ASSESSING THE SHORT-RUN BENEFITS FROM A COMBINED NORTHEAST MARKET

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October 23, 2001

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Andrew P. Hartshorn and Scott M. Harvey[1]

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EXECUTIVE SUMMARY

The formation of combined regional day-ahead and real-time markets for the Northeast would have a number of potential benefits, but the magnitude of these potential benefits has not yet been quantified. Energy and Environmental Analysis, Inc. ("EEA") has sought to quantify one source of these benefits, the potential benefits from implementing an interregional real-time dispatch in the Northeast, estimating price impact benefits in the $440 million a year range, based on the actual prices and flows during the June 2000- December 2000 period.

This is an important question and we have been requested by the New York ISO to review EEA's analysis. In doing so, we have extended the EEA analysis in time, improved on some elements of their methodology, and undertaken some sensitivity analysis of their estimates. These extensions suggest several conclusions. First, the EEA analysis of energy flows between New York and PJM inappropriately compared day-ahead prices to real-time energy flows. If the EEA methodology is applied to real-time prices and real-time flows between PJM and New York over the post-ECA-B period, October 11, 2000 to August 31, 2001 (a longer and more recent period than that analyzed by EEA), the estimated price impact of implementing interregional real-time dispatch would be to significantly reduce PJM prices, but to either have little effect on or to actually increase New York prices. Moreover, this finding appears to be relatively insensitive to different assumptions about the slope of the New York supply curve.

Second, it is noteworthy that most of the estimated potential gains from implementing interregional real-time dispatch between New York and PJM arise from the elimination of uneconomic flows from PJM to New York. This is why the price impact gains are concentrated

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in PJM, as the elimination of these flows would lower PJM prices and raise New York prices. It is striking that over the October 11, 2000 to August 31, 2001 period, there were net real-time energy flows into New York in over 95 percent of the hours in which such flows would have been economic based on the criteria employed by EEA, but there were net real-time energy flows into PJM in only a little over 8 percent of the hours in which such flows would have been economic based on the criteria employed by EEA. Understanding the reasons for this discrepancy, particularly the identification of constraints or costs not reflected in the EEA analysis, would be important in accurately assessing the benefits from a more rapid implementation of interregional real-time dispatch.

Third, apparently uneconomic interregional energy flows such as those highlighted in the EEA study can arise either from efficient prices and inefficient transactions or efficient transactions and inefficient prices. It appears to us that there is considerable ambiguity whether some of the apparently uneconomic flows identified by the EEA study reflect market inefficiency or reflect prices that do not measure the actual cost of meeting load. This consideration is particularly important with respect to the non-LMP NEPOOL prices used by EEA to analyze the efficiency of the energy flows between New York and NEPOOL. The NEPOOL prices used in the analysis are non-locational, and it is known that there were large uplift payments being made in this period to NEPOOL generators constrained on out-of-merit in real-time to meet load, i.e., their costs were higher than the NEPOOL price used by EEA to measure the efficiency of imports into NEPOOL. In this circumstance, the actual incremental cost of meeting load in NEPOOL may have been materially higher than indicated by the non-locational NEPOOL prices, which would account for the prevalence of apparently uneconomic exports from New York to NEPOOL in the EEA analysis.

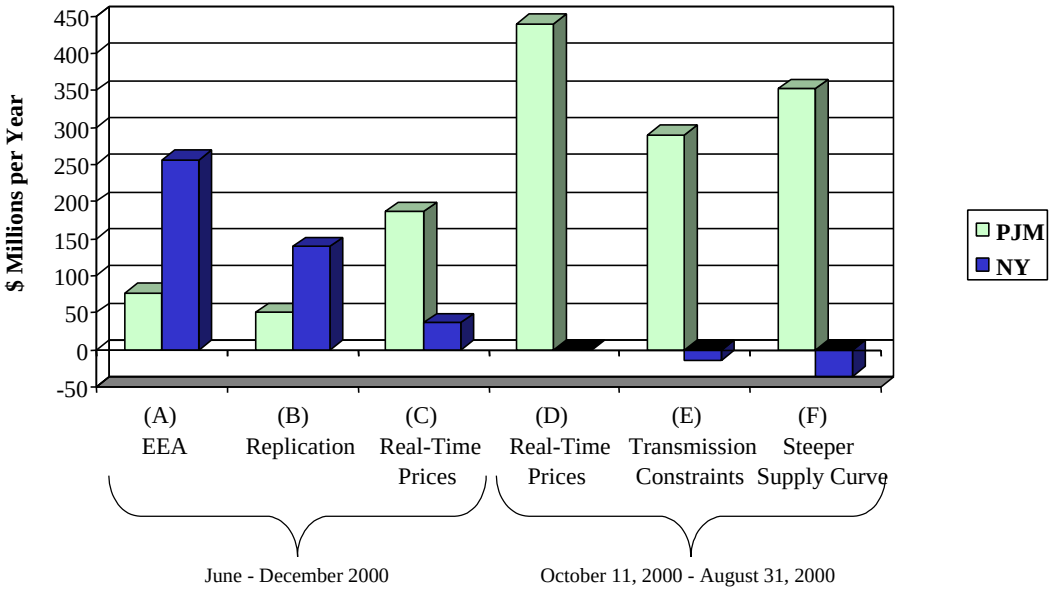
These non-locational NEPOOL prices were supported by a system of restrictions on real-time imports and exports, the purpose of which was to prevent market participants from responding to market prices. Absent information on the extent to which the NEPOOL prices actually reflected the incremental cost of meeting load, there is little if any value in comparing posted NEPOOL prices with New York prices and estimates of efficiency improvements or price changes based on the posted NEPOOL are meaningless. The fundamental reality is that New York and PJM are the only regions in the country for which meaningful real-time prices are available, and thus for which the kind of analysis undertaken by EEA is even possible. Even so, there are also a few circumstances in which either the posted New York or PJM prices do not accurately reflect the cost of meeting load and may therefore appear to suggest the existence of inefficient flows in circumstances in which there is actually little or no inefficiency.

Fourth, significant inter- and intra-regional transmission constraints exist on energy flows between PJM, New York and NEPOOL, but the EEA benefit analysis does not account for the hours in which real-time flows between PJM and New York were transmission constrained, and it uses a measure of available transmission capacity that may materially overstate the capacity available in the unconstrained hours. Sensitivity analyses suggest that accounting for these transmission constraints would materially reduce both the estimated price impact and welfare benefits of implementing an interregional real-time dispatch.

Fifth, the regional supply curves estimated by EEA, and used to estimate the price impacts of improved real-time dispatch, are remarkably flat. The flatness of these supply curves appears likely to be an artifact of the EEA estimation methodology rather than reflecting the actual slope of real-time supply curves. A limited set of sensitivity analyses suggest that the price benefits to PJM tend to be an increasing function of the slope of the New York supply curve (so steeper New York supply curves tend to reduce prices in PJM more), but also suggest that the welfare benefits tend to be a decreasing function of the slope of the assumed regional supply curves. In addition, these generalizations in part reflect the fact that the benefits identified in the EEA study predominantly flow from the elimination of apparently uneconomic flows from PJM to New York. If the reasons for these flows are identified, the impact on the estimated benefit of changes in the remaining flows within the Northeast might vary in a different manner with the assumed supply curve slope. Overall, there is not much reason to attach much significance to the supply curve slopes used in the EEA analysis, but the impact of more accurate supply curve estimates is uncertain.

The questions posed by EEA are important, particularly in assessing trade-offs between the gains from rapid implementation of a regional market and the potential costs from rapidly implementing a market model that is not well suited to all needs of the regional market. The study, however, compares real-time flows with day-ahead prices; ignores transmission constraints; bases part of its conclusions on meaningless non-LMP NEPOOL prices; relies upon estimates of extremely flat regional supply curves; and focuses on a period immediately after the start-up of PJM's day-ahead market and only about six months after the NYISO began operations. All of these considerations materially effect the conclusions, causing a material overstatement of the short-run benefits to New York consumers.

Figure 34
Annualized Price Impacts



Source: Table 33.

The EEA study is a useful initial effort to address a difficult problem, but some important elements of the data needed to accurately assess benefits using their methodology are not publicly available or even available to any single ISO. It is noteworthy that many of the difficulties EEA encountered in estimating the potential benefits of implementing a coordinated real-time dispatch could be reasonably addressed through a cooperative study by the Northeast ISOs using a combined dispatch model that accounts for actual transmission system constraints and real-time supply prices of all three ISOs.

I. INTRODUCTION

The day-ahead market study sponsored by ISO-New England, the NYISO, and the Ontario IMO concluded that the formation of combined regional day-ahead and real-time markets in the Northeast would have a number of benefits

- Reduced energy costs arising from the interregional imbalance energy market.
- Reduced congestion management costs and expanded congestion hedges.
- Reduced transaction/market participation costs for market participants.
- Reduced ISO costs.
- Improved reliability.[2]

In discussions of the results of the day-ahead market study with Northeast market participants,[3] a number of market participants accepted that there would be benefits from the formation of a combined Northeast market but observed that there would also be costs and suggested the need for a cost benefit study to assess the magnitude of these benefits, and the time frame within which they might be achieved, which the day-ahead market study explicitly did not attempt.[4] The Energy and Environmental Analysis, Inc. ("EEA") study[5] attempts to address this need for cost benefit analysis by assessing the potential gains from improvements in the interregional real-time imbalance energy market that would follow implementation of a combined energy market for the Northeast and attempts to quantify these gains. This is a useful question to ask because an assessment of the magnitude of the potential cost savings from simply better coordination of interchange, as opposed to more profound and difficult to implement changes, is an important element in assessing the cost and benefits of alternative time paths and strategies for moving to implement a Northeast RTO.

We have attempted to both repeat the EEA analysis, and also to examine some of the data in greater detail to provide a fuller discussion of the source and magnitude of potential cost savings from improved short-term coordination of real-time interchange. We have also undertaken sensitivity analyses of some of the methodological assumptions underlying the analysis that we viewed as doubtful, to assess whether these methodological assumptions caused the analysis to understate, overstate, or have little effect on the assessment of the short-term benefits associated with the implementation of a combined real-time energy market.

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2 John Buechler, Scott Harvey, Susan Pope and Robert Thompson, "Feasibility Study for a Combined Day-Ahead Market in the Northeast" (hereafter DAM Study), May 4, 2001, pp. 10, 95, 101, 103, 104, 105, 106, 181, 184.

3 February 5 and April 26, 2001.

4 DAM Study, p. 15.

5 Affidavit of E. Harry Vidas and Bruce B. Henning, October 8, 2001, hereafter Affidavit.

We have found that if the analysis is based on a comparison of real-time prices and real-time flows, focuses on the post-ECA-A and B[6] period (either October 11, 2000 to December 31,2000 or October 1, 2000 to August 31, 2001), uses the supply curves estimated by EEA, and takes account of transmission constraints, the price reductions from the implementation of a combined real-time market between New York and PJM would have been overwhelmingly concentrated in PJM, and that the impact on New York energy prices would have been to raise them.[7] Moreover, as discussed in greater detail below, the lack of LMP pricing in NEPOOL makes any estimation of supply curves, or assessment of gains from trade, based on posted NEPOOL prices of doubtful value. We also extended the EEA analysis by using the supply curve they estimated to assess the actual efficiency benefits of a combined regional market, rather than just calculating wholesale price changes.

Table 33
Annualized Benefit Estimates

	June-December 2000			October 11, 2000 – August 31, 2001		
	EEA (A)	**Replication (B)**	**Real-Time Prices (C)**	**Real-Time Prices (D)**	**Transmission Constraints (E)**	**Steeper Supply Curve (F)**
PJM	76	50	186	440	290	352
New York	256	139	36	-1	-15	-36

(A) Affidavit, Exhibit 6, p. 14.
(B) P. 10.
(C) Table 16.
(D) Table 22, Column B.
(E) Table 22, Column D.
(F) Table 22, Column E.

Although we have attempted to improve on the EEA methodology to provide a more reliable assessment of benefits, we have not been able to satisfactorily address all of these limitations. In particular, our analysis has been based on the supply curves estimated by EEA and the shape of these supply curves has a profound impact on the results. We find it very surprising that the estimated supply curve for PJM is steeper than the Western New York supply curve at every

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[6] An ECA is an "extraordinary corrective action." ECAA and B were implemented on October 11, 2000 to eliminate gaming at external proxy buses in the New York market and price real-time congestion affecting interregional transactions. Thus, prior to implementation of ECAA, certain market participants were submitting sham transactions that were designed to fail the inter-control area check-out process. These sham transactions could both prevent other transactions from being scheduled and affect real-time prices when they failed to flow, leading to anomalous real-time prices and unutilized transmission capacity. The current version of ECA-A can be found at http://mis.nyiso.com/postings/ ECA20010308A%20March%208,202001.doc. The current version of ECA-B can be found at http://mis.nyiso.com/postings/ ECA20010308B%20March%208,202001.doc.

[7] These price reductions in PJM due to increased imports from, or reduced exports to, New York might be offset in part by reduced imports into PJM from the West, but neither we nor EEA have attempted to estimate this effect.

price level and note that the implied supply curve for Western New York underlying the EEA analysis is remarkably flat. Our sensitivity analysis, based on modifying the EEA supply curve for New York, PJM and NEPOOL, found that the conclusion of little or no price benefits to New York consumers in the post-ECA-B period is little affected by these variations in the supply curve slope but that the estimate of welfare benefits tend to fall with increases in the slope.

The point of our analysis is not that there would not be important efficiency gains from implementation of an expanded and better coordinated real-time, and day-ahead, energy market in the Northeast. Instead, we focus on better understanding two questions. First, is it reasonable to conclude that the benefits of improved short-term coordination of energy markets between the three existing Northeast ISOs are so large that the details of the market design used to implement this short-term market are unimportant, because the costs of any flaws in market design would be swamped by the gains from improved coordination? Second, is a combined real-time dispatch necessary and sufficient to obtain the estimated benefits from improved short-term coordination of energy markets among the three Northeast RTOs? This second question is significant from two perspectives.

First, if these benefits can only be obtained from moving to a single real-time dispatch, then there is no point in undertaking interim steps, such as the implementation of real-time LMP pricing in NEPOOL and the elimination of pancaked tariff charges on inter-ISO transactions within the Northeast. If, on the other hand, import gains could be realized by other steps that could be implemented prior to implementation of a combined real-time interregional dispatch, then perhaps some of the interim steps should be undertaken. Second, if the realization of these benefits entails not only moving to a single real-time dispatch but also implementing other changes that would probably be undertaken on a longer-term basis, then the immediate gains from transitioning to a combined real-time energy market would be reduced.

It appears to us that neither the EEA analysis, nor our extensions of that analysis, provide a sound basis for answering either question based on publicly available data. While with more time and care both of these analyses could be improved, it appears to us that analyses based on publicly available data, or the data available to a single ISO, may not be able to even provide accurate order of magnitude estimates of the benefits from improved real-time coordination.

It should also be kept in mind that EEA has attempted to quantify, and we have also discussed, only one of the potential gains from implementation of a combined energy market in the Northeast. In particular, additional gains from implementation of a Northeast RTO would be likely from improved congestion management and there is a clear potential for further improvements in reserve sharing. Not all of these additional gains may be easy to achieve and their achievement may take some time and require improvements in existing market designs.

It is likely that development of reliable cost benefit assessments for an interregional combined real-time market in the Northeast will require participation by and cooperation among the ISOs in the Northeast. One approach might be to develop a combined dispatch model for the region that could be used in conjunction with historical bid, load and transaction data to simulate gains from real-time coordination. This approach would be the most thorough but it would likely take

some time to build a model that accurately reflects the significant real-world constraints (transmission, reserves, regulation, etc.) that affect the cost of meeting load in real time.

An approach that might be taken more quickly would be for the Northeast ISOs to cooperatively analyze a limited number of historical hours along the lines taken by EEA but using actual supply curves, transmission constraints, and reserve requirements to assess the likely gains from improved trade. Any study based on historical data is necessarily measuring historical rather than future benefits, but still may be of value in assessing the degree of inefficiency in the current multi-ISO market structure.

II. EEA STUDY

As observed above, the EEA study focuses on assessing the potential gains from the improvements in the interregional real-time imbalance energy market that would follow implementation of a combined energy market for the Northeast and attempts to quantify these gains. To further this discussion, we have attempted to both repeat the EEA analysis, and also to examine some of the data in greater detail to provide a fuller discussion of the source and magnitude of potential cost savings from improved short-term coordination of inter-change.

A. Replication

The EEA study has three basic components. First, the study compares prices between the importing and exporting control areas and compares this to the direction and amount of inter-control area energy flows. This comparison enables them to determine whether the flows appear to be uneconomic based on observed prices, or economic, and if economic whether the transmission interface appears to be fully utilized. This portion of their analysis can be readily replicated from the price and flow data posted by the Northeast ISOs.

Second, the EEA study estimates generator supply curves reflecting the impact on control area prices of increased or decreased flows between each pair of control areas. The exact methodology that was employed by EEA to estimate these supply curve slopes is very sparsely described and somewhat unclear. This is a difficult analysis and we have not attempted to replicate their analysis or develop alternative estimates.[8] It is noteworthy, however, that EEA's analysis is based on a PJM supply curve which is steeper than the Western New York supply curve they estimate, despite the much larger amount of generation in PJM.[9] It is not clear to us that this reflects reality, and if it does, understanding the reason for such a difference would very important in understanding the implications of EEA's study. The Western New York supply curve is also extremely flat, even at high load levels. In replicating the EEA analysis, we have

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[8] As discussed below, we have undertaken some sensitivity analyses based on the EEA supply curve slopes.

[9] Affidavit Exhibit 4, p. 11.

approximated the supply curves used by EEA in Exhibits 4 and 8 of their affidavit as best we could based on the data provided.[10]

Third, these supply curves were then used by EEA in conjunction with the price and flow data to assess what the impact would have been on prices in each of the three control areas of eliminating apparently uneconomic flows (exports from a high priced area to a low priced area) or of increasing apparently economic flows during the historical period they analyze. The EEA methodology takes "sub-optimal" price differential/interface flow observations and moves each such observation towards the hypothetical optimal dispatch curve until either the assumed transmission limit is reached, the prices in the two regions are equalized or the hypothetical optimal dispatch curve is reached.[11] We have attempted to replicate this portion of the EEA analysis based on the curves portrayed by EEA in Exhibits 4 and 8 of their affidavit.

We have also attempted to model what EEA describes as the Hypothetical Optimal Flow Pattern across each interface as presented in Exhibits 3 and 7 of the EEA affidavit.[12] The tolerance parameters were estimated from Exhibits 3 and 7 in the EEA affidavit and the flow parameters were estimated from Exhibits 3 and 7 and checked against the maximum and minimum observed flows across each interface.

Our analysis of the data based on the EEA methodology, as best we can replicate it, does not quite replicate the EEA base case findings.[13] Instead of finding a roughly $1.58/MWh average

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[10] EEA does not describe what supply curve was used for posted prices that were less than or greater than the minimum and maximum points described in these exhibits. Nor do they describe whether they take a single point from these curves as the slope of the supply curve over the whole range of import/export changes or whether they instead modify the slope of the supply curve as they optimize the interface flows. For the purposes of replicating EEA's analysis, we have assumed that the supply curve slopes defined by the ends of the supply curve regression lines in Exhibits 4 and 8 were applied to any past prices that fell outside the respective ends of the regression lines. Additionally, we have assumed that the supply curve slope defined by the posted price is applied over the entire range of import/export changes for that control area in that hour.

[11] As a MW of flow is added to an observation in the lower right quadrant of Figure 2 below the observation moves up in the Cartesian space by one MW and moves to the left by the combined slope of the supply curves in the importing and exporting region. An increase in the flow across the interface of 1 MW increases the price in the exporting region by the slope of that regions supply curve and decreases the price in the importing region by the slope of its supply curve reducing the price differential between the regions by the combined sum of the slopes of the two supply curves. Similarly a MW of flow reduced from an observation in the upper left quadrant of Figure 2 moves down by 1 MW and to the right by the combined slope of the regions respective supply curves.

[12] Across the PJM-New York interface the price differential tolerance was set at negative $16 at a maximum net flow of 1,900 MW from New York to PJM and positive $16 at a maximum net flow of 2,900 MW from PJM to New York. Across the New York-New England interface the price differential tolerance was set at negative $10 at a maximum net flow of 1,500 MW from New York to New England and positive $5 at a maximum net flow of 800 MW from New England to New York. The optimal dispatch frontier is modeled as a straight line between these flow and tolerance parameters.

[13] In some instances in which we were unable to replicate the EEA analysis, we varied some of the input parameters and determined it is possible that some of the EEA benefit calculations were derived with a mixture of price differential tolerances as described above, combined with price differential tolerances set to $0.

price reduction for New York and $.28/MWh price decrease for PJM, we find a $.87/MWh price reduction for New York and a $.19/MWh price reduction for PJM.[14] This would translate into an overall decrease in energy payments for the combined region of $139 million for New York and $50 million for PJM on an annual basis. These benefits are much less than those estimated by EEA but still substantial.

We were also unable to exactly replicate the EEA finding regarding New York and NEPOOL, finding a price reduction in New York of only $.46/MWh rather than the $.99 reported in the EEA study.[15] These impacts would translate into a $43 million energy payment reduction for New York consumers and $63 million energy payment reduction for NEPOOL consumers over the seven-month period, projecting to $73 million for New York and $107 million for NEPOOL on an annual basis.

In discussing and replicating the EEA analysis it became apparent that the EEA study measures what EEA calls "efficiency benefits" in terms of changes in the wholesale energy price. We have followed that approach in the calculations above. The more usual measure of efficiency benefits is the change in the total resource cost of meeting load resulting from the increase in market efficiency. The two measures are generally related, but changes in the energy prices paid by load do not measure efficiency and energy prices could be reduced (at least in the short run) by policies that reduce efficiency.[16] Differences between these two measures can arise because a change in consumer energy prices might in part be attributable to a wealth transfer between consumers and generators, without changing resource costs, or attributable to a change in other costs paid by loads, i.e., energy prices fall but ICAP and uplift charges rise. It should be kept in mind that the EEA price impact estimates, and our replication of those estimates, were merely estimates of the impact of the various changes on the market price of energy. In most cases, changes in the price of energy at one location or another would also lead to changes in the payments to TCC and FTR holders, changes in bid production cost guarantee payments to internal and external suppliers and, in the long-run, changes in ICAP prices. Moreover, the implementation of LMP in NEPOOL and the implementation of a combined real-time redispatch could also lead to changes in price levels, aside from those associated with changes in energy flows, that might also be very large. These other consumer cost impacts are not analyzed in the EEA study.

The same supply curve assumed by EEA can also be used to estimate the efficiency savings resulting from real-time interregional dispatch based on the change in the resource cost of meeting load. Based on this approach and the unmodified EEA methodology, the welfare gains from improved real-time interchange between New York and PJM would project to $105.48

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[14] Affidavit Exhibit 6, p. 14.

[15] Affidavit Exhibit 9, p. 16.

[16] For example, since PJM load is higher than New York load and the EEA study assumes that the PJM supply curve is steeper than the New York supply curve, creating uneconomic exports from New York to PJM would tend to lower payments by buyers in PJM more than the uneconomic exports would raise payments by loads in New York.

million on an annual basis and the welfare gains from improved trade between New York and NEPOOL would project to $89.62 million on an annual basis.

In addition to replicating the EEA study, we have also attempted to better understand the underlying price differences on which they base their assessment of efficiency gains and assess whether these price differences in reality provide a good measure of the likely welfare gains. In reviewing the EEA methodology, it became apparent that there were several questionable assumptions that might have an important impact on the findings of the study and that should therefore be subjected to sensitivity analysis. These assumptions include basing the analysis of real-time flows between New York and PJM on day-ahead prices rather than real-time prices, no assessment of whether apparently uneconomic flows reflected pricing problems rather than inefficiency, including the pre-ECA-A and B period in which flow patterns and prices were affected by gaming, no losses charges or consideration of transmission constraints within control areas and a very imperfect measure of whether imports and exports were limited by inter-control area transmission constraints. It turns out that some of these considerations appear to have an important impact on the findings of the analysis. We have also extended the analysis through the summer of 2001.

Although the EEA study developed a single assessment of the overall efficiency gains from the implementation of a combined energy market for the Northeast, it is helpful in understanding the sources of those potential gains to discuss them as arising from two situations. In the first situation, prices are lower in one control area than another, but the observed flow of power is from the high priced control area to the low priced control area, suggesting that the cost of meeting load could be reduced merely by eliminating these apparently uneconomic flows. In the second situation, the observed flow of power is from the low priced control area to the high priced control area but the observed flow is less than EEA's measure of the available transfer capability, and thus the cost of meeting load could be reduced by increasing the magnitude of the observed flows. Before turning to the discussion of these two cases, it is necessary to briefly discuss the estimated supply curves that underlie the EEA price impact calculations.

B. Supply Curves

We have, as noted above, not attempted to replicate EEA's estimation of New York, NEPOOL and PJM supply curves.[17] Nevertheless, in reviewing the results of this estimation, it is apparent that the Western New York supply curve EEA estimates is very price elastic, indeed more elastic than the PJM supply curve, which we find implausible. Although the process of estimating the various supply curves has not been described in detail, it apparently involved regressing control area load on control area electricity prices, holding gas prices constant.[18] If this analysis did not

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[17] It should be noted that EEA had a substantial disadvantage in its need to estimate these supply curves, inevitably running into the difficulties discussed below because it lacked access to the actual supply curves. A cooperative effort among the three Northeast ISOs to complete such a cost benefit analysis, on the other hand, could be based on the actual historical supply curves.

[18] Affidavit, p. 6. The gas price used is not specified and at least in the New York Control area it would be desirable to account for fuel switching when gas is expensive or interrupted.

hold imports constant (which has not been mentioned in any of the papers or discussions), then the supply curve that has been estimated for New York is not really the New York supply curve but a regional supply curve, including the impact of higher load in New York in attracting increased imports from PJM, Quebec, Ontario and NEPOOL. This methodology would tend to overstate the elasticity of the New York, PJM and NEPOOL supply curves.[19]

It is also not clear that anything was done in the EEA regression analysis to hold the unit commitment fixed as demand varied. If real-time demand was regressed on real-time prices without holding the unit commitment constant, then much of the variation in demand would be offset by a corresponding variation in the unit commitment. The relevant supply curve for assessing the benefits of improved interregional real-time redispatch, however, is the real-time supply curve holding the unit commitment fixed.[20] The real-time supply curve holding the unit commitment fixed is also likely to be quite a bit less elastic than a day-ahead supply curve in which both demand and the unit commitment are varying, again providing a reason why the supply curves estimated by EEA may be more elastic than real-world supply curves.[21]

Third, by regressing state load on zonal prices, EEA is, at best, estimating how the zonal price would respond to a load change that is spread out across the state. The import supply changes in Zones C and G whose effects they are modeling are not spread out across the state, however, but are felt on one side or the other of the Central East constraint.

Finally, the estimation of the supply curve apparently did not distinguish between periods in which Central East and other constraints were binding or non-binding. It is not apparent to us that this omission would necessarily bias the estimated supply elasticity in a uniform direction, but might reduce the estimated supply elasticity relative to the true elasticity in some hours and increase it relative to the true elasticity in other hours. The hours in which transmission constraints are binding, and the supply curve overstated, might, however, be correlated with some of the conditions being analyzed, such as the presence of uneconomic flows.[22]

Figure 1 below portrays our understanding of the supply curves underlying the EEA analysis. These supply curves appear to us to be remarkably flat compared to the price variations we have observed in these markets and our perceptions of the steepness of the relevant supply curves. This is particularly the case for New York West and NEPOOL where the supply curves suggest that loads greater than any yet experienced could be met at quite modest real-time prices.

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[19] On the other hand, if the regression analysis has not held demand constant outside New York, the estimated supply curve is probably less elastic than the true regional supply curve, because many of the high demand hours in New York were correlated with high demand hours in PJM, New England, Ontario and/or Quebec.

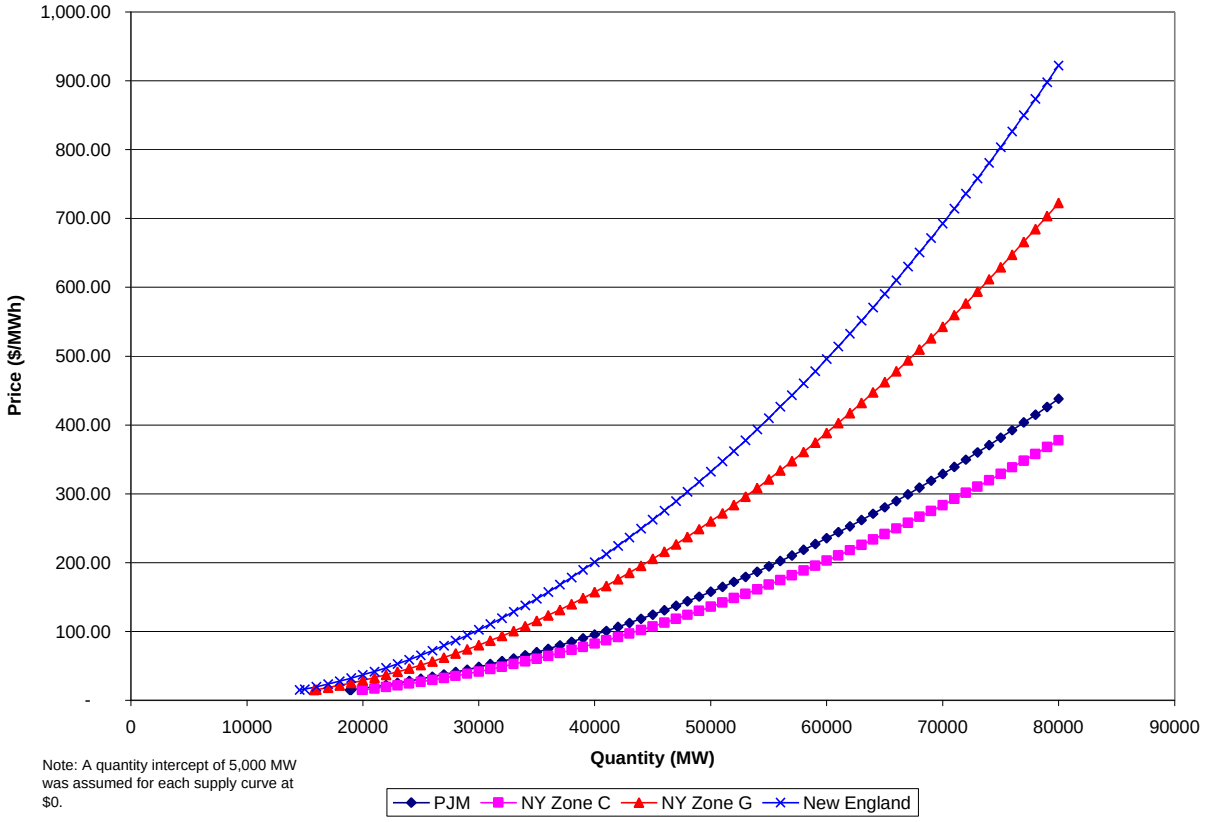
[20] The reason the real-time supply curve would be fixed is that steam units could and would not be committed or decommitted in real-time in response to changes in real-time load net of imports, while steam units could and would be committed or decommitted on a day-ahead basis in response to changes expected in net load,

[21] It is also not clear from the EEA papers and discussions whether the supply curve was estimated based on day-ahead prices or real-time prices.

[22] Uneconomic imports from PJM into New York might be particularly likely in circumstances in which Central East suddenly became binding, perhaps as a result of a line derating due to thunderstorm alerts.

The EEA study included a sensitivity analysis of changing the estimated supply slope by +/- 20 percent. It seems to us that these variations are far too modest given the extremely flat base case supply curves. We have therefore extended that sensitivity analysis by changing the New York West supply slope by +100, 200 and 300 percent and the PJM supply slope by +50 percent. We have similarly adjusted the NEPOOL supply curve by 100 and 200 percent, and the New York East supply curve by +50 percent.

Figure 1
EEA Supply Curves



The impact of these changed assumptions regarding supply curves is complex and does not uniformly serve to either increase or decrease the estimated price impacts. In general, however, the estimated welfare impacts fall with increases in the slope of the estimated supply curves, as steeper supply curves imply that larger price differences are associated with smaller output inefficiencies. Moreover, the estimated price impacts can vary substantially across control areas with variations in these supply curve slopes. The sensitivity analyses we have undertaken are intended to provide an indication of results that may be sensitive to inaccurate assumptions

regarding supply curve slopes, but they are only sensitivity analyses.[23] More reliable analysis could be undertaken based on the actual confidential supply curve within each ISO.

EEA has made a heroic effort in trying to advance the discussion of the gains from improved real-time coordination by estimating these supply curves and applying them to real-time prices and flows. Nevertheless, it should be recognized that EEA's estimates of supply curve elasticities have important limitations, even as estimates of the normal or average supply elasticity at a given output level. In addition, it is necessary to control for the unit commitment because price differences may exist precisely because the supply curve facing one ISO is much steeper than normal because of the unit commitment in that particular hour. It appears to us that there is no alternative in developing reliable benefit estimates to relying on confidential data in estimating a supply curve, and that the simplest approach is therefore for the ISOs to base such an analysis on actual historical real-time supply curves for the historical period examined.[24]

C. Uneconomic Flows

1. Improved Coordination

One source of potential cost and price reductions from improved real-time inter-region interchange coordination that is identified by the EEA study would be the elimination of the apparently uneconomic interregional electricity flows that have been occurring under the current market structure in the Northeast. By uneconomic electricity flows is meant flows for which the price in the export region exceeds the price in the importing region.[25] One reason that such uneconomic flows may exist today is the current lack of a real-time interregional redispatch. Thus, inter-control area transactions scheduled 90, 60, 30 or even 20 minutes before the start of the hour, may turn out to be uneconomic in real-time if real-time conditions are different than those anticipated, perhaps due to too many suppliers responding in the same direction to the prices in the previous hour, to unexpected generation outages or deratings, or to unexpected changes in weather, load or transfer capability. Under current conditions, these uneconomic transactions may continue for some period of time before they are eliminated. These uneconomic flows would not exist in a combined regional market with real-time redispatch, as

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[23] In particular, we have not examined the sensitivity of the results to supply curves that are flatter than assumed by EEA in some ranges and much steeper in others. Confidentiality concerns limit the analysis of such data to the ISOs.

[24] Even this would not provide a fully reliable guide because implementation of an interregional real-time market would very likely change bidding behavior by market participants.

[25] It should be kept in mind that the inefficiency arises from high cost generation being used to meet load that could have been met with lower cost resources in another control area. The same transactions might be scheduled as financial transactions under a common Northeast RTO, but the scheduling of the financial transactions would not affect the actual least-cost dispatch of resources to meet real-time load.

interregional flows would in effect be adjusted every five minutes to assure that load would be met with the least cost resources throughout the region.[26]

A second reason that uneconomic electricity flows may currently occur that would be eliminated by the implementation of real-time interregional redispatch, is that the interregional schedules between PJM and New York, and New York and NEPOOL, are currently adjusted on an hourly basis. Thus, energy flows that may be economic for part of the hour may continue past that point of time and become uneconomic over the hour as a whole.[27] In addition, these hourly schedule changes may cause ramping constraints internal to the Northeast to limit changes in schedules in a manner that would be largely eliminated by implementation of short-term interregional dispatch.

A third possible reason for the existence of such uneconomic flows could be that the observed flows were economic based on the prices being posted by the ISOs at the time but appear to have been uneconomic as a result of subsequent price corrections. While the implementation of an interregional real-time dispatch would not eliminate the potential for erroneous price postings, their impact would become less significant to the extent that generation within the region is being dispatched by the RTO software rather than attempting to follow posted prices.

EEA attempted to assess the magnitude of these potential inefficiencies, both permanent and transitory, by looking at the relationship between prices and interregional flows in the Northeast over the June 2000 to December 2000 period.

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[26] A possible, but probably much less important reason for the existence of uneconomic transactions are the price spikes that can occur at the beginning of each hour due to ramp limits as interregional schedules are changed. Thus, large increases in imports that would be economic if they had been gradually introduced through the five-minute imbalance dispatch, may lead to downward price spikes as generating capacity in the import region must be rapidly ramped down at the beginning of the hour to absorb changes in schedules. Conversely, large increases in exports can lead to significant price increases at the beginning of the hour. If these price spikes are large enough, they can make the change in imports or exports itself look uneconomic over the hour as a whole, even if the transactions are economic once ramping is completed.

[27] The EEA study methodology is limited to identifying transactions that were economic or uneconomic over the hour as a whole. This may not necessarily identify all of the benefits of a combined real-time market in improving short-term interchange because economic transactions may have been uneconomic during some intervals and apparently uneconomic transactions may have been economic during some intervals. The EEA study methodology is conservative in this regard. We have not had sufficient time to assemble and analyze the data required to assess whether this consideration is material.

Figure 2
Exports from PJM to New York Compared to Day-Ahead Prices

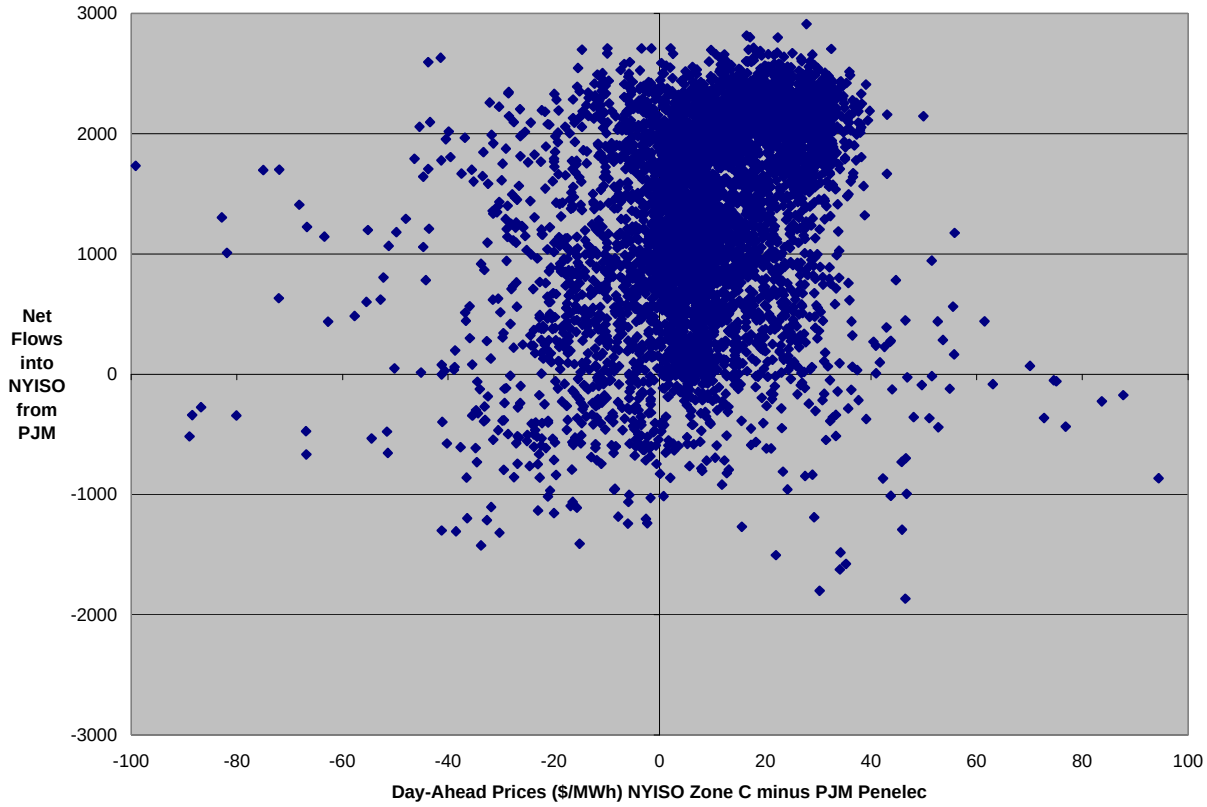


Figure 2 replicates Exhibit 6 in the EEA affidavit and is very similar.

Figure 3
Exports from NEPOOL to New York Compared to Real-Time Prices

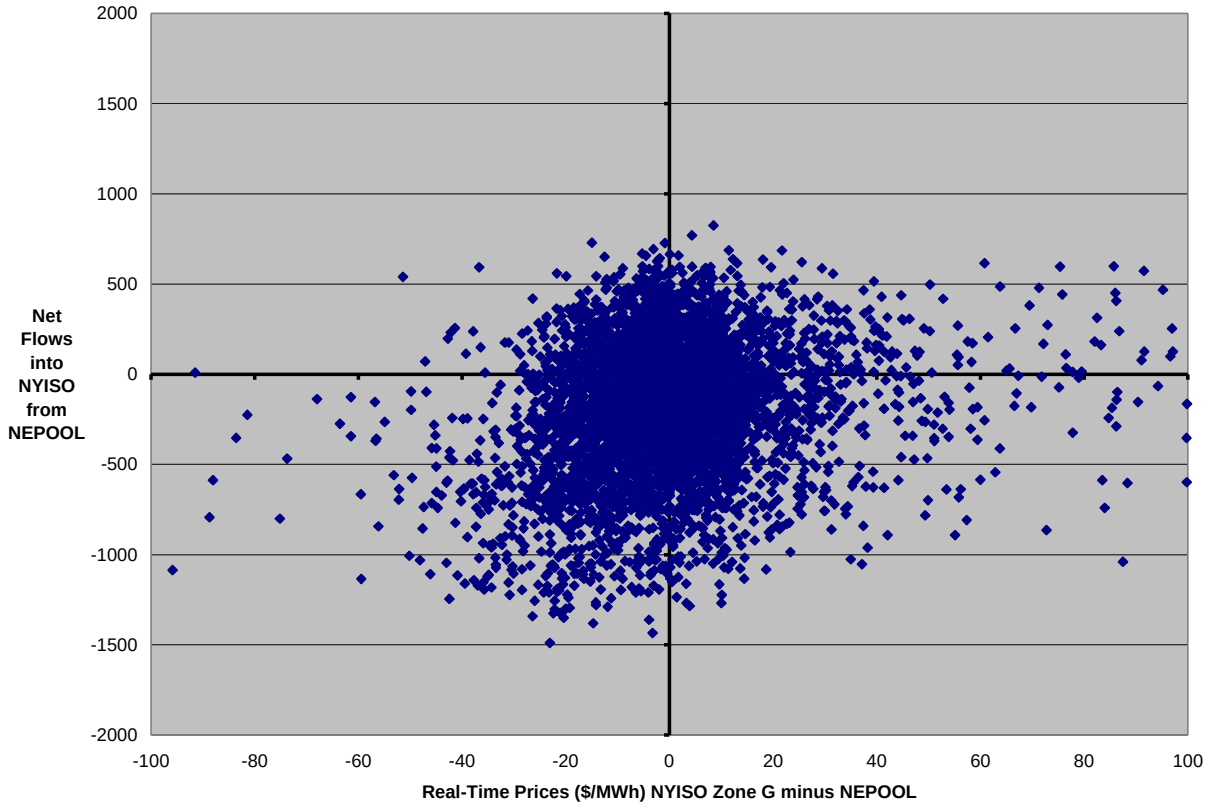
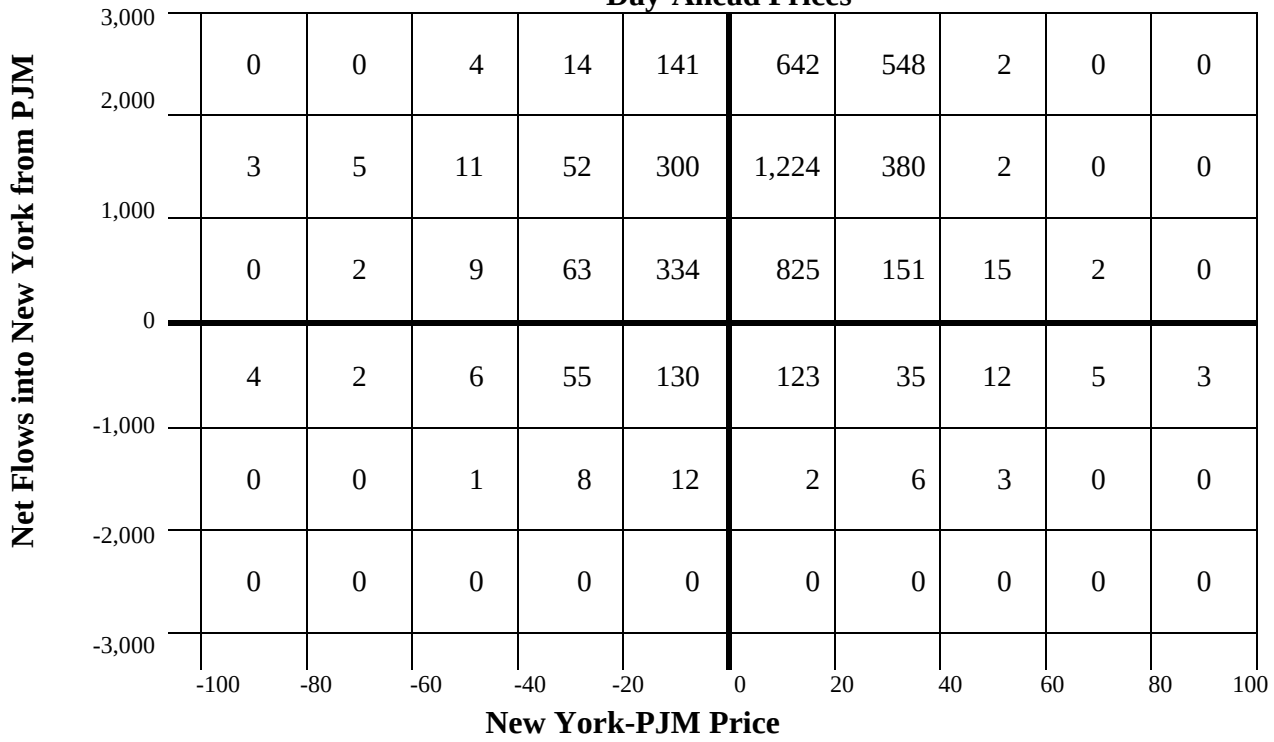


Figure 3 replicates Exhibit 7 in the EEA affidavit and is also very similar.

It can be seen in these figures that there are a fair number of hours in which apparently uneconomic flows occur, but it is difficult to sense the relative magnitudes with these scatter diagrams due to the number of superimposed dots. To better visualize the situation, we have converted these figures into a format in which the number of hours in each range is indicated in the figure.

Figure 4

Prices and Flows between PJM and New York

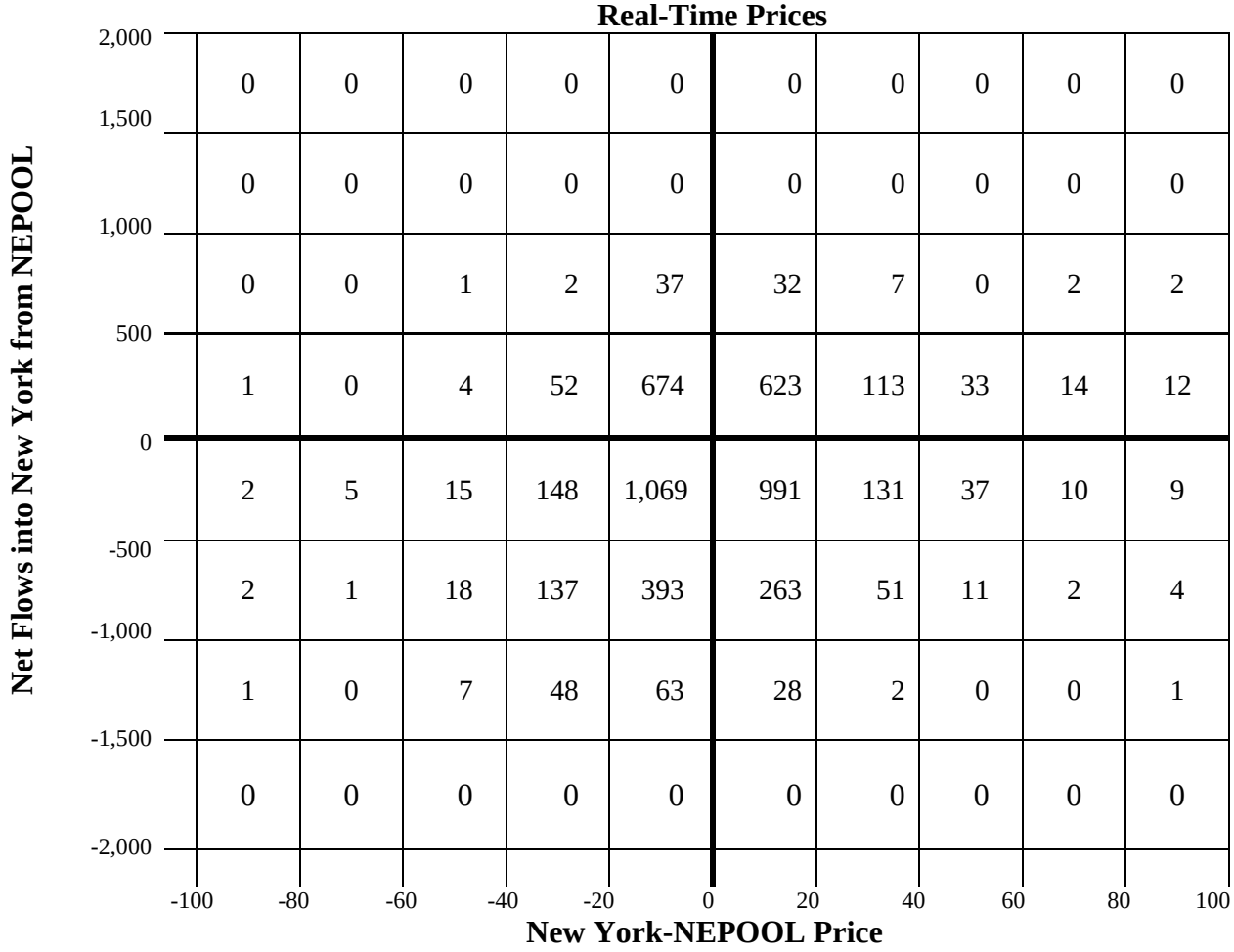


The number in each box is the number of hours over the period June 1 – December 31, 2000 that fell in the specified range.
New York price is the New York day-ahead Central zone price.
PJM price is the PJM day-ahead Penelec zonal price.

It can be seen that based on the comparison of day-ahead prices that there are apparently uneconomic flows from New York to PJM in 189 hours (out of 5,137), economic flows from New York to PJM in 218 hours, economic flows from PJM to New York in 3,791 hours, and uneconomic flows from PJM to New York in 938 hours. Thus, the apparently uneconomic flows are largely flows from PJM to New York. The elimination of these apparently uneconomic flows in the EEA study would serve to raise prices in New York and lower prices in PJM.

Figure 5

Prices and Flows Between New York and NEPOOL
Real-Time Prices



Net Flows into New York from NEPOOL	-100	-80	-60	-40	-20	0	20	40	60	80	100
2,000	0	0	0	0	0	0	0	0	0	0	
1,500	0	0	0	0	0	0	0	0	0	0	
1,000	0	0	1	2	37	32	7	0	2	2	
500	1	0	4	52	674	623	113	33	14	12	
0	2	5	15	148	1,069	991	131	37	10	9	
-500	2	1	18	137	393	263	51	11	2	4	
-1,000	1	0	7	48	63	28	2	0	0	1	
-1,500	0	0	0	0	0	0	0	0	0	0	
-2,000											

The number in each box is the number of hours over the period June 1 – December 31, 2000 that fell in the Specified range.
New York Price is the Hudson Valley zone price (Zone G)
NEPOOL price is the uniform price posted for NEPOOL.

A similar tabulation for NEPOOL and New York based on real-time prices shows many hours of apparently uneconomic exports from New York to NEPOOL, about 1,540 hours, and the elimination of these uneconomic exports would in the EEA study tend to reduce New York prices and raise NEPOOL prices. Conversely, Figure 5 also indicates that there are 771 hours in which there are apparently uneconomic flows from NEPOOL to New York, the elimination of which would tend to raise New York prices and lower NEPOOL prices. Finally, the observed real-time prices were consistent with the real-time flows in the remaining 2,747 hours.

The apparently uneconomic flows portrayed in Figures 4 and 5 also illustrate the reality that these differences between prices and flows may arise for a variety of reasons that may not

indicate market inefficiency or may reflect inefficiencies that would not be addressed by the development of a combined regional real-time energy market. These other considerations include:

- Differences between day-ahead and real-time prices.
- Market design.
- Reliability constraints.
- Other constraints and charges.

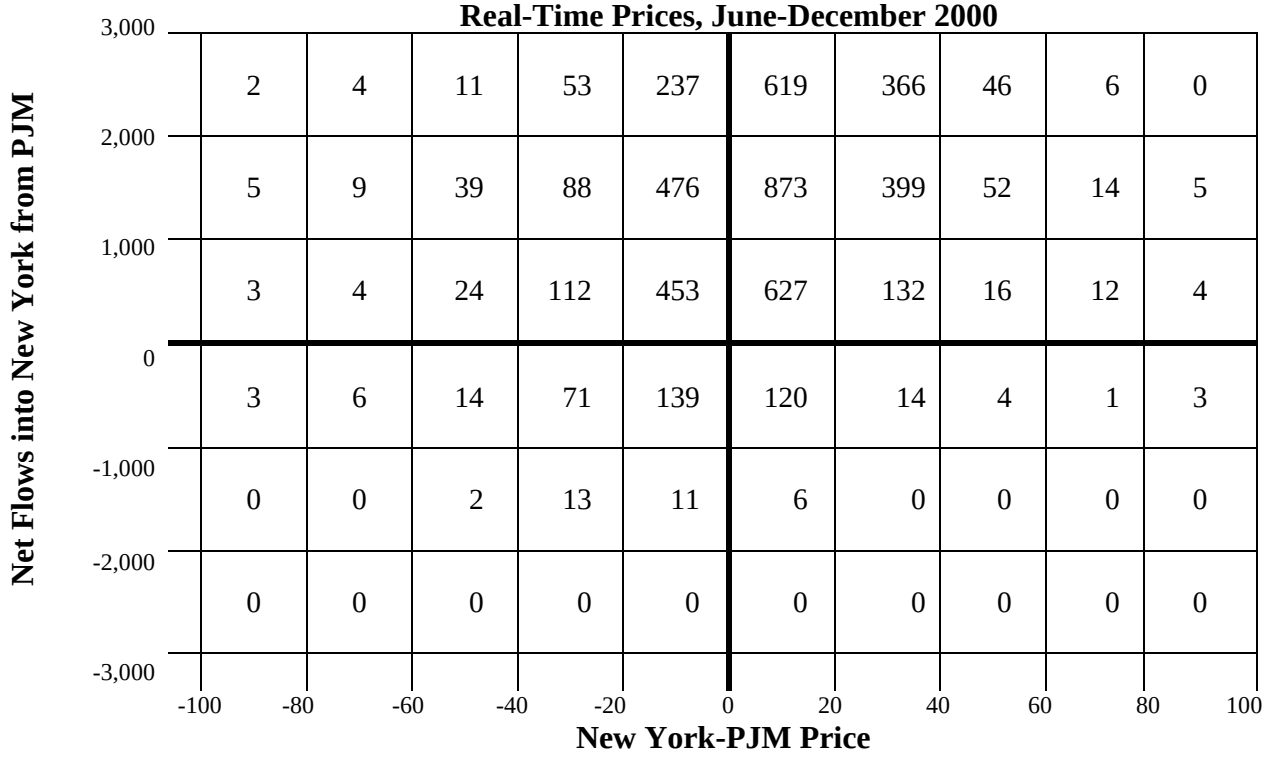
2. Day-Ahead versus Real-Time Prices

The comparison between New York and PJM prices in Figures 2 and 4 is based on day-ahead prices which are compared to real-time flows. The results of such a comparison do not necessarily reflect the level or pattern of any uneconomic flows occurring in real-time, but may merely reflect differences between real-time and day-ahead prices. Both market participants and ISOs lack perfect foresight today and this will not be changed by the development of a regional day-ahead and real-time market; day-ahead and real-time prices will still differ from day-to-day and hour-to hour. In a competitive market, we would expect real-time flows to be consistent with real-time prices and this is what we could reasonably expect to achieve with implementation of interregional real-time dispatch for the Northeast.[28]

[28] EEA's rationale for basing its analysis on day-ahead prices is apparently that most generation and load clears in the day-ahead or bilateral markets, Affidavit, p. 6. This does not change the basic reality, however, that day-ahead prices are not the same as real-time prices, and real-time flows should reflect real-time prices, regardless of what happened in day-ahead markets. Day-ahead schedules would presumably be related to day-ahead prices, but these schedules were not analyzed by EEA. Moreover, since day-ahead schedules are financial, their actual impact on economic efficiency and the resource cost of meeting load is limited and indirect.

Figure 6

Prices and Flows between New York and PJM
Real-Time Prices, June-December 2000



The number in each box is the number of hours over the period June 1 – December 31, 2000 that fell in the Specified range.
New York Price is the Central zone price (Zone C), New York-PJM price.
PJM price is the Penelec zonal price.

It can be seen in Figure 6 that if real-time prices are compared to real-time flows there are fewer hours of apparently uneconomic flows from New York to PJM (this figure drops from 189 hours to 148 hours) but there are many more hours of apparently uneconomic flows from PJM to New York (the elimination of which would tend to raise New York prices and depress PJM prices.

Applying the EEA supply curve and methodology to estimating the impact of these uneconomic flows indicates that the elimination of the apparently uneconomic real-time flows from PJM to New York would produce a net reduction in payments for energy of $116.94 million (price decreases in PJM less price increases in New York), while the elimination of the apparently uneconomic flows from New York to PJM would produce a net increase in energy payments (price decreases in New York offset by price increases in PJM) of $1.61 million, for a net change of $115.33 million. This $115.33 million reduction in energy payments over the seven-month period would, in turn, project to a reduction of $196.71 million over the year.

Thus, contrary to the overall EEA finding of substantial price impact benefits to New York consumers, elimination of uneconomic real-time flows would have had little impact on New York prices in the period studied by EEA.

Table 7
Benefit of Eliminating Uneconomic Flows
June-December 2000

Interface	Direction	Reduction in Payments ($MM)	Benefit Valued By Resource Cost Change ($M)
On PJM-NY Interface	PJM to NY	116.94	
	NY to PJM	-1.61	
Total		115.33	29.97
On NE-NY Interface	NE to NY	3.50	
	NY to NE	12.80	
Total		16.31	8.82

A similar elimination of apparently uneconomic real-time flows from New England to New York would have reduced net payments by $3.50 million over the seven-month period, while the elimination of uneconomic flows from New York to NEPOOL would have reduced net payments by $12.80 million for a net payment reduction of $16.31 million, or about $27.81 million on an annual basis.

Thus, there would have been a potential annual reduction in energy payments of about $224.52 million on an annual basis associated with the elimination of these uneconomic flows. If this is converted to a welfare loss criterion, the net decrease in the cost of meeting load in the combined region associated with these apparently uneconomic flows was $65.18 million on an annual basis, $50.14 million of which would have been attributable to the elimination of the apparently uneconomic flows between PJM and New York.

3. Market Design

The apparently uneconomic flows portrayed in Figures 5 and 6 may reflect an inefficient pattern of electricity flows or may arise from market design features that cause the prices in one control area or another to not reflect the actual cost of meeting load or delivering exports. In this circumstance, the flows might be efficient despite the anomalous prices and there would be no efficiency gains from moving to a Northeast RTO from eliminating these flows, although there likely would be efficiency gains from moving to prices that better reflected the cost of meeting load. The underlying reality is that New York and PJM are the only regions in the country for which meaningful real-time prices are posted and thus the only regions for which the kind of analysis undertaken by EEA is even possible.

Three market design considerations appear to be particularly relevant in understanding why such apparently uneconomic flows might be occurring in the Northeast and why the observed flows might actually be efficient. These are the lack of locational pricing in NEPOOL; a lack of explicit pricing of real-time reserve shortages in New York, PJM or NEPOOL; and PJM and NEPOOL policies that cut must-run transactions at a zero price. Each of these considerations is discussed below.

First, it is important to keep in mind that ISO-NE has not yet been able to implement locational pricing of energy. As a result, the NEPOOL market clearing price does not necessarily reflect the cost of exports or the value of imports. Indeed, when congestion exists in NEPOOL, it is likely that the NEPOOL price will be set by a unit dispatched down due to congestion somewhere in NEPOOL (including locations on the Northern side of the transmission constraints in New Hampshire or Maine), while the value of power generated in Massachusetts or delivered into Massachusetts from New York might be much higher. In these circumstances, generators in southern New England would be constrained on out of merit and would be paid more than the NEPOOL "market clearing price," giving rise to uplift. Imports from New York might therefore be much lower cost than the incremental energy bids of generators constrained on in Southern New England, yet appear highly uneconomic when evaluated in comparison with NEPOOL "market clearing" prices. In these circumstances the real problem is not uneconomic transactions, but prices that do not reflect the true cost of meeting load.

Table 8 New England Congestion Uplift	
Month	**Total Monthly Uplift ($MM)**
January 2000	7.25
February 2000	14.82
March 2000	25.17
April 2000	25.02
May 2000	25.58
June 2000	15.18
July 2000	9.98
August 2000	15.08
September 2000	15.70
October 2000	14.42
November 2000	5.89
December 2000	19.74
January 2001	19.51
February 2001	8.47
March 2001	12.03
April 2001	6.26
May 2001	7.41
June 2001	14.78
Total	262.27

It can be seen in Table 8 that congestion related uplift has been substantial in NEPOOL, totaling almost $200 million during 2000 and almost $96 million during the June-December 2000 period analyzed by EEA.

There would be likely be significant gains from the implementation of LMP pricing in NEPOOL, but the kind of apparently uneconomic New York to NEPOOL flows that appear in the lower right hand quadrant of Figures 3 and 5 might not disappear under LMP pricing. Instead, posted energy prices would be higher in Southern New England, reflecting the actual cost of meeting load, and it might be found that the same kinds of New York to NEPOOL flows currently observed would generally be economic when evaluated based on meaningful LMP prices.[29] If

[29] This situation also illustrates the desirability of focusing on efficiency gains, rather than price changes. The implementation of LMP in New England, either by ISO-NE or by the Northeast RTO, would likely raise market clearing prices in Southern New England, which would be viewed as a cost increase under the standard used in the EEA study. At the same time, however, uplift would decrease, reducing payments by consumers, and market efficiency would increase, reducing costs.

the price effects of these flows are excluded from the benefit calculation, the potential energy payment benefits from a combined New York-NEPOOL real-time market would be reduced from around $28 million to $6 million on an annual basis and would reduce the welfare gains from around $15 million to around $2 million on an annual basis.[30] Of course, some of the apparently uneconomic exports from New York to NEPOOL might be uneconomic on an LMP basis as well, and some of the apparently economic flows might actually be uneconomic, but there does not appear to be a reasonable/reliable method of determining the magnitude of truly uneconomic flows based on publicly available data. It is also the case that the posted NEPOOL price is sometimes anomalously high, and thus a lack of imports from New York when posted NEPOOL prices are high might also reflect pricing problems rather than uneconomic flows, but we do not have a good sense of how often this has been the case.

Overall, it seems to us that while there should be benefits to improved interchange between New York and NEPOOL, it is not possible to gain insight into the magnitude of those benefits from an examination of the publicly available price and flow data. Moreover, given the magnitude of the potential distortions in NEPOOL prices due to the lack of LMP pricing, and the restrictions that NEPOOL imposes on imports and exports (partly because its non-LMP prices do not reflect the actual value of the energy being imported or exported), it is also necessary to distinguish between inefficient interchange due to the lack of LMP pricing or these restrictions (which can be eliminated by implementing LMP and eliminating the restrictions), and improvements in interregional interchange that can be best obtained by implementing a coordinated interregional real-time dispatch. EEA did not include hours of apparent uneconomic flows from new York into NEPOOL in its benefits analysis, but if these hours are not included, the EEA methodology implies that improved real-time dispatch would substantially raise New York energy prices (see Table 20 below). In our view, however, the EEA price impact estimates based on NEPOOL non-LMP prices are meaningless.

A second situation in which inter-control area flows might appear uneconomic, but the problem might lie with the prices rather than the flows is in reserve shortage situations. At present, PJM, New York, and NEPOOL all have real-time pricing mechanisms that imperfectly reflect real-time reserve shortages in real-time prices. While prices will usually rise in reserve shortage situations, this is not always the case, and the amount of the increase is not necessarily proportionate to the magnitude of the reserve shortage.

One example of the impact of these reserve shortage situations can be found on May 9, 2000. On this day loads were very high relative to available generation in all three control areas (New York, NEPOOL and PJM) but PJM was unable to obtain sufficient imports to maintain its reserve levels and bought emergency energy from New York commencing during hour beginning 14, continuing through hour beginning 15 and phasing out during hour beginning 16. During these hours the PJM real-time prices were consistently lower than the New York real-time prices, but it is definitely not the case that these flows were uneconomic and that efficiency

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[30] It should be noted that EEA did not include the impact of reductions in uneconomic exports from New York to NEPOOL in overall their benefit calculation. Affidavit, p. 18.

would have been improved had New York cut these flows, as cutting these flows would have adversely affected reliability in PJM, and the Northeast generally.

Table 9
May 9, 2000 Real-Time Prices and Flows

Hour	PJM Penelec Price ($/MW)	New York Central Price ($/MW)	Flows to PJM from New York (MW)
14	148.72	691.31	-275
15	216.80	557.41	+375
16	119.35	806.31	-41

The problem was not that the flows from New York to PJM were uneconomic on May 9, 2000, but that the PJM energy prices did not really reflect the true level of scarcity/value of energy.[31]

A similar situation prevailed with New York prices on several days during August 2001, when the New York ISO was reserve short in real time, but this was not well reflected in real-time energy market prices in New York. On August 9, for example, the NYISO was short of 30-minute reserves in real time during the hours beginning 12 –16. The New York Central price was lower than the Penelec price in all of these hours but the net flows were into New York from PJM in four of these five hours. The net flows into New York that were scheduled in the New York balancing market evaluation ("BME") were efficient, however, because the BME evaluation indicated that New York would be reserve short and it was in fact reserve short in real-time in all of these hours and thus needed to import energy.[32]

[31] The NYISO also made emergency energy sales to PJM during hours beginning 17 and 18 on August 8, 2001 and the New York real-time price exceeded the PJM real-time price in one of these hours as well.

[32] New York generators were offering sufficient capacity capable of providing reserves to the market, but because load was high, this capacity was needed to meet load. Additional imports of energy from PJM, as well as Ontario, Hydro-Quebec or New England, would make it possible to back down the output of New York generators, restoring reserves.

Table 10 August 9, 2001 Real-Time Prices and Flows			
Hour	**New York Central Price ($/MW)**	**Penelec Price ($/MW)**	**Flows PJM to New York (MW)**
12	246.47	465.77	555
13	219.27	475.64	60
14	85.44	485.93	-405
15	103.57	489.27	146
16	140.44	488.32	160

Similarly, the NYISO made sales of emergency energy to NEPOOL on hours 13 through 22 on August 31, 2001, a period when the net flows were from New York to NEPOOL. The NEPOOL real-time prices, however, were often lower than the New York prices during these hours, so that the flows of energy from New York to New England appeared uneconomic as portrayed in Table 11. These flows were efficient, however; the real problem was not inefficient flows but that the NEPOOL real-time prices did not reflect the actual reserve shortage situation.[33]

Table 11 New York Sales to NEPOOL August 31, 2001				
Date	**Hour**	**NEPOOL Price**	**NYISO Hudson Valley**	**NEPOOL Flows to NYISO**
8/31/01	12	82.21	134.34	-30
8/31/01	13	80.12	82.86	-224
8/31/01	14	53.12	83.89	-285
8/31/01	15	51.64	57.06	-324
8/31/01	16	50.63	249.50	-229
8/31/01	17	50.00	98.39	-270
8/31/01	18	40.01	33.67	-257
8/31/01	19	46.15	46.69	-288
8/31/01	20	42.40	166.90	-249
8/31/01	21	39.44	41.36	-177
8/31/01	22	44.36	29.30	-343

[33] In the case of NEPOOL, it is difficult to distinguish between pricing anomalies arising in reserve shortage situations and those arising from non-LMP prices.

The principle illustrated by these examples is that during generalized high load conditions in the Northeast, when one or more of the Northeast control areas is reserve short, the relative prices in the three control areas have not always reflected the actual relative level of reserve shortage, and this will not be the case until reserve and capacity shortages are explicitly and directly reflected in real-time prices, such as through a reserve demand curve.[34] If the same locational reserve requirements were kept in place under a regional RTO, there would be no change in the flows in these circumstances and thus there would be no welfare gains from improved dispatch efficiency. The pricing anomalies would likely disappear, as prices in the reserve short region would rise. Rather than these circumstances producing a price decrease in the exporting area and a price increase in the receiving region as assumed by the EEA analysis, however, the effect would be simply to raise prices in the receiving region.[35] These changes would produce at least a somewhat better price signal, which would be desirable, but they would not produce the gains identified by the EEA analysis.

In practice, this consideration was not very important during the summer of 2000, which was relatively cool and there were not a large number of reserve shortage hours. This consideration was more important during the summer of 2001, and therefore inflates price and welfare benefit estimates for the post-ECA-B period through August 31, 2001 discussed below.

The third market design issue is that there can be low load hours in which the apparently uneconomic flows may not reflect inefficiency in the flows, but limits on the posted prices. In particular, New York allows generators and importers to self-schedule through bids as low as -$1,000 and will redispatch the system to avoid cutting these self-schedules until prices fall to -$1,000. As a result, prices can fall below $0 even absent congestion, when injections are high relative to load but self-schedules rarely need to be cut. PJM and NEPOOL on the other hand, effectively have minimum bids of zero for self-scheduling. As a result, self-scheduled transactions, including imports, are administratively curtailed when prices fall to zero. This can give rise to situations in off-peak hours in which PJM and NEPOOL cannot accommodate self-scheduled transactions and begin to administratively curtail imports at a price of zero. The resulting decrease in net exports from New York can drive New York prices negative to accommodate the change in interchange and self-scheduled generation. In these circumstances, flows from PJM and NEPOOL into New York will appear uneconomic based on prices, but the flows may actually be efficient and the problem lies with the price limits in PJM and NEPOOL, as exports from New York would not be permitted despite the higher posted prices in PJM and NEPOOL. While the hours with negative real-time prices in New York, positive real-time prices

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[34] A variety of market changes to address the potential for such price discrepancies have been considered in NEPOOL over the past year and are under consideration by NYISO committees for implementation by summer 2002. A number of possible initiatives for improving energy price signals in reserve-short situations were presented to the Market Structures Working Group on October 9, 2001 in a presentation called "BME/SCD Pricing Issues" at http:/www.nyiso.com/services/documents/groups /bic_mkt_struct_group/10_09_01/bme_scd_initiatives.pdf.

[35] Thus in circumstances in which the NYISO is reserve short and the energy imported from PJM is higher priced than the incremental energy being dispatched within NYISO, a coordinated interregional dispatch would set real-time prices based on the offer price of the energy dispatched in PJM and the NYISO generation would be infra-marginal. The flows would be unchanged, but NYISO prices would rise.

in PJM and net flows into New York from PJM do not account for a large proportion of the energy price changes (about $2 million between New York and PJM on an annual basis), they account for a material proportion of the welfare gains from eliminating uneconomic flows of around $15.2 million on an annual basis out of the $50.1 million total.[36] Thus, over 30 percent of the apparent welfare gains from eliminating uneconomic flows may arise from PJM's zero minimum price for self-scheduling and no gains will be realized from a better coordinated real-time market unless this minimum price is eliminated.

4. Reliability Constraints

A third consideration affecting apparently uneconomic flows are reliability constraints. This consideration is related to the reserve shortage situation discussed above but is slightly different. It should be kept in mind that the three control areas are three different regions for reliability and load shedding purposes and this status is likely to continue following implementation of a combined regional real-time energy market. In particular, load shedding decisions and criteria would be applied separately, as is apparently intended between PJM and PJM West. This means that in hours of generation emergency, export transactions will be curtailed without regard to price, in order to maintain reliability within the individual control areas. This happened on a large scale on May 8, 2000 when PJM curtailed in real-time a large number of export transactions into New York that had been scheduled in the day-ahead market. It has subsequently happened on August 8, 9 and 10, 2001. In these circumstances, implementation of a coordinated interregional real-time dispatch would not change the flows, but would raise prices in the generation-short region.

5. Other Constraints and Charges

One reason that the potential benefits from eliminating uneconomic flows are particularly significant is that since they entail reducing, rather than increasing, interregional flows, the realization of these gains would generally not be prevented by transmission constraints. Under the current multi-ISO market structure, there are also ramping constraints on the magnitude of the changes in flows over particular interfaces or for each ISO as a whole that at times limit changes in flows and could limit the elimination of such uneconomic flows.

We would in general assume that one of the gains from implementation of a combined energy market in the Northeast would be the effective elimination of the ramp constraints that would become internal to the Northeast RTO, i.e., the ramp constraints affecting flows between New York and PJM and between New York and NEPOOL. The rationale for this view is that the replacement of hourly NEPOOL, New York and PJM schedule changes with 5-minute dispatch

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[36] The exclusion of all of the hours fitting this description probably excludes some hours in which neither PJM nor NEPOOL were cutting import transactions. A more accurate assessment would require a detailed review of operator logs that has not been undertaken. It is also possible that this approach fails to exclude some hours in which transaction cuts during an hour drove New York prices negative for a portion of the hour but averaged out positive over the hour as a whole.

signals would permit flows to and from NEPOOL, New York and PJM to be adjusted in a manner that would generally not cause concern regarding the level of short-term schedule changes on the inter-ISO interfaces.[37]

PJM and New York also enforce overall ISO wide ramp constraints on changes in aggregate imports, reflecting their overall ability to ramp generation, particularly regulating units, to absorb these schedule changes. While the ramp limits internal to the Northeast would effectively be eliminated by implementation of interregional real-time redispatch, the external ramp limits would likely remain in some form. In general, the combination of PJM, New York and New England would reduce ramp constraints because the internal ramp constraints will be much less significant. Nevertheless, there have been circumstances in which PJM has been able to accommodate large schedule changes on its Southern and Western interfaces, because its schedules with New York were moving in the opposite direction. If New York schedules were not moving in the opposite direction, smaller schedule changes would have been required.

In at least some of the hours in which the EEA study and our analysis have identified inefficient net exports from PJM to New York, PJM was cutting New York exports to PJM, i.e., preventing reductions in the apparently uneconomic net exports to New York, because of ramping constraints within PJM. The reasons for these cuts was presumably that large schedule changes in the same direction needed to be accommodated on PJM's southern and western interfaces. To the extent that the apparently uneconomic flows from PJM to New York identified in the EEA study reflect the impact of PJM ramp constraints on its Western or Southern interfaces, then the price and efficiency impacts associated with eliminating these apparently uneconomic flows could not have been attained in full without also eliminating other flows between PJM and these other control areas.[38] We have not been able to quantify the potential impact of these kinds of constraints, because the necessary information regarding ramp constraints does not appear to be posted.

In addition, PJM assigns real-time uplift to deviations between day-ahead schedules and real-time transactions. Thus, market participants that adjust their day-ahead schedules to respond to real-time price differences would apparently incur real-time uplift charges in PJM. It appears to us that these charges are on average too small to account for the failure of market participants to adjust uneconomic transactions in response to real-time prices. We do not know, however, whether market participant actions reflect correlations between high real-time uplift charges and the circumstances in which these apparently uneconomic flows are occurring. If these uplift charges are the reason for the failure to eliminate these apparently uneconomic flows, PJM would be able to address the problem directly by eliminating these charges on changes in external schedules.

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[37] There has also been discussion of shifting from hourly schedule changes to quarter hour schedule changes, which would also tend to make the ramp constraints within the Northeast less binding.

[38] It appears likely that even in these circumstances the uneconomic flows could have been reduced with a few dispatch intervals of delay, but without a clear understanding of the nature of the constraints, if any, on the elimination of these apparent we do not know whether this would generally have been the case or not.

We have calculated that over the period October 11, 2000 through August 31, 2001 there were net real-time flows from PJM into New York during 95 percent of the hours that such flows would have been profitable evaluated at the real-time Zone C and Penelec prices. Surprisingly, there were real-time flows from New York into PJM in only 8.4 percent of the hours in which such flows would have been profitable, evaluated at the real-time zone C and Penelec prices (see Table 12). One explanation for this pattern was noted above, in some hours the apparently uneconomic exports arise in low load conditions in which PJM cuts imports from New York when PJM prices fall to zero, causing New York prices to go negative while PJM prices remain at zero or above. Because PJM is administratively curtailing imports, it is not possible for market participants to eliminate the apparently uneconomic flows, as this would require increasing imports into PJM. If these hours are excluded from the comparison, it is still found that there were real-time flows from New York into PJM in only 8.6 percent of the hours in which such flows would have been profitable, evaluated at the real-time Zone C price.[39]

[39] In addition, we tested whether the pattern changed if we excluded the hours in which imports from PJM would have been economic when evaluated at the BME price (and thus in which uneconomic imports might have been scheduled by the BME evaluation process). This would have only raised the percentage of correctly scheduled transactions to 12.9 percent. Thus, in the vast majority of these hours the economic flows would have been scheduled in BME had market participants submitted loads bids at the Penelec price.

We have made similar calculations for the NEPOOL/New York interface (see Table 13). In this case, there are net flows from New York to NEPOOL in 87 percent of the hours in which such exports would appear to be profitable, but net flows from NEPOOL to New York in only 21 percent of the hours in which such flows would appear to be profitable. Once again, we tested whether these differences could be attributable to incorrect price forecasting or reserve constraints enforced in the New York BME process and this was not the case. If the hours in which the BME price exceeded the NEPOOL price are excluded, the proportion of economically scheduled hours with exports to NEPOOL rises to 93.6. If the hours in which the BME price was less than the NEPOOL price are excluded, the proportion of economically scheduled hours with exports to New York rises only to 23.2 percent.

Given the lack of meaningful LMP prices in NEPOOL and the FERC approved restrictions on exports from NEPOOL to New York, we find the New York/NEPOOL pattern much less surprising than the PJM/New York pattern. The reasons for both of these patterns could be best diagnosed by a cooperative effort of the ISOs.

Table 12 Economic Flows PJM-New York		
	Percentage of Time Net Flows Are Consistent with Real-Time Prices	
Real-Time Price Difference	**All Hours (A)**	**Excluding Hours Impacted by BME (B)**
June-December 2000 Period		
PJM (Penelec) > New York (C)	14.4	19.0
New York (C) > PJM (Penelec)	95.6	96.3
ECA-B Period – October 11-December 31, 2000		
PJM (Penelec) > New York (C)	1.2	1.4
New York (C) > PJM (Penelec)	99.9	99.9
ECA-B Period – October 11, 2000-August 31,2001		
PJM (Penelec) > New York (C)	8.4	12.9
New York (C) > PJM (Penelec)	95.6	96.0
(B) excludes all hours in which the uneconomic flows were consistent with BME prices.		

The reasons for this difference are not known to us, but it is possible that a portion of the difference is attributable to the impact of ramping constraints on PJM's Western or Southern interfaces as discussed above or possibly charges or restrictions on changes in day-ahead schedules that are not correctly reflected in our analysis or that of EEA. It has also been pointed out to us that the NYISO provides a bid production cost guarantee for imports into New York that are economically scheduled in BME, but that PJM does not operate a BME process nor provide a corresponding bid production cost guarantee for imports into PJM.

It has also been pointed out that the continuation of the day-ahead scheduling adder in New York in effect makes it expensive for market participants that scheduled imports into New York from PJM day-ahead to make use of the BME evaluation to adjust their position in real-time.[40] In effect, the adder makes it impossible for market participants to use BME to directly back down imports into New York that were scheduled day-ahead. Market participants could still do this by bidding an export transaction that would cancel out the import into BME, but that export transaction would incur TSC and Schedule 1 costs. Market participants are free to reduce the

[40] The day-ahead adder is a rough fix for the pricing inconsistency ultimately corrected by implementation of ECA-B. The adder became unnecessary once it was determined that ECA-B was operating as intended, however, it has been kept in place at the request of the PJM ISO until the NY pre-scheduling mechanism is in place (this is scheduled for late 2001 or perhaps January 2002), as it is believed to help the PJM ISO manage its ramp constraints on its Southern and Western interfaces in conjunction with NY schedules.

quantity of transactions scheduled day-ahead, but this approach does not make use of the BME economic evaluation. It is not known to what extent the adder accounts for the apparent unresponsiveness of scheduled imports.[41] If the adder does account for part of the apparent inflexibility, the source of the problem should be eliminated within the next few months.

There may also be other constraints of which neither we nor EEA are aware that currently constrain the elimination of uneconomic exports from PJM. These constraints could best be identified by the PJM ISO. This would be an important element of any follow up cost benefit study by the Northeast ISOs because almost all of the welfare gains from real-time interregional redispatch between New York and PJM arise from increased net flows from New York to PJM when PJM real-time prices are higher than New York prices. It is therefore very important in assessing the potential gains from implementing real-time interregional redispatch and the importance of a speedy implementation to understand why the apparently uneconomic flows are occurring today.

Table 13
Economic Flows New England-New York

	Percentage of Time Net Flows Are Consistent with Real-Time Prices	
Real-Time Price Difference	**All Hours (A)**	**Excluding Hours Impacted by BME (B)**
June-December 2000 Period		
NEPOOL > New York (G)	71.3	81.9
New York (G) > NEPOOL	35.4	41.2
ECA-B Period – October 11-December 31, 2000		
NEPOOL > New York (C)	83.0	89.9
New York (G) > NEPOOL	19.2	23.9
ECA-B Period – October 11, 2000-August 31,2001		
NEPOOL > New York (G)	86.9	93.6
New York (G) > NEPOOL	20.1	23.2
(B) excludes all hours in which the uneconomic flows were consistent with BME prices.		

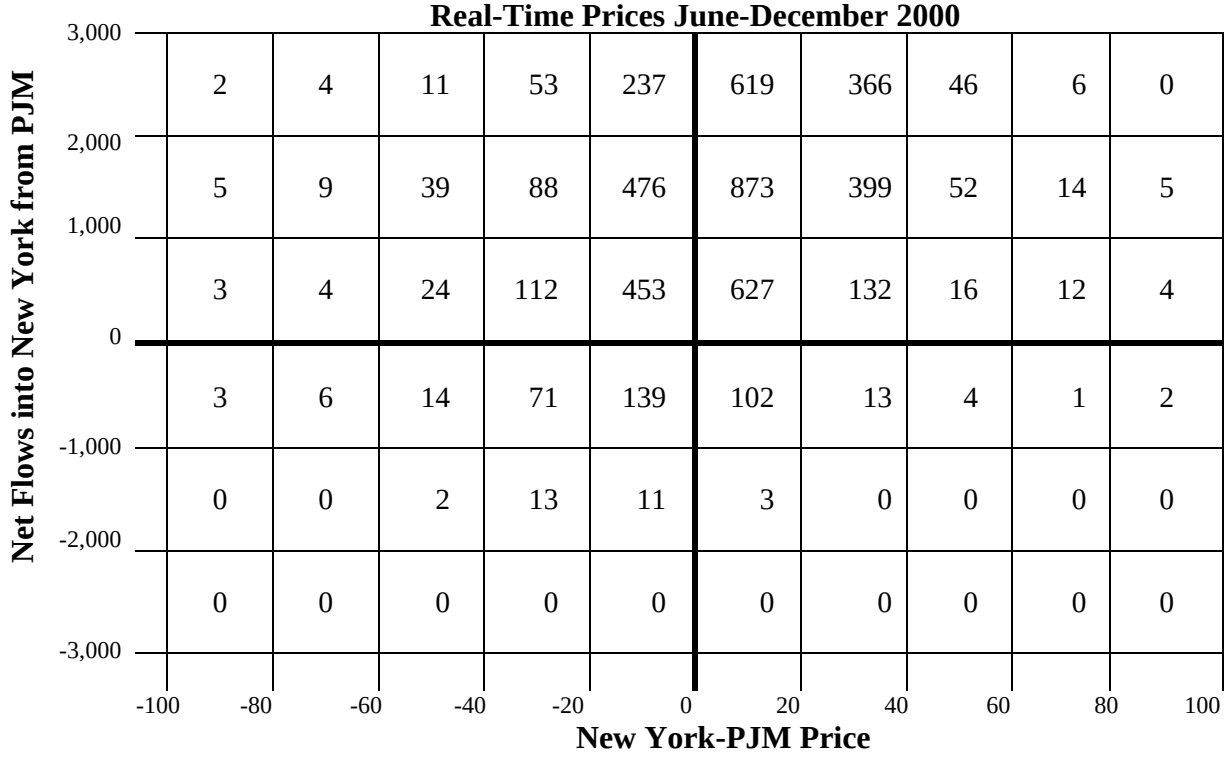
[41] This could perhaps be assessed to a degree by examining the extent to which the apparently uneconomic flows are attributable to transactions scheduled day-ahead.

6. Transitory Factors

Finally, there were three transitory source of apparent uneconomic flows during the period studied by EEA. First, the two proxy bus system was in place in PJM during the period studied by EEA, and apparently uneconomic flows from New York to PJM under the EEA methodology may have been economic to market participants based on the New York export price and the PJM east import price. To assess the importance of this consideration, we undertook two additional analyses; first, we have checked whether any of these apparently uneconomic transactions would be economic if evaluated based on the PJM NYPP E price instead of the Penelec price.

Figure 14

Prices and Flows Between New York and PJM
Real-Time Prices June-December 2000



The number in each box is the number of hours over the period June 1 – December 31, 2000 that fell in the Specified range.
New York Price is the Central zone price (Zone C).
PJM price is the Penelec zonal price.
Hours in the lower right quadrant during which the flow was economic based on the PJM NYPP East proxy price are excluded.

It can be seen in Figure 14, that if the profitability of exports to PJM from New York is evaluated based on the price for the PJM NYPP East proxy price rather than Penelec, the number of hours with apparently uneconomic flows falls from 148 to 125, with only 20 hours in which the price discrepancy is $20/MWh or more.

The impact of removing the 23 additional hours where flows were economic based on PJM-NYPP East is small, increasing price benefits by $0.45 million and decreasing welfare benefits by $0.09 million.

A second transitory consideration, noted above, was that until late July 2000 the NYISO real-time pricing software was prone to miscalculate prices in circumstances in which many GTs were running in New York, a situation which arose with some frequency in June and July.[42] While many of the resulting price corrections only affected prices East of Central East, some affected prices in the West as well. These price corrections affect the EEA analysis in two ways. First, some of the apparently uneconomic transactions may have appeared economic based on the real-time prices that were being posted at the time. Second, the potential for restatement of prices may have deterred some market participants from scheduling exports from PJM to New York that appeared profitable based on real-time prices, thus resulting in under utilized transfer capability when exports to New York would appear profitable. While these erroneous price postings likely adversely impacted real-time scheduling incentives during June and July, the rate of price correction fell materially in August and September and continued to decline through the fall.[43]

A third transitory consideration potentially leading to the scheduling of apparently uneconomic transactions during the period studied by EEA, was that prior to the implementation of ECA-A and B, certain market participants were scheduling sham transactions[44] into New York, PJM and NEPOOL that at times moved real-time prices in unpredictable directions and may have made otherwise profitable transactions appear uneconomic. To assess the importance of this consideration, and other related changes that may have improved inter-ISO transaction scheduling, the analysis of uneconomic transactions has been repeated for the post-ECA-A/B period.[45] This post-ECA-B analysis also excludes the period in which price corrections were significant, so the differences could arise from more than one source.

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[42] The PJM-ISO and ISO-New England do not publish data on price corrections/revisions but the New York ISO does. It is known that there was a software flaw affecting the calculation of real-time prices in New York that caused far higher rates of price corrections in June and July 2000 than in subsequent months.

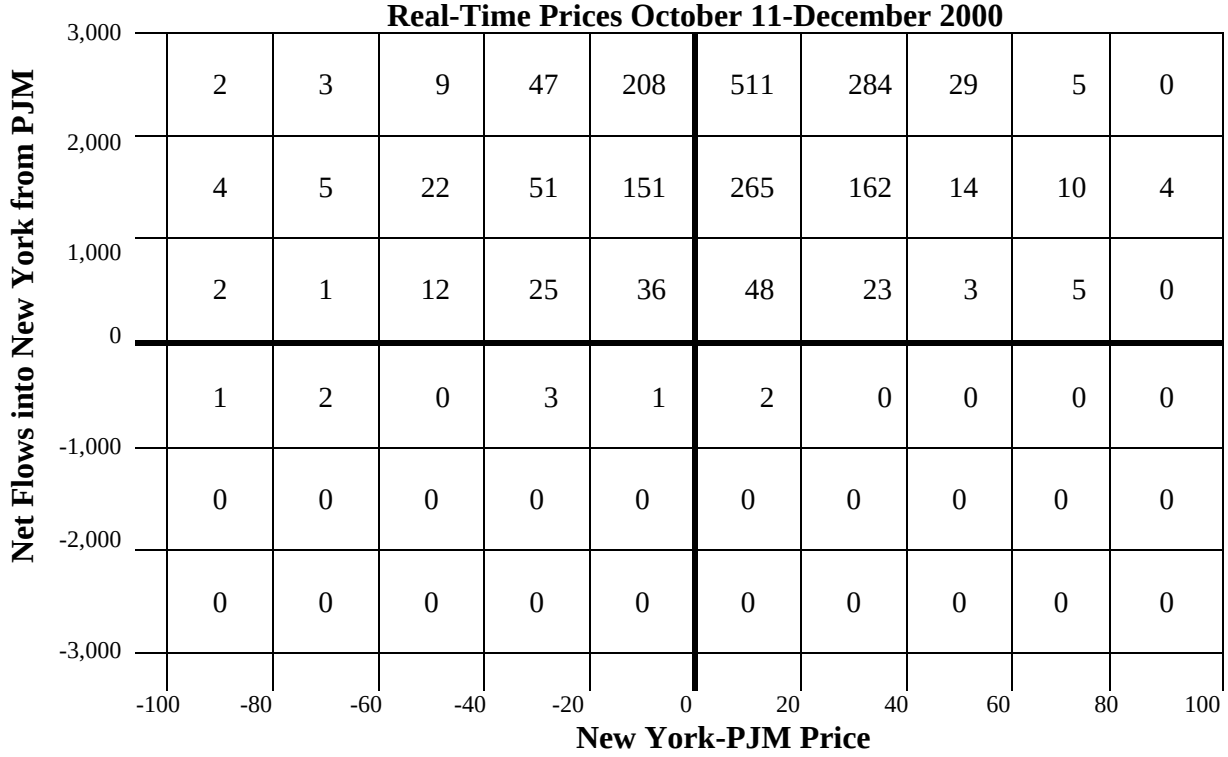
[43] The risk of real-time price corrections rendering real-time transactions uneconomic may of course have continued to affect scheduling incentives after July and the rate of change of market perceptions is uncertain.

[44] Sham transactions were transactions that were designed to be scheduled by the control areas, using up transfer capability, ramp, and affecting the schedules of 30 minute GTs and off-dispatch units, but were also designed to fail check out so that they would not flow in real-time. This could be accomplished by submitting the transaction to only one control area or submitting the same transaction to both control areas but with different NERC tags. These kind of check-out failures could happen from time to time for a variety of reasons, but prior to the implementation of ECAs A and B they were happening many times a day, day after day, for certain market participants.

[45] After the implementation of ECA A and B, the scheduling of sham transactions in and out of New York ceased almost immediately.

Figure 15

Prices and Flows Between New York and PJM
Real-Time Prices October 11-December 2000



The number in each box is the number of hours over the period October 11 – December 31, 2000 that fell in the specified range.
New York Price is the Central zone price (Zone C).
PJM price is the Penelec zonal price.

It can be seen in Figure 15 that there were very few flows into PJM in this period, so the elimination of uneconomic flows means eliminating flows from PJM into New York. Overall, the potential gains from eliminating uneconomic flows during the post-ECA-B have been to raise prices in New York by almost $170 million on an annual basis while lowering prices in PJM by about $509 million on an annual basis. The welfare benefits would have been about $62 million on an annual basis. The calculation for the impact of eliminating uneconomic transactions between NEPOOL and New York during the post-ECA-B period would have been to reduce prices in New York by $91 million on an annual basis while raising them in NEPOOL by $67 million on an annual basis. The estimated welfare benefit would have been $17.5 million on an annual basis. The benefits to New York from improved coordination with NEPOOL are again doubtful, however, because they arise from the elimination of apparently uneconomic transactions from New York to NEPOOL that may well have been economic if evaluated based on LMP prices.

The potentially most important gains from improved coordination are those arising from the elimination of uneconomic transactions, as realization of these gains does not require that the RTO increase transmission system utilization but only eliminate uneconomic usage. Our analysis based on real-time prices indicates potential welfare gains based on the EEA methodology and supply curve of around $66 million per year.[46] However, about $13 million of this gain arises from the elimination of apparently uneconomic NEPOOL transactions which may well be economic, the actual problem lying in the NEPOOL prices. A large portion of the remainder appears to arise from economic flows that appear to be uneconomic because of PJM rules that curtail self-scheduled transactions when prices fall to zero. Again the problem is not with the economics of market participant transactions, the problems lies with the posted prices.

D. Increased Economic Transactions

Another potential gain from a Northeast RTO is an increase the magnitude of imports in the periods in which they were economic, i.e., improved arbitrage. This would include both increased economic imports up to transmission limits in hours in which imports occurred or imports up to the transmission limit in hours in which imports should have occurred but did not. EEA has attempted to quantify this impact based on an assumed supply curve and the economics of imports. Several features of the EEA analysis, however, deserve further discussion and sensitivity analysis.

First, like the analysis of uneconomic transactions, the comparison between PJM and New York was based on day-ahead prices and real-time flows. We have recalculated the gains from increased for economic imports the period studied by EEA based on real-time prices and flows between New York and PJM. These results are portrayed in Table 16. In these hours, most of the apparent price impact would be to reduce prices in New York.

[46] This is based on the June-December period; the figure would be around $80 million if projected based on the post-ECA-B period (2-2/3 months).

Table 16 Price Impacts June-December 2000			
	Reduce Uneconomic Flows	**Increase Economic Flows**	**Total EEA**
PJM-New York	115.33	106.11	221.44
PJM	173.48	12.31	185.79
New York	-58.15	93.80	35.65
New York-NEPOOL	16.31	89.62	105.93
New York	40.65	2.32	42.97
NEPOOL	-24.35	87.31	62.96
Impact estimates are not annualized.			

Second, the EEA methodology also indicates that improved optimization of flows between New York and New England would materially reduce prices in NEPOOL and slightly reduce prices in New York. As previously discussed, however, we are very skeptical of the meaning of the EEA methodology as applied to the New York/NEPOOL interface. Because of the lack of LMP pricing in NEPOOL the price difference between New York and NEPOOL is not always a good indicator of the actual value of incremental resources.

Third, like the uneconomic transactions, the magnitude of scheduled economic transactions may have been affected by the scheduling of sham transactions prior to the implementation of ECAs A and B. This possibility can be examined by focusing on the period after the implementation of ECAs A and B. If the EEA methodology is applied to analyzing the impact of improved interregional real-time coordination in the post-ECA-B period, the estimated price impact of coordination with PJM increases, while there is little change in the estimated price impact between New York and NEPOOL or in the overall welfare effects. Curiously, the price impacts become even more highly concentrated on price reductions in PJM and NEPOOL, with estimated prices rising in New York, as can be seen in Table 17.

Table 17 Post-ECA-B Impacts		
	7-Month Total ($MM)	**Post-ECA-B 2-2/3 Months ($MM)**
PJM-New York		
Total Price Impact	221.44	120.21
New York	35.65	-7.86
PJM	185.79	128.06
Welfare Impact	111.46	42.92
NEPOOL		
Total Price Impact	105.93	39.79
New York	42.97	-13.98
NEPOOL	62.96	53.77
Welfare Impact	52.54	16.27

It is possible that this post-ECA-B pattern reflects changes in weather conditions rather than fundamental changes in market conditions, and Table 18 projects patterns from a very limited 2-2/3 month period of time. We have therefore extended that analysis to cover the period from October 11, 2000 through August 31, 2001, or about 10-2/3 months. The results are very similar to those for the October –December period. The energy price impact on New York is to raise energy prices by $1.22 million over the 10-2/3-month period (by $1.37 million on an annual basis) and to reduce energy payments by PJM customers by $392 million or $440 million on an annual basis. The estimated welfare gain from improved coordination is substantial $185 million on an annual basis.[47]

Fourth, the EEA analysis does not take account of the PJM or NEPOOL losses charges, which are collected in a separate charge, while New York losses costs are reflected in prices. This omission tends to make increased imports into New York from PJM and NEPOOL look economic when they are not. We have adjusted the PJM export price for transactions in the right side of Figure 6 by adding the 5 percent losses charge to the PJM price. No losses charge is added to transactions on the left side in which power is imported into PJM from New York, as the New York cost of losses is included in the price of energy.[48] The impact of these adjustments

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[47] No adjustment has been made in this calculation for the hours in which the New York price was negative and power flowed from PJM to NY due to PJM cuts, transmission constraints or reserve shortages.

[48] There are a variety of other charges on exports that reduce trade. These charges could be eliminated without moving to a combined real-time market and this would increase efficiency. This is in essence simply a matter of pancaked tariffs across the Northeast. Elimination of the pancaked rates within the Northeast would raise

is modest, slightly increasing the energy price impact (by decreasing prices in PJM and increasing prices in New York) over the June-December period as shown in Table 18. The impact on welfare benefits is immaterial.[49]

Table 18
Impact of Losses on Price Impacts
June-December 2000

	No PJM Losses Charge	PJM Losses Charge Included
Total PJM-New York	221.44	227.39
PJM	185.79	201.58
New York	35.65	25.81

In addition, transaction schedules designed to exploit the arbitrage opportunities provided by the PJM two-proxy bus pricing system when PJM was congested may have served to reduce the net flows into New York from PJM. This behavior appears to have become significant sometime after August 2000 and was very significant in the December 2000 to February 2001 period.[50] Almost 270 of the hours in which the New York Zone C price exceeded the Penelec price were also hours in which the PJM NYPP East price exceeded the New York Zone C price and thus in which proxy bus gaming may have affected the observed level of net flows. It was not apparent how to take this into account using publicly available data. This problem ended in early 2001 when PJM moved to a single proxy bus.

Fifth, as noted above, the supply curves used by EEA in its benefits analysis for PJM, New York and NEPOOL are remarkably flat. We have tested the impact of this assumption by also calculating the estimated price and welfare impacts assuming a PJM supply curve that is 1.5 times steeper and a New York West supply curve that is 2, 3 and 4 times steeper than those utilized in the EEA analysis. The results are portrayed in Table 19 for the June-December period used by EEA, the 3-month post-ECA-B period, and the 10-month post-ECA-B period. We again see contrasting trends for the June-December and the two post-ECA-B periods. For the June-December period, the steeper supply curve very slightly reduces the PJM benefits but greatly increases the reductions in the New York energy price. For the post-ECA-B period, however, the steeper supply curve serves to reduce the estimated price reductions in PJM but the price reductions in New York remain small or slightly negative. For both periods, the steeper supply curve reduces the estimated welfare gains.

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equity and cost shifting issues, but they would likely be less than the similar equity and cost shifting issues that have already been successfully addressed within the individual control areas.

[49] We have not been able to undertake all permutations and combinations of these sensitivity analyses so have not repeated this losses analysis for other periods or with other supply curves.

[50] See Andrew L. Ott, Congestion Charges and Loop Flow, pp. 4-6.

Table 19 PJM-New York Annual Impacts				
	EEA Supply Curve	**Supply Curve x 2**	**Supply Curve x 3**	**Supply Curve x 4**
June-December 2000 Period				
PJM Impact	316.89	362.64	330.26	303.42
New York Impact	60.80	134.67	165.67	174.55
Welfare Impact	190.11	155.87	143.54	134.65
ECA-B Period – October 11, 2000 – December 31, 2000				
PJM Impact	570.03	643.24	566.64	509.37
New York Impact	-34.97	13.05	9.44	-1.03
Welfare Impact	191.03	152.37	138.69	128.72
ECA-B Period – October 11, 2000 – August 31, 2001				
PJM Impact	440.64	541.76	496.24	457.66
New York Impact	-1.37	19.98	6.48	-11.27
Welfare Impact	184.77	147.00	134.82	126.19

A similar analysis was also performed for the New York East and NEPOOL supply curves, multiplying the New York East curve slope by 1.5 and the NEPOOL curve slope by 2, 3 and 4. As described elsewhere, it is not clear how meaningful these estimates are given the lack of locational prices in NEPOOL. If it is assumed that the exports to New York in hours in which the NEPOOL price is lower are truly uneconomic, then eliminating these flows would lower New York prices. If these flows are assumed to actually be economic at LMP prices, then adjusting the other inter-New York/NEPOOL flows using the EEA supply curve would raise New York prices but reduce NEPOOL prices as shown in Table 20.

Table 20 NEPOOL-New York Annual Impacts				
	EEA Supply Curve	**Supply Curve x 2**	**Supply Curve x 3**	**Supply Curve x 4**
June-December 2000 Period				
NEPOOL Impact	242.63	324.70	363.50	375.93
New York Impact	-123.38	-107.91	-76.58	-64.30
Welfare Impact	57.21	45.32	40.64	38.10
ECA-B Period – October 11,2000 –December 31, 2000				
NEPOOL Impact	377.87	537.40	619.25	644.72
New York Impact	-238.56	-234.78	-196.87	-180.87
Welfare Impact	43.68	31.05	26.12	24.17
ECA-B Period – October 11, 2000 – August 31, 2001				
NEPOOL Impact	259.17	375.26	429.38	449.42
New York Impact	-155.48	-163.24	-133.22	-120.83
Welfare Impact	56.34	46.60	42.98	41.18
Note: Benefits from correcting uneconomic flows to NEPOOL are excluded.				

Sixth, the EEA analysis assumes that the available transfer capability is equal to the highest flow observed in practice. This in is in effect equivalent to assuming that there are no transmission outages or other reductions in transfer capability affecting inter-control areas flow when such flows are valuable, which is not the case. Making such an assumption in assessing the benefits of a combined Northeast RTO overstates the potential benefits as it includes benefits arising from reduced outages. The impact of this consideration can be assessed for the post-ECA-A and B period by identifying the hours in which the inter-control area flows were in fact constrained by transmission[51] and thus could not have been increased. We have done so, by identifying the hours in which the scheduling of additional imports from PJM was, in fact, limited by transmission constraints on imports monitored by the NYISO during the post-ECA-B period.[52] Our analysis of transmission constraints on inter-ISO flows is limited to the transmission constraints identified by the NYISO in the BME evaluation and posted as part of the ECA-B implementation process. We have not identified as constrained the hours in which transactions were cut during check out or in real-time as a result of transmission constraints in PJM. Nor

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[51] This analysis only takes account of transmission constraints per se, between New York and PJM, not ramp constraints. This information is posted by the NYISO in conjunction with the implementation of ECA-B.

[52] These data are readily available for the post ECA-A and B period because these transmission constraints are identified in the process of validating prices.

have we identified as constrained the hours in which the BME schedules were cut in real-time by the NYISO as a result of constraints that developed in real-time such as voltage problems. Some of the apparently economic flows that did not occur, may therefore have reflected transmission constraints on exports monitored by PJM, or real-time constraints monitored by the NYISO.

In addition, just as ramping constraints between PJM and control areas to its south and west may have precluded elimination of some uneconomic transactions between New York and PJM, these constraints may have limited the ability of PJM to import or export additional energy to or from New York in real time. If this is the case, these ramping constraints would therefore preclude full realization of the estimated benefits from implementation of a coordinated energy market in the Northeast.

Taking account of the hours in which transmission between PJM and New York was constrained in BME raises the adverse impact on New York prices by about $8 million, reduces the price benefit to PJM by almost $94 million, and reduces the annual welfare benefit by almost $42 million.[53] The impact of this calculation is portrayed in Table 21.

The EEA price impact estimates also assume that imports into New York can be increased up to 2,900 MW, compared to the average flow of 2,143 MW in the hours in which imports into New York were actually constrained by transmission. It appears to us that the benefits of expanded trade are perhaps materially overstated by these assumptions regarding transmission capability. As a sensitivity analysis, we have recalculated benefits for the post-ECA-B period setting transmission capacity equal to actual flows in constrained hours, and the higher of 2,143 MW or actual flows in hours in which transmission was not constrained in BME. The impact of this calculation is also portrayed in Table 21 and it can be seen that both the price and welfare impacts of improved interregional real-time interchange are materially reduced.

These calculations are only sensitivity analyses and may either overstate or understate the impact of transmission constraints on the estimated benefits. More accurate estimates would require more review of BME data than we have been able to undertake and would ultimately require access to PJM and ISO-NE data.

[53] The same issue exists for transmission between New York and NEPOOL, but given the limited value of analyzing flows based on NEPOOL non-LMP prices, we have not undertaken a similar calculation for New York and NEPOOL

Table 21 Transmission Constraints New York – PJM Interface						
	Post-ECA-B Period October 11-December 31, 2000			Projected Annual		
	No Constraints	Exclude Constrained Hours	Constrained Capacity	No Constraints	Excluded Constrained Hours	Constrained Capacity
Total Price Impact	120.21	97.25	76.97	535.07	432.88	342.63
New York Impact	-7.86	-9.70	-20.26	-34.97	-43.19	-90.17
PJM Impact	128.00	106.95	97.23	570.03	476.07	432.80
Welfare Impact	42.92	33.43	22.35	191.03	148.79	99.51

No Constraint: EEA methodology; flow increased to maximum observed, even in transmission constrained hours.

Exclude Constrained Hours: Flows increased to maximum observed, except no increase in transmission constrained hours.

Constrained Capacity: No increase in transmission constrained hours, capacity set at higher of average of constrained hours or actual flows in unconstrained hours.

Seventh, the EEA study calculates the potential price impact of changes in imports and exports based on a single supply curve for each control area and under the assumption that prices in the exporting and importing control areas would move up uniformly based on that single supply curve. This assumption is problematic, at least in the case of New York, because many of the hours in which uneconomic imports or exports occurred were hours in which Central East or New York City constraints were binding. When such constraints are binding, the impact of either price increases or decreases in Western New York (resulting from changes in imports and exports with PJM) would potentially be limited to Western New York and the impact of either price increases or decreases in Zone G (resulting from changes in imports and exports with NEPOOL) would potentially be limited to Zone G. Not only does the presence of such constraints limit the loads affected by the estimated price changes, but the failure to take account of these transmission constraints in estimating the supply curve means that the supply curve estimated may not be a good representation of the New York supply curve either when transmission constraints are binding. In practice, however, since New York prices were found to be very little impacted by expanded real-time interchange in the base case above, the assumption that the energy price impact would be felt throughout New York has little impact on the revised estimates.[54] The impact of this assumption could be important in assessing benefits in NEPOOL

[54] In addition, the impact of price changes in Zone G on the actual payments by New York loads would be further muted by the fact that market participants hold substantial quantities of TCCs from West to East and changes in the price of energy in zone G move the value of these TCCs in the opposite direction. A better measure of the net impact of price changes on consumer costs would be the East of Central East load, less West to East TCCs. A similar effect runs in the opposite direction with changes in Western prices impacting Eastern consumers to

and PJM, which the EEA methodology indicates would have been impacted by the improved real-time dispatch. We did not attempt to make such an adjustment for either PJM or NEPOOL.

Overall, it can be seen that the EEA study methodology indicates that there would have been little or no price impact benefits to New York consumers from the implementation of real-time interregional dispatch in the post-ECA-B period, but potentially substantial price impact benefits to PJM consumers. The potential welfare gain could have been as high as $100-$200 million, but estimates in this range are inflated by overstated transmission capabilities, schedules attributable to gaming of the PJM two-proxy bus system, exclusion of losses charges and the impact of the PJM curtailment policy. There would likely have been benefits from improved real-time dispatch between NEPOOL and New York, but these benefits are even harder to assess based on the publicly available data given the lack of LMP pricing in NEPOOL, which makes it impossible to distinguish between uneconomic flows that might have been different in a regional market and incorrect price signals that make efficient flows look uneconomic.

As discussed above, there are a variety of simplifications underlying the EEA estimates that have the potential to affect the estimated price impacts and welfare benefits from implementation of interregional dispatch in real-time. Table 22 summarizes the impact of some of the more important of these simplifications analyzed over the extended post-ECA-B period, October 11, 2000 through August 31, 2001, and then projected to annual costs levels. It can be seen that there would apparently be substantial price benefits to PJM consumers, and little or no price benefit to New York consumers.

As observed above, we do not claim that any these revised estimates provide the single best estimate of the potential price impacts or welfare benefits of implementing a coordinated regional real-time dispatch in the Northeast. These alternative estimates need to be viewed as sensitivity analyses, illustrating the need to correctly account for the various factors. In particular, the reduced transmission interface limits we use may be too low, but also may be too high, particularly in reflecting the impact of real-time curtailments. Similarly, our attempt to exclude from the benefit calculation hours in which interregional flows were efficient but prices misleading is approximate and may exclude hours in which there was inefficiency and include hours in which there were no inefficient flows. In particular, a substantial portion of the calculate welfare benefit arises in hours in which both PJM and New York prices exceeded $100, and flows may have in fact been efficient and constrained by reserve shortages, while the prices were misleading.

Finally, the assumed supply curve slopes can have an important impact on both price and welfare impacts, and the true supply curve slopes in the hours in which the estimated benefits arise may not be encompassed within any of our sensitivity cases. Our analysis indicates that these factors matter, and failure to correctly account for transmission constraints, failure to account for efficient flows that appear uneconomic and vice versa, and failure to calculate benefits using the real-world supply curve will materially impact the estimated benefits.

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the extent of their TCC holdings in constrained hours. Given the very limited changes in New York prices, we did not attempt to adjust these impact estimates for the effect on TCC values.

Table 22 Comparison of PJM-New York Impacts ($ MM)					
		October 11, 2000 – August 31, 2001			
	June 1-December 31, 2000 Period[1] (A)	Base Case (B)	Transmission-Constrained Curtailments (C)	Reduced Interface Limits[4] (D)	Increased Supply Curve Slopes (E)
PJM Impact	316.89	440.64	373.92	290.55	351.66
New York Impact	60.80	-1.37	6.73	-15.38	-36.54
Welfare Impact	190.11	184.77	151.22	104.57	79.89

All figures are annualized.

(C) Transfer limit set equal to actual flows in transmission constrained hours, and no benefits from eliminating apparently uneconomic flows into New York in hours in which the New York price was negative.

(D) Case C and the transfer limit set at the higher of actual flows or the actual average flows in constrained hours October 11, 2000 to August 31, 2001.

(E) Case D and the supply curve slope in New York increased 200 percent and the PJM supply curve slope increased 50 percent.

Overall, there do not appear to be large price impact benefits for New York consumers in any of these scenarios although there are substantial price benefits for PJM consumers and welfare benefits. Critical to the magnitude of these benefits is understanding the reason for the uneconomic exports from PJM to New York, as these account for most of the price benefit and nearly 60 percent of the estimated welfare benefit. Actual supply curves should be used, and actual transmission constraints, curtailments and reserve shortages accounted for in developing more meaningful estimates of potential savings. Ideally, as noted above, a cooperative effort by the Northeast RTOs would permit benefit analyses to be based on a regional dispatch model that addresses these factors.

E. Barriers to Trade

As discussed above, there are several varieties of barriers to expanded trade in the Northeast, some of which would be eliminated by the formation of a Northeast RTO and the implementation of real-time interregional dispatch by the RTO, some which would not be eliminated by formation of the RTO alone and some that could be eliminated prior to the implementation of real-time interregional dispatch. Limitations on inter-control area arbitrage arising from ramp rate limits on the inter-control area interfaces internal to the Northeast RTO and the inability of market participants to arbitrage intra-hour price variations would be largely or completely eliminated by the implementation of real-time interregional dispatch and could not be fully realized without the implementation of real-time interregional dispatch.

There are, however, a number of charges on exports that reduce interregional arbitrage, in effect serving as tariffs. These charges would in practice need to be eliminated before a coordinated real-time dispatch could be implemented for the Northeast but could also be eliminated prior to the implementation of real-time interregional dispatch. In the case of New York, these charges include the TSC collected by the New York transmission owners on exports from New York and the ancillary service charges collected on exports by the NYISO. PJM collects a charge for non-firm transmission on exports from PJM, as well as charges for spinning reserve and real-time uplift on exports from PJM that were not scheduled day-ahead.[55] NEPOOL also collects a charge on exports. All of these charges on exports can make it uneconomic in the real-world to schedule transactions that would be dispatched following implementation of real-time interregional dispatch.

The EEA analysis includes a Hypothetical Optimal Flow Pattern, which does not alter flows for small price differences which might be intended to proxy for the effect of these various tariff charges. Under a combined Northeast RTO these charges would need to be completely eliminated, but from a price impact standpoint, the costs currently recovered from these charges would still need to be borne by someone. The EEA flow pattern assumptions might be an approximate method of recognizing these complications. From a welfare standpoint, however, the reduction in trade associated with these pancaked transmission charges is a loss, however, so we have recalculated the gains from trade using the original EEA and modified supply curves for the original June-December period without the hypothetical optimal flow pattern.

It can be seen in Table 23 that the estimated benefits of full real-time arbitrage through a single energy market would be somewhat larger than under the EEA partial arbitrage assumption. The estimated price reductions between New York and PJM raise by $50 million and between New York and NEPOOL by about $25 million. The change in total payments by consumers would be different, however, as the costs currently recovered through tariff, schedule 1 and ancillary service charges on export transactions would need to be recovered from consumers. The more appropriate measure of the gains from perfect arbitrage would therefore be the welfare change, which is around $20 million between New York and PJM and $2.5 million between New York and NEPOOL.[56] A portion of these gains could be realized by eliminating these various taxes on exports even prior to implementation of a regional real-time imbalance market.

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[55] PJM also collects a losses charge on exports but we do not classify that as a tariff charge because that charge is related to the actual additional losses incurred in generating incremental energy for export. Because PJM does not employ marginal losses pricing the charge may be very poorly related to the actual incremental cost of losses but we do not classify it as a barrier to trade because it is a proxy for a real cost that would presumably remain under the Northeast RTO.

[56] This assessment uses the other EEA assumptions regarding supply curve slopes and transfer limits, so the gains are accordingly overstated.

Table 23 Energy Charge and Welfare Impacts Elimination of All Tariff Barriers (June 2000 – December 2000)		
	Partial Arbitrage ($MM)	**Full Arbitrage ($MM)**
New York/PJM		
Total Price Impact	377.69	429.18
PJM	316.89	313.56
New York	60.80	115.62
Welfare Impact	190.11	210.46
New York/NEPOOL		
Total Price Impact	180.68	205.66
New York	73.29	104.55
NEPOOL	107.39	101.10
Welfare Impact	89.62	92.23
All figures are annualized.		

Another class of restrictions on exports that could be eliminated prior to implementation of the Northeast RTO are the artificial restrictions on imports and exports included in the current NEPOOL tariff. While ISO-New England will probably continue to impose some restrictions on exports in circumstances in which NEPOOL is constrained and the posted real-time energy price does not reflect the actual incremental cost of the energy that must be dispatched to support exports, these restrictions need not persist after the implementation of LMP and their application should be limited in the interim.

III. MARKET PERFORMANCE

In addition to the cost benefit analyses, the EEA affidavit and related *Public Utilities Fortnightly* article also raise several interesting questions about other elements of market performance that bear directly or indirectly on the benefits from closer coordination of real-time interchange among the Northeast RTOs. These issues relate to the pricing of interregional flows, in particular the number of pricing points, the variability of interregional prices, and the relationship between day-ahead and real-time prices.

A. Proxy Bus

The New York ISO prices imports from PJM and exports to PJM based on the price it determines for a single PJM "proxy bus." Until early 2001, on the other hand, PJM priced imports from and exports to New York based on prices determined for both a NYPP East and a NYPP West proxy bus. In early 2001, PJM moved to a single proxy bus for pricing imports from and exports to New York. The *Public Utilities Fortnightly* article discusses the question of single versus multiple proxy buses but mischaracterizes the issue. It is stated that:

> "The New York ISO pays one price for imports from PJM that blends the differences between relatively lower prices in the West with higher prices in the east. New York's blended price is so low, compared to other Eastern markets, that on average PJM sellers get a 61 percent higher price selling real-time in PJM than selling to New York – even though New York prices are consistently higher than PJM! The two ISO's approached this pricing difference as a `seams issue' i.e. as a different scheduling practice since PJM used two prices and New York used one price. When New York declined to accommodate PJM's two pricing zones because of 'software problems,' PJM changed to one pricing zone. The 'seams issue' was resolved because both ISOs now use one zone – even though each ISO still calculates a different price for its zone. Ironically, the pricing problem for New York City is actually worse because now neither ISO has zones that reflect the value of energy in eastern New York. New York City is an even less attractive market for PJM suppliers than before the change."[57]

The EEA data portrayed in Exhibit 1 indicate that the New York-PJM day-ahead proxy bus price averaged $38.12 for the June 2000 – March 31, 2001 period, which can be seen to be materially above the price in any of the PJM load zones in the day-ahead market for the same period. Thus, the New York day-ahead price was not artificially low or discouraging imports. The real-time price, particularly post-ECA-B, for the PJM proxy bus can be lower than the PJM price, but this is typically true in periods in which there was excess demand for transmission into New York, driving the price at the PJM proxy bus down. If the PJM-New York interface is transmission constrained, then obviously no imports are being discouraged as no more can be accommodated. Indeed, in some hours the real-time PJM proxy bus price is determined by the market price of the counterflow transactions that were scheduled to enable day-ahead transactions to continue to flow without curtailment despite reductions in transfer capability not reflected in day-ahead schedules.

Moreover, the issue relating to the use of a single or multiple proxy bus had nothing to do with the New York software and was entirely a matter of market design and avoiding gaming opportunities. The first consideration that needs to be understood is that whether a market participant designates an export as destined for NYPP E or NYPP W does not change how PJM

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[57] "Northeast Power Markets: The Argument for a Unified Grid," *Public Utilities Fortnightly* (PUF), September 1, 2001, p. 42-43.

would move generation to supply the generation to support such a change in net interchange.[58] In either case, PJM would dispatch generation at least cost, given any binding transmission constraints, to supply the net interchange. It is New York's belief that this would usually entail raising generation on a unit located somewhere in Western PJM, not in Eastern PJM. The selection of the NYISO PJM proxy bus was intended to roughly reflect the region of PJM in which generation would usually be raised to support an export schedule to New York. If the NYISO had established an Eastern PJM proxy bus and modeled this as having an impact on New York reflecting a generator being raised in Eastern PJM to support exports, this would have raised the proxy price paid for imports. This would not have changed the generators raised by PJM to support exports and NYISO market participants would have paid the higher Eastern price for generation flows that would actually have come from Western PJM and backed down cheap Western New York generation, rather than expensive Eastern New York generation. This would have raised, not lowered, the cost of meeting load in New York.

In fact, had New York set up a PJM East proxy bus, market participants could have set up money machines that would have extracted payments from New York customers without delivering any energy. Indeed, it was precisely this kind of gaming by PJM market participants, not any inability of the New York ISO to modify its software, that caused the PJM ISO to move to a single proxy bus pricing system in early 2001.[59]

Some of the potential gaming strategies can be illustrated with a simple example.

Figure 24 portrays a simple 4-bus, two-ISO system, with prices from the standpoint of the North ISO.[60] It can be seen that the line A-B within the North ISO is at its limit, and given this constraint, and the generation offer prices at A and B, the value of injections at C and D would be $70 and $85. No constraints are binding within the South ISO, and the LMP prices as calculated by the South ISO are the same everywhere and equal to $50, set by a generator at C.

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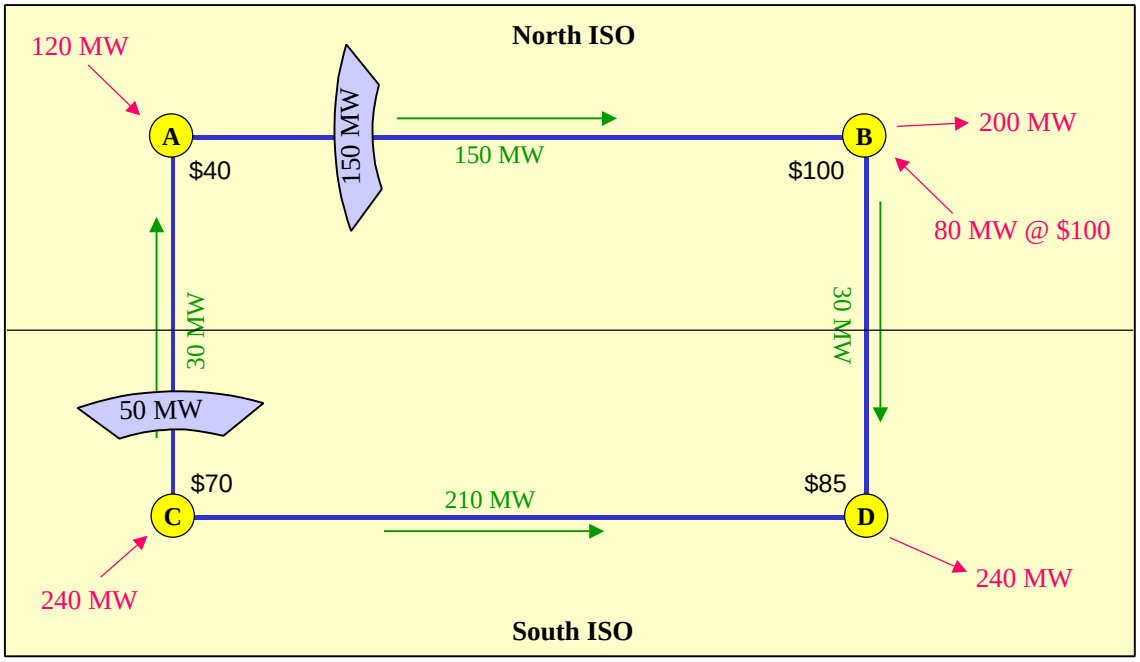
[58] The same is true for the NYISO. The NYISO would redispatch the New York system in exactly the same way to adjust interchange with PJM, regardless of the proxy bus destination that had been designated.

[59] See Andrew L. Ott, "Congestion Charges and Loop Flow."

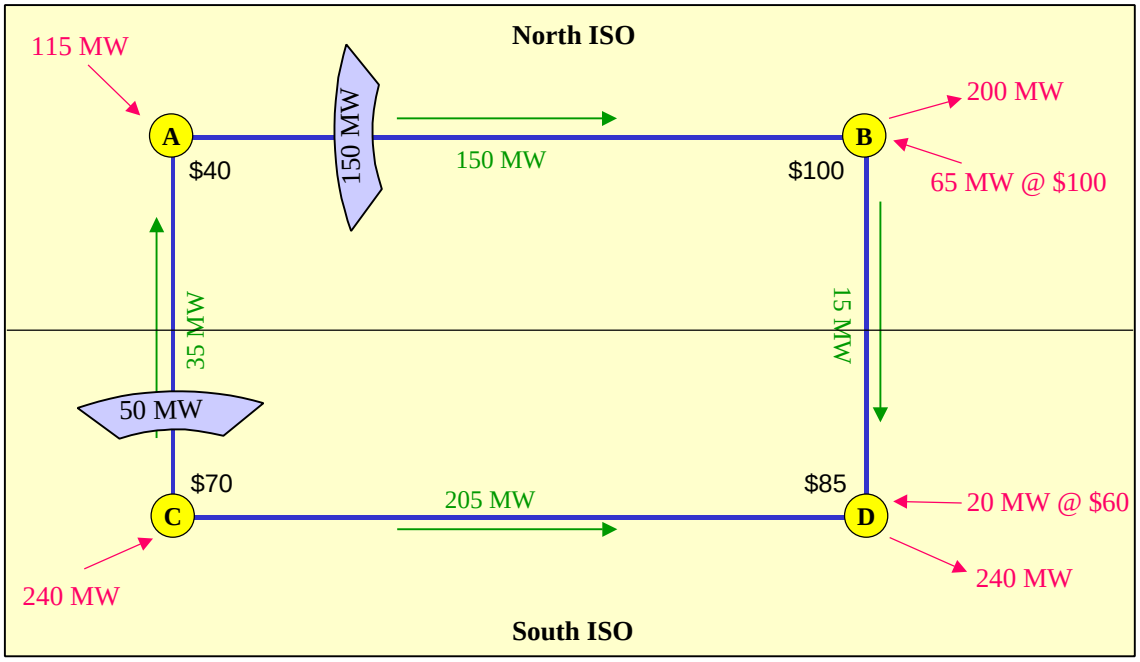
[60] For simplicity, all of the lines are assumed to have equal reactance and zero resistance and the example ignores post-contingency constraints.

Figure 24



Suppose that the North ISO had separate East (D) and West (C) proxy buses for imports scheduled into the North ISO from locations in the South ISO. A supplier in the South ISO, observing the $85 price at the East proxy bus would offer to sell power into the North ISO at the East Proxy bus. The impact of such a transaction is shown in Figure 25. Compared to Figure 24, generation injections are increased 20 MW at D, decreased 5 MW at A and decreased 15 MW at B.

Figure 25



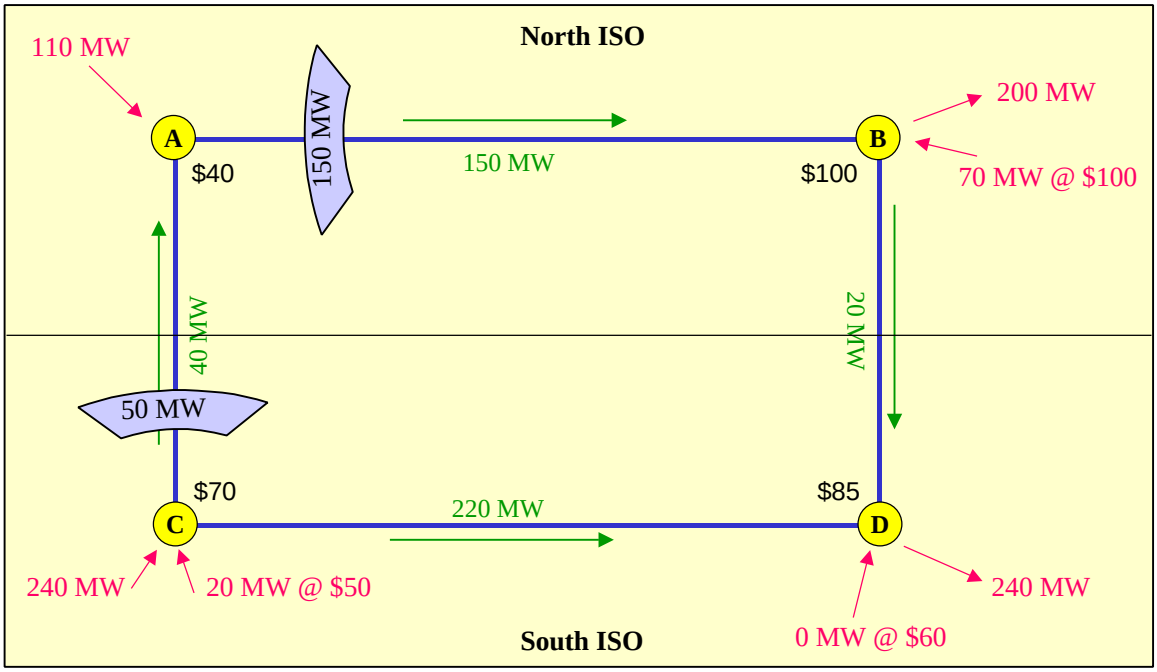
It is shown in Table 26 that the North ISO could settle these additional imports at the $85 price as imports at D would enable the North ISO to reduce injections costing this much within the North ISO.

Table 26
Expected Change in Payments

-5 MW @ A	$40	-$200
+20 MW @ C	$85	+$1,700
-15 MW @ B	$100	-$1,500
Net		0

When the supplier schedules its export with the South ISO, the South ISO adjusts its interchange with the North ISO but increases the cheapest generation in its system, which is $50/MWh generation at C, rather than $60 generation at D. The dispatch by the South ISO results in a net change in interchange of +20 into North ISO, but the change in flows is portrayed in Figure 27. Because the South ISO has increased generation at C rather than at D, the impact on the North ISO is different than in Figure 25. Instead of being able to reduce generation by 15 MW at B, it is possible to reduce generation by only 10 MW without overloading the A-B line.

Figure 27



The result is that the purchase of power from the supplier in the South ISO actually raised the cost of meeting the load in the North ISO, as shown in Table 28. The supplier, however, would find the transaction quite profitable, as it would buy power at $50 in South ISO and sell it for $85 in North ISO.

Table 28
Actual Change in Costs

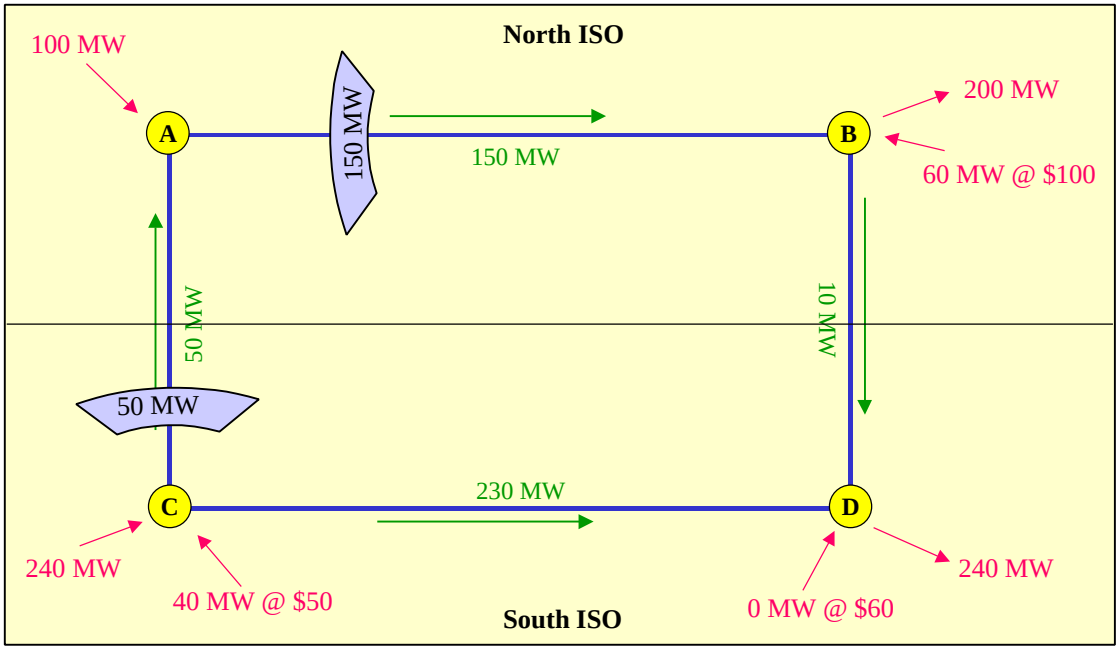
-10 MW @ A	$40	-$400
+20 MW @ C	$85	+1,700
-10 MW @ B	$100	-$1,000
Net		+$300

This is the arbitrage possibility that concerned the New York ISO with multiple proxy bus systems applied to free-flowing ties.[61] It is also the crux of the arbitrage that forced PJM to move

[61] A multiple proxy bus pricing system can be applied to schedule flows over controllable lines, as described in the DAM Study (Appendices I and II). Schedules from the New York and PJM proxy buses, however, are not linked to flows over controllable lines and the controllable lines are not always operated to maintain scheduled flows.

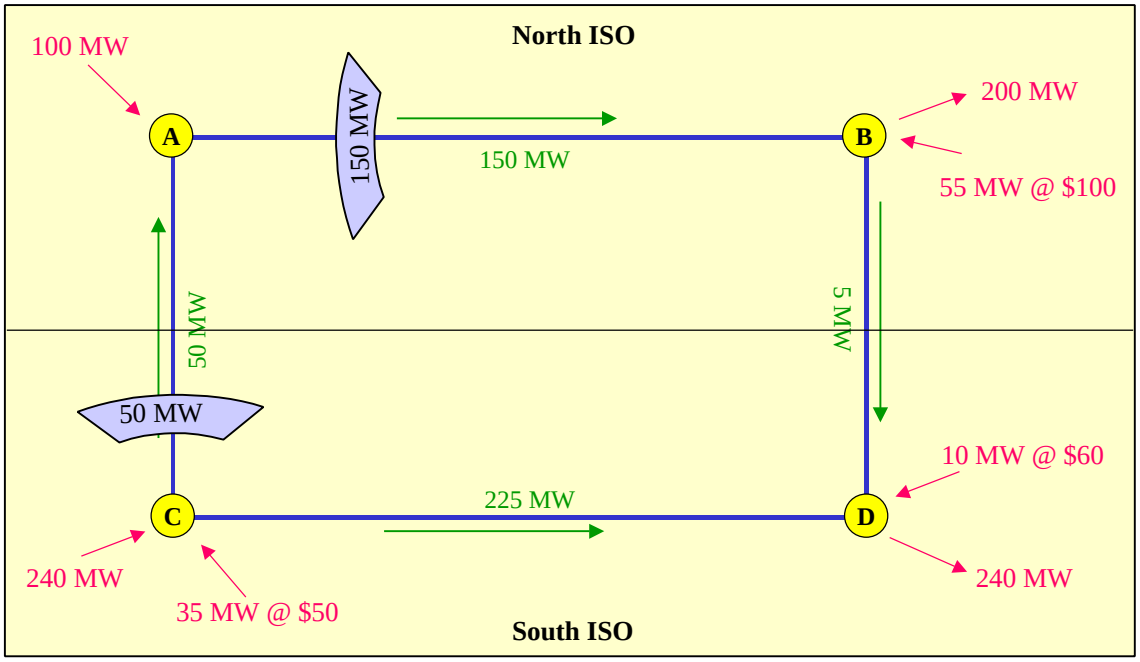
to a single proxy bus. The issue is not software but gaming. The arbitrage described in these examples could continue with increasing imports being scheduled into the North ISO from the proxy bus at D but actually dispatched from C until the constraint on the line C-A became binding as shown in Figure 29. At this point, raising generation at C to support additional exports to the North ISO would overload the line C-A.

Figure 29



It would be possible, however, to further increase exports to North ISO by 5 MW by backing down generation at C 5MW and dispatching the $60 generation at D at operate at 10MW as shown in Figure 30. The prices in the South ISO would then be $50 at C, $60 at D and $70 at B, which would be economic from the standpoint of the North ISO. The interesting issue is then whether the South ISO dispatches the generation at D to support the exports to North ISO, raising the LMP prices for the South ISO customers at D, or cuts the schedule because it would overload the line C-A if generated at C.

Figure 30



The proxy bus issue indeed reflects a seams issue and it can be fully addressed for flows over open ties only by moving to a coordinated regional dispatch, establishing a second proxy bus simply creates gaming opportunities.[62]

B. Volatility

A related issue raised by EEA concerns proxy bus volatility. EEA calculates a 593 percent real-time price volatility at the New York market's PJM proxy bus over the period from June 2000 through March 2001.[63] While we were not able to exactly replicate the EEA calculation it is important to understand why the data might produce such a seemingly extreme result.

Prior to the implementation of ECA-A and B on October 11, 2000 the real-time prices posted for the PJM proxy bus did not reflect congestion between New York and PJM, even when the interface between the two areas was binding in the hour-ahead scheduling process and there was excess demand for transmission between PJM and New York (or between New York and any of

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[62] As discussed at length in the DAM Study (Appendix I and II), and pp. 180-181, additional proxy buses could be established to price scheduled flows over controllable lines without giving rise to gaming opportunities and this step might be taken in the interim period prior to implementation of the Northeast RTO. This pricing mechanism would be applicable to the PAR controlled lines between New York and PJM if those PARs were operated to hold flows.

[63] Affidavit, Exhibit 2, p. 8.

the other adjacent control areas). This failure to correctly price real-time congestion led to market outcomes that New York participants justifiably viewed as unacceptable. ECA-B was implemented on October 11, 2000 to correct this problem and to ensure that when congestion existed between the ISOs, congestion would be reflected in the real-time prices.

The volatility that differentiates the PJM proxy bus from other zones in the New York market is attributable almost exclusively to the post-ECA-B period and in particular to the hours in which transmission or ramp constraints existed on the PJM interface in the hour-ahead scheduling process. In the hours when the interface is constrained it is the bids of market participants who most highly value the use of the interface in the hour-ahead market that set the price and the PJM proxy bus price separates from Western new York prices as a result of transmission congestion.

If the volatility calculation is repeated including only hours with no constraints on the PJM interface the calculated volatility at the PJM proxy bus falls to 93 percent, compared to 95 percent for the Central zone and 95 percent for Hudson Valley zone analyzed over the same hours. Exactly the same consideration is applicable to the Hydro Quebec, NEPOOL and Ontario proxy bus prices, which also have elevated variability in the EEA calculations.

C. Day-Ahead Prices

A third interesting question raised in the *Public Utilities Fortnightly* article is whether day-ahead prices should be higher or lower than real-time prices. It is stated that "In theory day-ahead prices ought to run higher than average prices do in real-time. The difference represents the premium paid to avoid a given level of risk."[64] It is possible that these considerations would motivate a day-ahead premium but there is no compelling reason that this should be the case or that such a premium would survive arbitrage. If the real-time price is lower than the day-ahead price on average, the generator will on average be able to cover its outage at a profit. A more complex analysis might take into account correlations between states of the world in which outages occur and prices are high but this kind of analysis is not referenced by EEA and we are not familiar with any strong conclusions.

On the other hand, it could be argued that because there are more options day-ahead than in real-time, real-time prices are likely to be more volatile than day-ahead prices, but this also does not imply that they necessarily would be lower in equilibrium.

Overall, one would anticipate that expected day-ahead and real-time prices should converge, taking account of transaction costs.[65] Market participants in PJM are able to arbitrage differences between day-ahead and real-time prices through virtual load and supply bids at all locations, although such arbitrage positions are subject to an allocation of real-time uplift, which does not appear to be posted, but we understand to average around $1/MWh. We should

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[64] PUF, p. 39.

[65] See Severin Borenstein, James Bushnell, Christopher R. Knittel and Catherine Wolfram, "Trading Inefficiencies in California's Electricity Markets," October 2001.

therefore expect PJM day-ahead and real-time prices to converge, within the range of the real-time uplift cost.

The ability of market participants in New York to similarly arbitrage expected price differences with price sensitive virtual supply and demand bids was initially limited to the four proxy buses.[66] Bids and offers at these four buses, however, would enable market participants to arbitrage most differences other than the differences in New York City, which are actually the smallest. The NYISO does not impose any charge on real-time imbalances analogous to the PJM real-time uplift charge, so market participants should have been able to arbitrage these spreads. As observed by EEA, however, day-ahead prices averaged several dollars above real-time prices in Western New York over the June-December 2000 period.

It should be kept in mind, however, that the June-December period was really the first time either market operated under a two-settlement system, and in the case of New York, there was not even past experience with historical real-time prices. From this perspective, it is useful to consider some of the considerations giving rise to differences between day-ahead and real-time prices in both Western and Eastern New York, looking separately at the on and off-peak hours. First, in the off-peak hours both in New York City and the Western Zone, the 20 hours with the largest difference between day-ahead and real-time prices is overwhelmingly dominated by nighttime hours in which the real-time price was negative, 20 out of 20 hours in New York City and 17 of 20 cases in the West, and most are in fact the same hours. The remaining three cases in the West were attributable to weekend prices that were negative. Many of these negative prices probably arose from cuts of NYISO exports by PJM and NEPOOL. It is not entirely surprising that market participants were not able to fully arbitrage these impacts in the first summer.

Second, the on and off-peak hours in which New York City real-time prices greatly exceeded day-ahead prices were dominated by hours of thunderstorm alerts and other real-time deratings of the transmission system (on-peak 10/20 hours thunderstorm alerts, 6/20 due to other real-time reductions in transfer limits; off-peak 16/20 hours thunderstorm alert, 2/20 other real-time reductions in transfer capability). Again, it is not surprising that these events were not accurately forecast by market participants during the first few months of operation.[67]

Third, on-peak day-ahead prices exceeded on-peak real-time prices on average both in New York City and in the West over the period analyzed by EEA and in both cases the outliers were a few days on which day-ahead prices were materially higher than real-time prices. The relationship between day-ahead and real-time prices on high load days is affected both by arbitrage and by the treatment of reserves in real-time, so it is again not surprising that arbitrage was imperfect during the first summer of NYISO operation.

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[66] This limitation will be eliminated November 1, 2001, with the implementation of full virtual supply and demand bidding at all locations within New York, pending FERC approval.

[67] It should be noted that the New York City day-ahead price was lower than the real-time price in the off-peak hours and slightly higher than the real-time price in the on-peak hours.

It can be seen in Tables 31 and 32 that the difference between day-ahead and real-time on-peak prices in New York and PJM during the period studied by EEA, June 2000 to March 2001, ranged from differences of $2.36 to +$4.29 in PJM to +$1.01 to $8.97 in New York. The spread between day-ahead and real-time off-peak prices appears to be much smaller in PJM than in New York, ranging only from -$.35 to +$1.26.

Table 31
NYISO DAM versus RT Zonal Price Analysis

Peak	Zone	West	Genesee	Central	North	Mohawk Valley	Capital	Hudson Valley	Millwood	Dun-woodie	New York City	Long Island
ALL	6/00-8/00	7.66	7.17	7.75	5.74	7.21	11.74	9.76	8.82	9.42	(0.27)	5.58
ON	6/00-8/00	10.15	9.07	10.14	5.89	8.75	21.30	17.18	15.89	16.68	6.64	5.81
OFF	6/00-8/00	5.44	5.48	5.62	5.60	5.84	3.22	3.15	2.52	2.94	-6.43	5.38
ALL	6/01-8/01	4.34	4.11	5.13	5.22	5.50	2.85	3.13	-0.44	-0.29	2.13	-12.00
ON	6/01-8/01	6.27	6.65	7.53	7.70	8.39	3.35	2.91	-2.84	-2.78	-0.50	-22.01
OFF	6/01-8/01	2.63	1.84	3.00	3.02	2.93	2.41	3.32	1.69	1.93	4.47	-3.09
ALL	6/00-3/01	5.09	4.24	5.57	4.81	5.45	4.19	4.90	3.58	4.07	-2.12	0.22
ON	6/00-3/01	5.67	5.13	6.71	4.94	6.30	8.89	8.97	7.87	8.41	1.01	0.56
OFF	6/00-3/01	4.58	3.47	4.59	4.71	4.72	0.10	1.36	-0.15	0.31	-4.83	-0.09
ALL	6/00-8/01	5.08	4.34	5.64	5.24	5.73	3.12	4.09	2.05	2.49	-1.10	-3.28
ON	6/00-8/01	5.69	5.36	6.78	5.54	6.69	7.17	7.34	4.68	5.16	0.72	-5.49
OFF	6/00-8/01	4.56	3.44	4.64	4.97	4.89	-0.42	1.24	-0.25	0.16	-2.69	-1.34

Tables 31 and 32 extend the comparison of day-ahead and real-time prices through August 2001 and permit comparison of the spread in day-ahead and real-time prices in Summer 2000 and Summer 2001. It can be seen that in New York there was a decrease in this spread between 2000 and 2001, although the spread was still several dollars in the summer of 2001. In PJM, there was an even more dramatic decrease, as real-time on-peak prices averaged substantially above day-ahead prices in several Eastern PJM zones during the summer of 2001.

Table 32 PJM DAM versus Real-Time Zonal Price Analysis													
Peak	**Period**	**PJM**	**AECO**	**BGE**	**DPL**	**GPU**	**JCPL**	**METED**	**PECO**	**Penelec**	**PEPCO**	**PPL**	**PSEG**
ALL	6/00-8/00	2.19	0.66	2.86	1.34	2.29	2.15	2.53	1.67	2.63	3.02	3.01	1.58
ON	6/00-8/00	4.34	2.01	4.96	3.40	4.66	4.76	4.97	3.65	4.69	5.30	5.61	3.73
OFF	6/00-8/00	0.28	-0.54	0.98	-0.50	0.18	-0.17	0.36	-0.09	0.79	1.00	0.69	-0.34
ALL	6/01-8/01	-3.14	-3.93	-2.56	-2.88	-3.49	-4.82	-4.28	-2.94	1.08	0.01	-2.72	-3.41
ON	6/01-8/01	-7.51	-9.82	-5.95	-7.73	-7.32	-11.10	-9.40	-8.14	3.92	-0.81	-6.14	-8.75
OFF	6/01-8/01	0.76	1.31	0.45	1.44	-0.08	0.78	0.28	1.70	-1.45	0.74	0.32	1.34
ALL	6/00-3/01	1.92	1.43	2.20	1.56	2.23	2.57	2.23	1.71	1.90	2.25	2.33	0.91
ON	6/00-3/01	3.22	2.53	3.28	2.88	3.64	4.29	3.55	2.93	2.99	3.44	3.71	2.36
OFF	6/00-3/01	0.79	0.47	1.26	0.41	1.01	1.08	1.08	0.64	0.95	1.22	1.14	-0.35
ALL	6/00-8/01	0.86	0.37	1.17	0.52	1.01	0.99	0.87	0.80	1.68	1.73	1.23	0.13
ON	6/00-8/01	0.92	-0.03	1.32	0.38	1.29	0.95	0.83	0.65	3.13	2.47	1.58	0.06
OFF	6/00-8/01	0.80	0.72	1.04	0.63	0.77	1.02	0.89	0.93	0.41	1.07	0.92	0.20

The *Public Utilities Fortnightly* article drew a number of conclusions about the New York and PJM markets based on differences between day-ahead and real-time prices over the period June 2000- March 2001 such as the absolute magnitude of the differences between day-ahead and real-time prices and whether real-time prices were lower than day-ahead prices. In the summer of 2001, by far the largest absolute differences between day-ahead and real-time prices were found during the on-peak hours in PJM, and these prices also had the property that the real-time prices greatly exceed day-ahead prices for the on-peak hours in Eastern PJM. It appears to us that these relationships between day-ahead and real-time prices are complex and considerable additional analysis would need to be undertaken to understand the reasons for these patterns.

IV. CONCLUSIONS

The EEA analysis is an important effort to advance our understanding of the potential gains from implementation of a Northeast RTO. Some of the simplifications made in developing the EEA analysis appear, however, to have potentially important effects on the validity of the study's conclusions. In particular, the study compares real-time flows and day-ahead prices, ignores inter-ISO and intra-ISO transmission constraints, assumes that posted prices in all cases accurately reflect the incremental cost of energy, relies upon estimated regional supply curves that are remarkably flat, and estimates impacts for a largely pre-ECA-B period, prior to the implementation of important changes in the pricing and scheduling of interregional transactions.

We have attempted to assess the impact of these simplifications on the EEA findings, and it appears that more accurate assumptions tend to result in estimates of large price impact benefits to PJM customers and little or negative price impacts for New York energy customers. This outcome is fundamentally a reflection of the finding that there are many hours in which there appear to be uneconomic flows from PJM into New York, but very few hours in which uneconomic flows into PJM appear to be occurring. The magnitude of the price impacts and welfare benefits from implementing improved real-time dispatch therefore depends in

considerable part on whether these apparently uneconomic flows are in fact inefficient or reflect constraints or costs not taken into account in the EEA analysis.

From the perspective of the overall question, the gains from more rapid implementation of a Northeast RTO, some of the anomalies the EEA study points to, particularly those involving the non-locational energy prices in NEPOOL, are good reminders that the gains from implementing a market faster will not necessarily be sufficient to offset the costs arising from problematic market design. Our analysis has corrected, or taken sensitivity analyses of, some, but not all, of the data limitations of the EEA study. Most of the remaining limitations are correctable, and could be addressed by a cooperative study by the Northeast ISOs, although some of the data used in such a study would likely need to be kept confidential.