of the transmission grid;
- Avoids reliance on complicated 'but for' calculations that would require a determination of alternative dispatches, limits shifting of costs into uplift and reduces the potential for gaming."

William W. Hogan, Report on PJM Market Structure and Pricing Rules,, Compliance Filing of the Pennsylvania-New Jersey-Maryland Interconnection with Order No. 888, Docket OA97- December 31, 1996 p. 44.

GOALS IN IMPLEMENTING LMP PRICING

Open Access to the Transmission System: William Hogan observed regarding open access and cost shifting:

> "The proposal also avoids cost shifting by providing comparable access and pricing to all users and by pricing energy and transmission on a locational marginal basis, rather than through some averaging scheme. The latter feature helps ensure that native load customers (who will pay the fixed costs of the existing grid) do not subsidize the use of the transmission grid by other customers."

William W. Hogan, Report on PJM Market Structure and Pricing Rules,, Compliance Filing of the Pennsylvania-New Jersey-Maryland Interconnection with Order No. 888, Docket OA97- December 31, 1996 p. 48.

GOALS IN IMPLEMENTING LMP PRICING

Open Access to the Transmission System: William Hogan also observed: :

> "with spot trading and balancing based on the difference in locational prices, no trader can lean on the system (or on any other trader) to implement its trades. It will therefore be unnecessary for the SO to place artificial restrictions on bilateral trades under the Supporting PJM Companies' proposal, as there will be no cross subsidization or averaging of energy or transmission prices that must be protected against arbitrage."

William W. Hogan, Report on PJM Market Structure and Pricing Rules,, Compliance Filing of the Pennsylvania-New Jersey-Maryland Interconnection with Order No. 888, Docket OA97- December 31, 1996 p. 86.

GOALS IN IMPLEMENTING LMP PRICING

Provide a pricing system that would support reliability with financial incentives that were consistent with the system operators dispatch instructions.

- The combination of LMP pricing and FTRs allowed transmission customers that have paid for firm transmission service to continue to use the transmission system without paying congestion, with the LMP pricing design providing efficient marginal incentives for participation by all market participants in the system operator’s economic dispatch.

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GOALS IN IMPLEMENTING LMP PRICING

Support Reliability: William Hogan observed:

"Because FTRs would be purely financial instruments, they would impose no constraints on the actual dispatch. Thus, unlike must-take power contracts, must-run generation or strict physical transmission rights, FTR ownership alone would not affect either the line availability or transaction scheduling. The economic dispatch consistent with the physical configuration of the grid would be determined by the SO without regard to FTR ownership…

If they choose, holders of FTRs could schedule bilateral transactions that match their FTRs. In this sense, the dispatch would be affected by the schedule, not by ownership, of the FTR. However, the FTRs, coupled with locational pricing, provide an economic incentive to avoid such inflexible schedules, since the FTR owners can realize the value of its transmission rights whether it actually schedules its generation or its loads are met by the SO's coordinated scheduling a lower cost."

William W. Hogan, Report on PJM Market Structure and Pricing Rules,, Compliance Filing of the Pennsylvania-New

GOALS IN IMPLEMENTING LMP PRICING

Provide an efficient price signal for actions by consumers and suppliers that would be consistent with system conditions.

In addition to providing incentives for participation in the system operators economic dispatch, LMP pricing sought to provide an efficient price signal for actions by consumers and suppliers outside the time frame of the 5 minute dispatch:

- Scheduling of interchange transactions with other regions;
- Commitment of generation by the suppliers
- Output of self-scheduled resources
- Reductions in consumption by consumers paying spot market prices.

CONSTRAINTS ON LMP PRICING DESIGN

Some of the important factors constraining the design of the initial LMP pricing designs were:

- The tight implementation deadline FERC imposed on tight power pools for compliance with Order 888 required that any pricing system for PJM and the New York Power Pool utilize existing dispatch software with as few changes or additions as would be workable;
- The extended debate over the need for LMP pricing precluded discussion of other important issues in developing competitive power markets;
- The design required FERC approval.

CONSTRAINTS ON LMP PRICING DESIGN

FERC implementation deadline:

- Order 888, issued April 24, 1996, required that the tight power pools file their open access tariffs by December 31, 1996 and that their members "must begin to take service under that tariff for all pool transactions no later than December 31, 1996." [1]
- Order 888 was preceded by a NOPR, but the NOPR was only issued on March 29, 1995.
- The PJM Supporting Companies and the member systems of the New York Power Pool were already discussing LMP pricing when Order 888 was issued but the FERC deadline left very little room for development of more than a basic LMP pricing design.

1. Order 888 Final Rule, April 24, 1996 pp. 270-271.

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CONSTRAINTS ON LMP PRICING DESIGN

FERC implementation deadline

- PJM was in a particularly difficult situation from an implementation standpoint because FERC required PJM to implement a uniform pricing system on April 1, 1997, then on November 25, 1997 ordered PJM to implement LMP pricing on January 1, 1998 (LMP Pricing was actually implemented on April 1, 1998). [1]
- Although LMP pricing had been previously implemented in New Zealand and was embedded in various industry software tools such as GE MAPPs, LMP pricing systems were not an off the shelf design that could be acquired on short notice from industry vendors.

1. Order Conditionally Accepting Open Access Transmission Tariff and Power Pool Agreements, Docket Nos ER96-2668-002 and EC96-29-002, November 25, 1997 at p. 90 order (G).

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CONSTRAINTS ON LMP PRICING DESIGN

PJM's initial implementation was therefore constrained by the capabilities of its existing dispatch tools.

- PJM could only send one electronic signal to each transmission owner region (a total of 13 electronic signals), with additional dispatch instructions for individual units relayed by phone. [1]
- The PJM operators relied on dispatch tools that identified resources that should be dispatched up or down, but did not solve a complete optimization.
- These features led to implementation of an ex post pricing design in which a pricing module calculated the LMP prices that were most consistent with the dispatch instructions.

1. See, Andrew Ott, PJM, Locational Marginal Pricing, June 16, 1998 p. 20.

CONSTRAINTS ON LMP PRICING DESIGN

The short time frame for LMP implementation similarly meant that the NYISO implemented LMP pricing in the real-time dispatch using the current NYPP dispatch software (SCD), with all limitations of that dispatch software.

- Load zone prices were calculated using generator node prices because SCD did not calculate prices at load nodes.
- Constraints that could not be solved in the 5 minute dispatch were relaxed, sometimes not enough, sometimes more than enough.
- Capacity was designated in advance to provide reserves or regulation, then completely blocked off from the real-time dispatch.
- Although the New York Power Pool's real-time dispatch tool (SCD) had penalty prices embedded in it that we recognized could be used to set prices, the practical issues in implementing such a design had yet to be worked through by the vendors.
- The changes made in SCD basically involved adding an additional dispatch pass (the ideal dispatch) and a price calculation module.

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CONSTRAINTS ON LMP PRICING DESIGN

LMP Debate

- Rather than spending the mid 1990s discussing topics such as resource adequacy mechanisms in markets with retail competition, shortage pricing designs, market power mitigation mechanisms, transmission expansion incentives or the details of an ideal LMP pricing design, the industry spent these years debating the need for LMP pricing with Enron.
- The amount of time and resources stakeholders such as state regulators and market participants had to spend on the LMP debate precluded significant discussion of other, much less straight forward and complex market design issues.

CONSTRAINTS ON LMP PRICING DESIGN

FERC Approval. A critical constraint on any pricing design proposed by the PJM Supporting Companies or the member systems of the New York Power Pool is that it had to be approved by FERC.

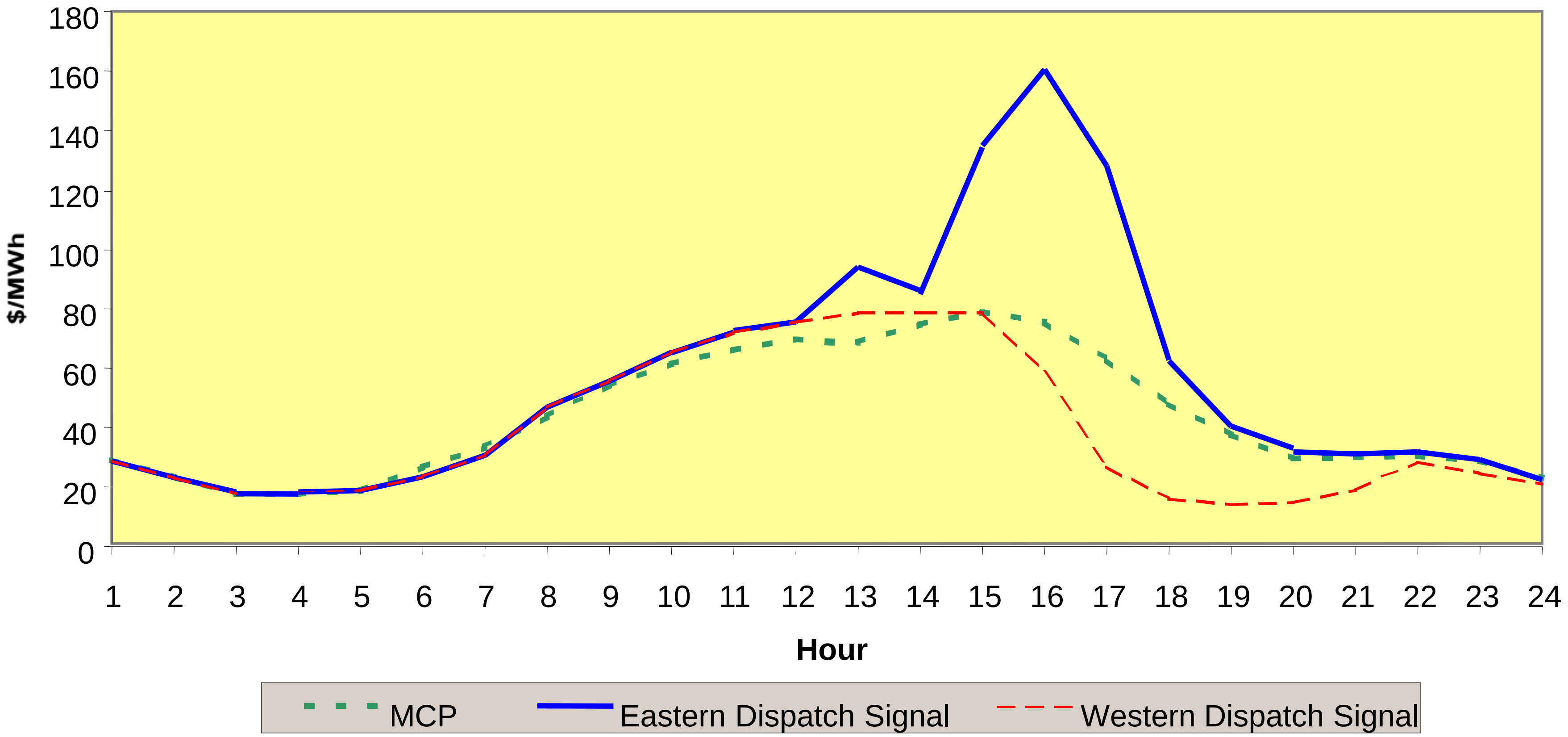
- FERC did not even approve the initial PJM LMP pricing design, instead approving the MCP pricing design that sent a price signal based on a make believe dispatch that was completely unrelated to system conditions and immediately failed when it got hot in Philadelphia in June 1997.

- FERC ordered the New York ISO to stop using fixed block pricing in July 2000 when it learned it was incorporated in NYISO real-time pricing. [1]

1. Order on Tariff Filing and Complaint, Docket ER00-3038-000 and EL00-70-000 and 0001, July 26, 2000 Section III E 2 pp. 18-20.

CONSTRAINTS ON LMP PRICING DESIGN

PJM Dispatch Signals and MCP, June 26, 1997



CONSTRAINTS ON LMP PRICING DESIGN

PJM's FERC-mandated transmission pricing system in 1997:

- Led to large differences between the dispatch signal and the MCP price for locations in the east and west of PJM.
- Caused constrained-off generators with costs that were less than the MCP price to withdraw from the ISO's dispatch and self-schedule their units.
- Self-scheduling spread as successively lower-cost units were first constrained-off and then returned to operation as self-scheduled units.

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CONSTRAINTS ON LMP PRICING DESIGN

Key real-time energy market design features that we take for granted today were far beyond what FERC would have approved in 1997 or 1998:

- Shortage pricing for energy and ancillary services based on penalty prices;
- Transmission demand curves.

CONSTRAINTS ON LMP PRICING DESIGN

FERC Approval: The limits of what we could discuss with FERC in 1997-1998 were encompassed by:

- LMP pricing for energy and transmission usage
- Marginal losses pricing
- Market based pricing for energy offers
- Ancillary service markets based on opportunity costs and offer prices.

Fixed block pricing is not on this list because it appears FERC did not intend to approve fixed block pricing in its NYPP orders and likely would not have approved fixed block pricing had it known.

FIXED BLOCK PRICING IN NYISO

The origins of New York ISO fixed block pricing lay in the design of the New York Power Pool's SCD dispatch program that was in use in the 1990s.

- SCD sent out dispatch instructions to all on dispatch resources every five minutes, minimizing the cost of meeting load while taking account of transmission constraints and resource characteristics such as ramp rates, minimum load levels and upper operating limits.
- Included in the resources that could be, and were, "dispatched" by SCD were off-line fast start, 10 minute, gas or oil combustion turbines. These resources were dispatched by SCD just like any other resource, with the actual physical start instruction confirmed by an NYPP operator before it was sent to the resource.

FIXED BLOCK PRICING IN NYISO

- While these fast start resources could be dispatched “on” by SCD, they could only be turned off after they had completed their minimum run time. Moreover, once they came on line they operated at their upper limit, i.e. their output was not dispatchable between zero and their upper limit.
- These resources were not just a footnote in the NYPP resource mix in November 1999. The New York Power Pool had dozens of units like this and while many would be scheduled to provide 10 minute reserves, a considerable number of such units were available for dispatch on a typical day and they were an important component of the New York Power Pool’s ability to reliably meet load on a hot summer day.
- SCD was not designed to take account of commitment costs, it was a single interval optimization engine. Hence, there were no start-up cost bids for quick starting gas turbines, any start-up costs were to be rolled into the bid price for the resource, effectively a minimum load offer price.

FIXED BLOCK PRICING IN NYISO

While there was no discussion of fixed block pricing in the original NYISO LMP tariff filings in 1997, the ambiguities in setting LMP prices that load to the development of fixed block pricing were discussed with FERC over the period 2000-2002.

- A key observation was that while the short-run marginal cost of meeting load was well defined if one held the unit commitment fixed, the unit commitment was not fixed.
- NYISO's SCD and later RTD software could commit additional generation to meet load in the 5 minute dispatch.
- The short-run marginal cost of meeting load by committing additional generation is not well defined and some approximation was needed to sent an approximately efficient price signal.

EVOLUTION AND LESSONS FROM NYISO

The discussion of fixed block pricing in in 2002 in the context of day-ahead markets pointed out the trade-offs inherent in the determination of prices when there are fixed block units, observing:

> "LMBP pricing provides perfect short-run incentives for generators to operate in a manner consistent with the reliability needs and economic dispatch of the ISO when applied to problems in which the cost functions are convex. Minimum run times, minimum down times, and units that either operate at capacity or do not operate at all violate these assumptions. In these circumstances, LBMP pricing will still provide workably efficient incentives but the determination of the LBMP price has ambiguities that do not exist in a convex world." [1]

1. Joint Affidavit of Scott M. Harvey and William W. Hogan para 25, June 12, 2002 Docket ER02-2081.

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EVOLUTION AND LESSONS FROM NYISO

It was further observed that:

> "There is no perfect solution to determining LBMP prices in the presence of these complicating factors and reasonable people will differ on the appropriate resolution of these ambiguities….It is important to recognize, however, that the cost of meeting the next MW holding unit on-line status fixed is not the only way to look at marginal costs when one of the short-run dispatch decisions is turning units on or off, as well as dispatching units up or down. In this situation all pricing rules involve tradeoffs." [1]

1. Joint Affidavit of Scott M. Harvey and William W. Hogan para 26, June 12, 2002 Docket ER02-2081.

FIXED BLOCK PRICING IN NYISO

The New York ISO implemented fixed block pricing at its start up on November 19, 1999, and the basic concept remains in operation in NYISO pricing software today.

- Changes were made in the real-time dispatch software in July 2000 to correct the initial implementation of ramp constraints;
- Changes were made in response to guidance from FERC in Docket EL00-70;
- Minor changes were made with implementation of new real-time dispatch software in February, 2005;
- Changes were made to accommodate changes in the modeling of dragging, March 2009;
- Changes were implemented in early 2017 that basically reversed the changes made in response to FERC's orders in 2000. [1]

1. See Docket ER17-549-000

FIXED BLOCK PRICING IN NYISO

The New York ISO's 1999 fixed block pricing design was motivated by a desire to send an efficient price signal when non-dispatchable gas turbines were committed to meet load.

- Prices set by the offers of steam units that are dispatched up and down to balance load between gas turbine commitments would not send an efficient price signal for the scheduling of interchange, the self-scheduling of generation, or reductions in power consumption by price responsive loads.
- Allowing these high cost resources to set prices when they were needed to meet load in real-time was also necessary to avoid creating incentives for load serving entities to underbid their load in the day-ahead market if they recognized that real-time prices could not be set by the high cost resources used to balance load and generation in real-time.
- Allowing these high cost resources to also set prices in the day-ahead market was similarly needed to provide efficient forward contracting incentives.

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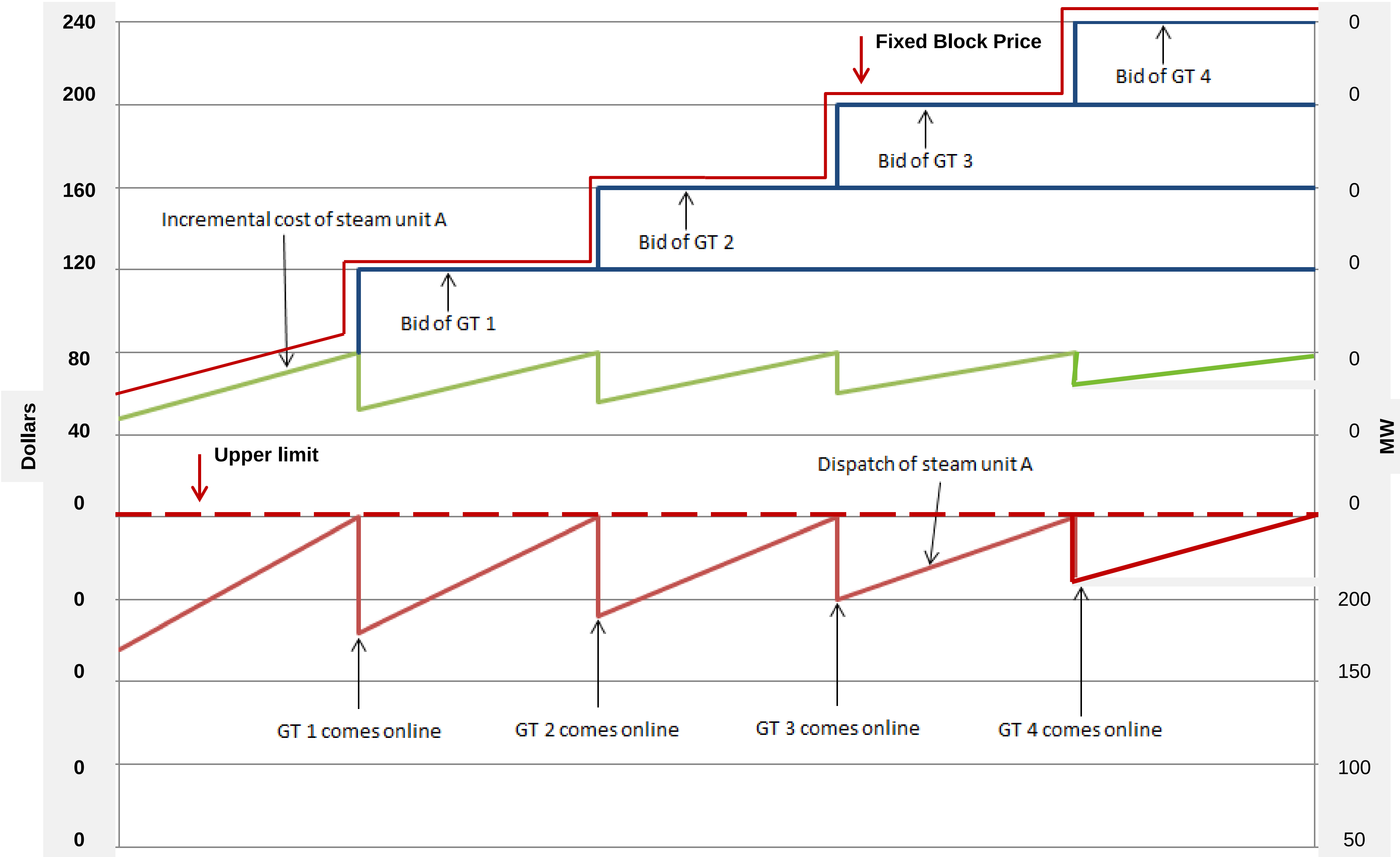
FIXED BLOCK PRICING IN NYISO



FIXED BLOCK PRICING IN NYISO

The ability of high cost quick starting fixed block units to set real-time prices was also important in incenting real-time performance by resources with day-ahead market schedules.

- If real-time prices were set by the offer prices of steam units that were dispatched up and down to accommodate the output of fixed block resources;
- But load was met with higher cost fixed block resources when generators or import suppliers with day-ahead market schedules failed to perform in real-time;
- Then the cost of supplier non-performance would be reflected in uplift payments borne by loads, rather than reflected in the cost of settling deviations between day-ahead and real-time schedules, and borne by the suppliers that failed to perform.

Such a pricing design would undermine an important role of day-ahead market schedules and compromise reliability.

FIXED BLOCK PRICING IN NYISO

- Fixed block units that were only on-line because they had not yet reached the end their minimum run time were not to set price, as their offers would not send an efficient signal for scheduling interchange or other actions by market participants.
- The fixed block resources that set price in the 1999 design were:
  - Fast start resources that were committed to balance load and generation in the five minute dispatch;
  - Resources with short-minimum run times so (it was anticipated) they would not remain on line for long when their operation became uneconomic;
  - Non-dispatchable resources that could not provide spinning reserves, so they were never on line at minimum load in order to provide reserves, rather than energy.

FIXED BLOCK PRICING IN NYISO

The NYISO observed in its August 25, 2000 filing in Dockets ER00-3038-001 and EL00-70-002 that requiring that real-time prices be set by the offers of steam resources dispatched down to accommodate the output of fixed block resources:

> "will be inefficient in cases where the fixed block unit is actually required to run in order to meet load, prevent the dispatching of a more expensive steam-unit, or satisfy a NERC reserves requirement. In such situations, the GT that sets the LBMP price is running because its operation is economic and necessary, not because of minimum run-time requirements or other inflexibilities. LMBPs set by these fixed block units will, in the NYISO's view, truly reflect market conditions because units that must operate in order to meet load will run economically at the LBMP prices they establish." [1]

1. NYISO Request for Partial Rehearing, August 25, 2000, Dockets ER00-3038-001 and EL00-70-002 p. 7.

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FIXED BLOCK PRICING IN NYISO

The NYISO further observed that such a pricing rule would:

> "very likely discourage external suppliers from delivering real-time imports from external resources that are scheduled in the day-ahead market. This disincentive would arise because the real-time imbalance price would be artificially driven below the market clearing level." [1]

And such a pricing rule would:

> "discourage the development of price-responsive real-time loads in New York, because the real-time price it would establish would not reflect the incremental cost of meeting load." [2]

1.NYISO Request for Partial Rehearing, August 25, 2000, Dockets ER00-3038-001 and EL00-70-002 p. 8; see also Joint Affidavit of Dr. Scott M Harvey and Andrew W. Hartshorn, August 25, 2000 p. 4,

2. NYISO Request for Partial Rehearing, August 25, 2000, Dockets ER00-3038-001 and EL00-70-002 p. 9

FIXED BLOCK PRICING IN NYISO

The NYISO further observed in a 2002 filing that:

> "prohibiting Fixed Block Units from setting Day-Ahead prices would tend to distort price signals by improperly depressing prices in the Day-Ahead Market." [1]

In addition:

> a limitation "on Fixed Block Units setting price in the Day-Ahead market would also change supplier bidding incentives and behavior…This would encourage Suppliers to bid at the expected actual market clearing price, rather than at their marginal cost." [2]

1.NYISO Filing of Tariff Modifications, June 12, 2002, Docket ER02-2081-000 p. 7;
2.NYISO Filing of Tariff Modifications, June 12, 2002, Docket ER02-2081-000 p. 8

FIXED BLOCK PRICING IN NYISO

The NYISO further observed in 2002 that:

> "preventing Fixed Block Units from setting prices in the Day-Ahead settlement would also increase statewide uplift charges, since the higher bid costs of Fixed Block Units would not be recovered in the zonal price of energy but instead would be paid in the form of Bid Production Cost Guarantee payments recovered through statewide uplift . The result would be to subsidize the cost of power in areas where demand is met by higher priced bas turbines by shifting those costs into uplift paid by customers statewide."[1]

1.NYISO Filing of Tariff Modifications, June 12, 2002, Docket ER02-2081-000 p. 9;

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FIXED BLOCK PRICING IN NYISO

The focus of the discussions with FERC regarding fixed block pricing during the summer of 2000 were focused on fixed block pricing in real-time.

- It became apparent that FERC still did not understand the current NYISO pricing system when in a July 16, 2001 order, FERC listed the elements of the fixed block design that it wanted the NYISO to explicitly spell out in its Market Services tariff, including that fixed block units "will never set day-ahead LBMPs." [1]
- This ruling was a surprise to the NYISO because fixed block units had been setting day-ahead LBMPs since NYISO start-up, and this was necessary to provide an efficient price signal in the day-ahead market, to avoid inefficient bidding incentives, to enable price consistency between day-ahead and real-time, to avoid cost shifts across New York consumers, and to provide efficient incentives for forward contracting.

1. See FERC Order on Compliance Filing, Docket Nos ER00-3591-007, ER00-1969-008 ER00-3038-004 and EL00-70-005, July 16, 2001 p.3.

FIXED BLOCK PRICING IN NYISO

The NYISO ultimately had to make a section 205 filing in Docket ER02-2081 on June 12, 2002 supporting the continued use of fixed block pricing in the NYISO day-ahead market.

- FERC concluded in a August 9, 2002 letter order that “we find persuasive NYISO’s arguments that precluding fixed block generation from setting day-ahead prices will have adverse effects on its markets at this juncture.” [1]

- This was the end of the 2000-2002 discussion of fixed block pricing at FERC. The NYISO was allowed to continue to apply fixed block pricing in both the day-ahead market and in real-time and it does so today.

1. 100 FERC ¶ 61,182 p. 4.

EVOLUTION AND LESSONS FROM NYISO

The details of the New York ISO's fixed block pricing implementation have been modified over time to accommodate a variety of situations and changes in other elements of the real-time dispatch, but there have been two core designs:

Original Design and Post January 2017 Design

- Fixed block resources are modeled as dispatched either to zero or to their upper limit in a physical dispatch that determines basepoints.
- Fixed block resources are modeled as dispatchable down to zero in a pricing dispatch, so that the offers of fixed block resources whose output is needed to meet load can set price.
- Fixed block resources that are uneconomic and presumably only on line until the end of their minimum run time would not be dispatched in the pricing dispatch.

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EVOLUTION AND LESSONS FROM NYISO

Original Design and Post January 2017 Design:

- If there are fixed block units on line whose operation is not needed to meet load, their output in the physical dispatch will create a difference between the dispatch of dispatchable units in the physical dispatch (when the dispatchable units would be backed down to accommodate the output of the uneconomic gas turbines) and the pricing dispatch in which the output of the dispatchable units would replace the output of the uneconomic gas turbines.
- The real-time price set by fixed block pricing in this design corresponds to the incremental cost of meeting load once the fixed block resources operating uneconomically have gone off line.
- If there are a lot of fixed block units operating uneconomically, perhaps because of an event earlier in the hour or because the resources have long minimum run times, the real-time price set by fixed block pricing could be materially above the short-run incremental cost of meeting load over the next 5 minutes.

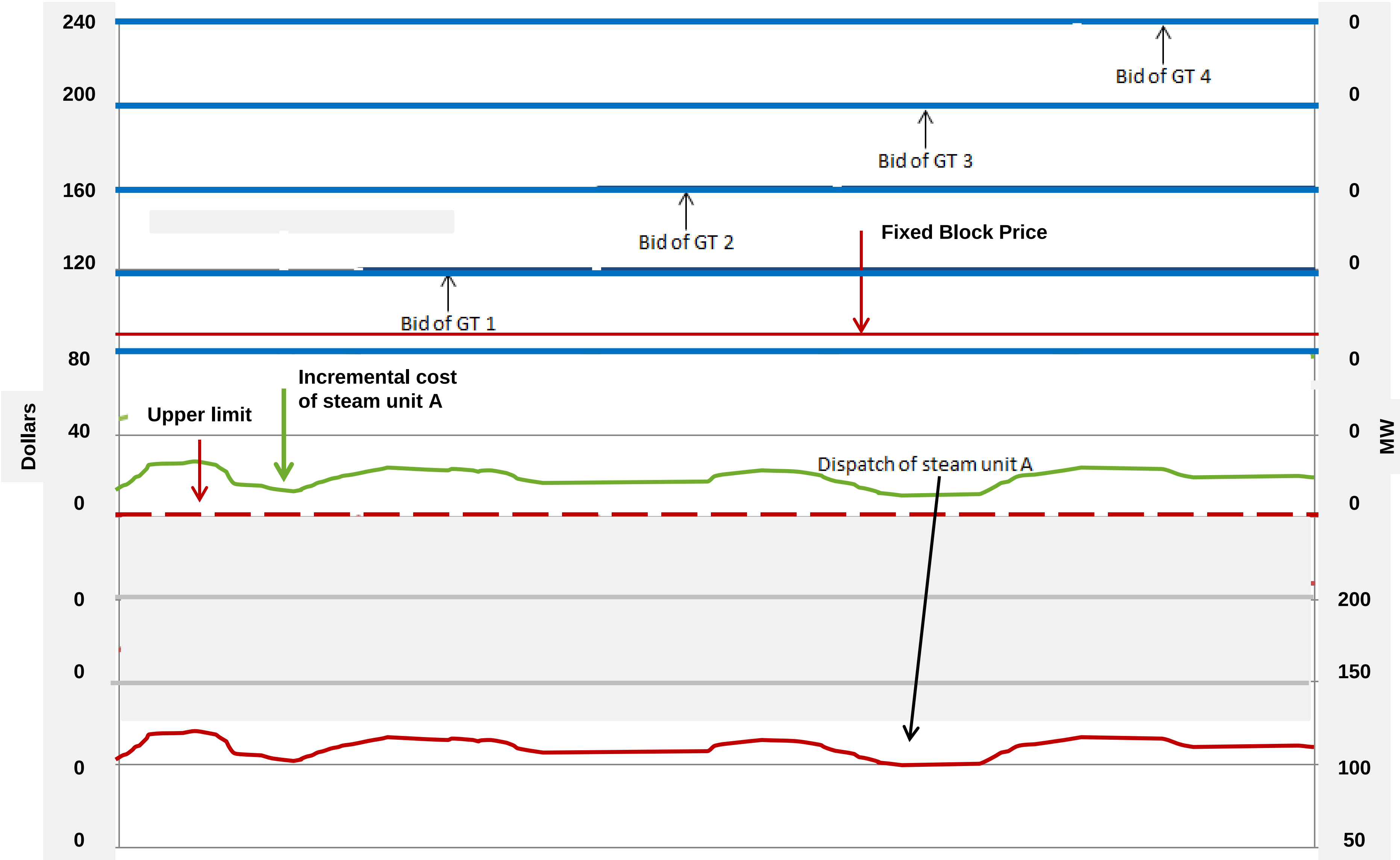
EVOLUTION AND LESSONS FROM NYISO

The original fixed block pricing design sent an efficient price signal in the circumstances in which it was expected to set prices, when gas turbines were being committed to meet incremental load on a high load day.

- However, the design did not send as efficient a signal when there were a large number of gas turbines on line that were not needed to meet load, but were operating due to minimum run time constraints, because the operators were reluctant to turn them off, or because the NYISO's real-time commitment software (BME) only ran once an hour and conditions had changed since BME last evaluated committment status.

- The NYISO found itself in this second situation at times during 2000, some gas turbines were on line and needed to meet load but hundreds of megawatts of other gas turbines were running uneconomically and steam generating units were dispatched far down out of merit relative to the fixed block price in order to accommodate the output of the uneconomic gas turbines.

EVOLUTION AND LESSONS FROM NYISO



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EVOLUTION AND LESSONS FROM NYISO

The Hybrid Fixed Block Pricing Design implemented in response to FERC Orders in 2000-2001 was implemented to produce a lower clearing price when there was a large amount of fixed block output operating uneconomically and reduced consumption or increased supply would not avoid the need to commit additional high cost fixed block resources.

- Fixed block resources that had been committed were blocked on at their upper limit in a physical dispatch pass. All fixed block resources are dispatched either at zero or to their upper limit.
- Fixed block resources that had been committed were modeled as dispatchable between zero and their upper limit in a second pass.
- Fixed block units that were dispatched down to zero in the second pass would be blocked on at their upper limit in the third pass, the pricing dispatch, so that their offers would not set price.
- Fixed block resources that were dispatched above zero in the second pass were treated as dispatchable down to zero in the third, pricing pass, and hence could set price.

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EVOLUTION AND LESSONS FROM NYISO

Hybrid Pricing Design implemented in response to FERC Orders in 2000-2001.

- The real-time price calculated in the third pass of the hybrid pricing design was a compromise between the price set by the offer prices of the steam generators that were marginal in the 5 minute dispatch and the cost of meeting load once the fixed block resources operating uneconomically have gone off line.
- This modified price signal reflected that fact that in this situation, reduced consumption or increased supply would not avoid the need to commit more gas turbines, because there were already too many gas turbines on line.

EVOLUTION AND LESSONS FROM NYISO

Lessons from New York ISO Fixed Block Pricing implementation:

- While the goal in committing fixed block resources is to commit those that are needed to meet load at least cost and to avoid uneconomic commitments, this goal is hard to consistently achieve in actual operation.
- This goal may get harder to achieve with higher levels of intermittent resource output.
- When there is a lot of fixed block capacity operating uneconomically, there can be a big difference between the fixed block price and the offers of the flexible resources dispatched down to accommodate the output of the uneconomic fixed block resources, requiring a constrained off payment to align incentives with dispatch instructions.

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EVOLUTION AND LESSONS FROM NYISO

Lessons from New York ISO Fixed Block Pricing implementation:

- Differences between the physical and pricing dispatches due to the operation of uneconomic fixed block capacity is reduced with three and four pass designs (relative to two pass designs), but the prices set by three and four pass designs do not provide as good a forward price signal for changes in demand and supply, such as changes in net interchange or reductions in consumption.
- Conversely, two pass designs provide an efficient forward price signal for the supply needed after fixed block resources operating uneconomically have gone off line, but they do not provide an efficient price signal for very short-term supply changes while the uneconomic fixed block resources are still on line due to minimum run times or lags in changing the unit commitment.

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EVOLUTION AND LESSONS FROM NYISO

As observed above there is no perfect method of calculating LMP prices when these kinds of non-convexities exist in the cost of meeting load, fixed block pricing and ELMP are approximations intended to provide "workably efficient incentives."

- There is also no bright line standard for the start-up time or minimum run time of the resources whose offer prices would be taken into account in setting prices.
- While NYISO fixed block pricing was originally applied to the 10 minute gas turbines that could be started in SCD, it has been extended to resources that can start in 30 minutes.
- The longer the start-up time of a resource, however, the greater the potential for the offer price of the long start resource to not reflect system conditions and the cost of meeting load when it comes on line.

EVOLUTION AND LESSONS FROM NYISO

- Similarly, the longer the minimum run time over which fixed block resources can set prices, the greater the potential for the offer price of the long minimum run time resource to not reflect system conditions and the cost of meeting load during some portions of that minimum run time.
- The inclusion of long starting and long minimum run time resources in a fixed block pricing design therefore increases the potential for the resources to be operating uneconomically due to their minimum run time, rather than operating because they are needed to meet load, potentially creating larger differences between the physical and pricing dispatch.
- The potential for long starting and long minimum run time resources to be operating uneconomically due to their minimum run time, rather than operating because they are needed to meet load, may increase with increases in the amount of intermittent output used to meet load and changes in system conditions that are occurring much more rapidly than fixed block resources are coming on or going off line.

FIXED BLOCK PRICING IN MISO, ISO NE, AND PJM

During the initial years of MISO operation MISO market design did not allow fixed block resources to set prices in the real-time dispatch .

- This pricing design resulted in situations in which MISO had high cost gas turbines on line to meet load in real-time but the price paid to imports was much lower, providing an inefficient price signal for price taking imports and contributing to volatility in import scheduling.
- The inability of high cost gas turbines to set prices in real-time also understate the cost of balancing deviations between the day-ahead market and real-time, incenting net buyers to under schedule load in the day-ahead market and insulating non-performing suppliers from the consequences of their actions. Both of these incentives tended to undermine reliability.

FIXED BLOCK PRICING IN MISO, ISO NE AND PJM

David Patton observed in his 2010 MISO market report that:

"Most peaking resources were dispatch in-merit order in 2010, which is unusual. Approximately 40%were out-or-merit in 2010, compared to 67 per cent in 2009. The higher in-merit share in 2010 was due to the large share of peaking resource dispatch that occurred during high-load periods in the summer when peaking resources were more likely to set price. Under the majority of conditions, however, peaking resources are typically dispatched out-of-merit because they cannot set prices when they run at their economic minimum or maximum (gas turbine often have a very narrow operating range.

When peaking or demand-response resources are the most economic option for meeting market demand but do not set price, real-time prices can generally be inefficiently low. This condition affects incentives to schedule load in the day-ahead market and ultimately determines the commitment of resources in the day-ahead market. A suboptimal commitment coming from the day-ahead market tends to raise real-time production costs. Inefficiently low real-time prices when peaking resources are dispatched also distorts incentives of participants to import and export efficiently." [1]

1.Potomac Economics, 2010 State of the Market Report for the MISO Electricity Markets, June 2011 p. 69. Similar statements can be found in the 2009 State of the Market Report at p. 67; and in the 2008 State of the Market Report p. 55.

FIXED BLOCK PRICING IN MISO ISO NE AND PJM

ISO NE CMS/MSS Compromise Proposal of Dec 13, 1999 addressed the dispatch of fast start resources but did not provide for them to set prices in real-time. [1] It did, however, provide for block loaded resources to set prices in the day-ahead market. [2] This design was not implemented, however, when ISO NE shifted to implementing the then PJM design at the time.

- As in MISO, fixed block resources have rarely set prices in PJM, either in the day-ahead or real-time market, even when a considerable number of these units have been scheduled or committed.

1. ISO NE CMS/MSS Compromise Proposal of Dec 13, 1999 p. 30.
2. ISO NE CMS/MSS Compromise Proposal of Dec 13, 1999 p. 17.

Notes re Fixed Block Pricing in NYPP/NYISO LMP Filings

FIXED BLOCK PRICING IN NYISO

The early tariff history of NYISO fixed block pricing is somewhat muddled because it was not explicitly discussed or described in any of the pre-start up tariff filings.

- January 31, 1997: There is no mention of fixed block pricing in the Filing letter or filing summary, nor in the attached testimony of William Hogan. [1] The tariff itself has no details about LMP price calculations.
- December 19, 1997: There is no mention of fixed block pricing in the transmittal letter or filing summary, nor is it mentioned in attachment I "LMBP Calculation Method." While attachment I mentioned a second SCD execution with relaxed generator ramp constraints when SCD could not solve, there was no mention that prices would be calculated in an "ideal dispatch. "

1. William Hogan's accompanying testimony, "Report on the Proposal to Structure the New York Electricity Market, " discussed the fact that LMP prices would not always cover the start-up and minimum load costs of resources committed in either the day-ahead market or in real-time and the resulting need for uplift payments (pp. 47-57 and Appendix D, but it did not discuss fixed block pricing.

FIXED BLOCK PRICING IN NYISO

- April 29, 1999 Compliance filing: There is no mention of fixed block pricing in the Filing letter or filing summary, of the compliance filing. The LMP calculation method is in attachment B of the market services tariff and again refers to an additional SCD pass when the dispatch does not solve but does not refer to fixed block pricing in the ideal pricing pass.
- Fixed block pricing and the ideal dispatch was mentioned in the LECG/Navigant reports on market trials software testing. [1]

1. See, for example, Scott Harvey, William W. Hogan, Susan L Pope, Andrew Hartshorn and Kurt Zala, "Final Report, Phase IV Market Trials," October 26, 1999, which reported "In order to identify the marginal generator for each SCUC or SME hour and SCD interval, NCI used data from the 'ideal' dispatch used to calculate prices in which GTs are modeled as if they are dispatchable." p. 4

FIXED BLOCK PRICING IN NYISO

- The NYISO's May 25, 2000 filing defending its tariff authority for fixed block pricing stated: "This fixed block bidding rule has been in place since the very first market trial conducted prior to the commencement of NYISO operations and is consistent with the NYISO's Open Access Transmission Tariff or Services Tariff." Unfortunately the footnote following this statement in the filed version read "Explanation to be added."
- FERC directed the NYISO to eliminate fixed block pricing in a July 26, 2000 Order.

1. See, New York ISO's Answer to Complaint… Docket Nos EL00-70-000 and EL00-67-000, May 25, 2000 p. 42.

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