Appendix A

Analyses Performed by CRA International

for the

Department of Energy

in relation to the

Response to Comments on the

National Electric Transmission Congestion Study

and

Proposed Designation of National Interest Electric

Transmission Corridors

In performing its *National Electric Transmission Congestion Study* (August 2006) and in preparing its proposals for the designation of National Interest Electric Transmission Corridors in the Mid-Atlantic and Southwest areas, DOE tasked CRA International (CRAI), an energy consulting firm, to prepare several analyses. The work done by CRAI in relation to the Congestion Study was posted on DOE's website, xxx, after the publication of the Congestion Study. This appendix presents several memos, spreadsheets, or tables that summarize and explain additional analyses that CRAI has performed for the Department pertaining to the development of the Department's current proposals.

The items included in this appendix are:

A.1. CRAI memo to Poonum Agrawal, "Analysis of Implications of Transmission Congestion in PJM and NYISO," December 18, 2006, revised March 2, 2007.

A.2. CRAI memo to David Meyer and Poonum Agrawal, "Impact of Congestion on the Efficiency of the Dispatch of Generation Capacity in PJM and New York," January 17, 2007, revised March 2, 2007.

A.3. CRAI memo to Poonum Agrawal and David Meyer, "ICAP and Transmission in NYISO," January 18, 2007, revised March 2, 2007.

A.4. CRAI Powerpoint presentation, "Transmission Constraints Limiting Power Delivery from Underutilized Generators and/or to High Price Load Areas in PJM and NYISO," February 16, 2007.

A.5. New York LBMP Data and Graphics, 2004-2006 (no date).

A.6. CRAI Memo to Poonum Agrawal and David Meyer, "SCIT Congestion", March 23, 2007.

A.7. CRAI Memo to Poonum Agrawal and David Meyer, "San Diego Congestion", January 16, 2007

A.1.

Memorandum

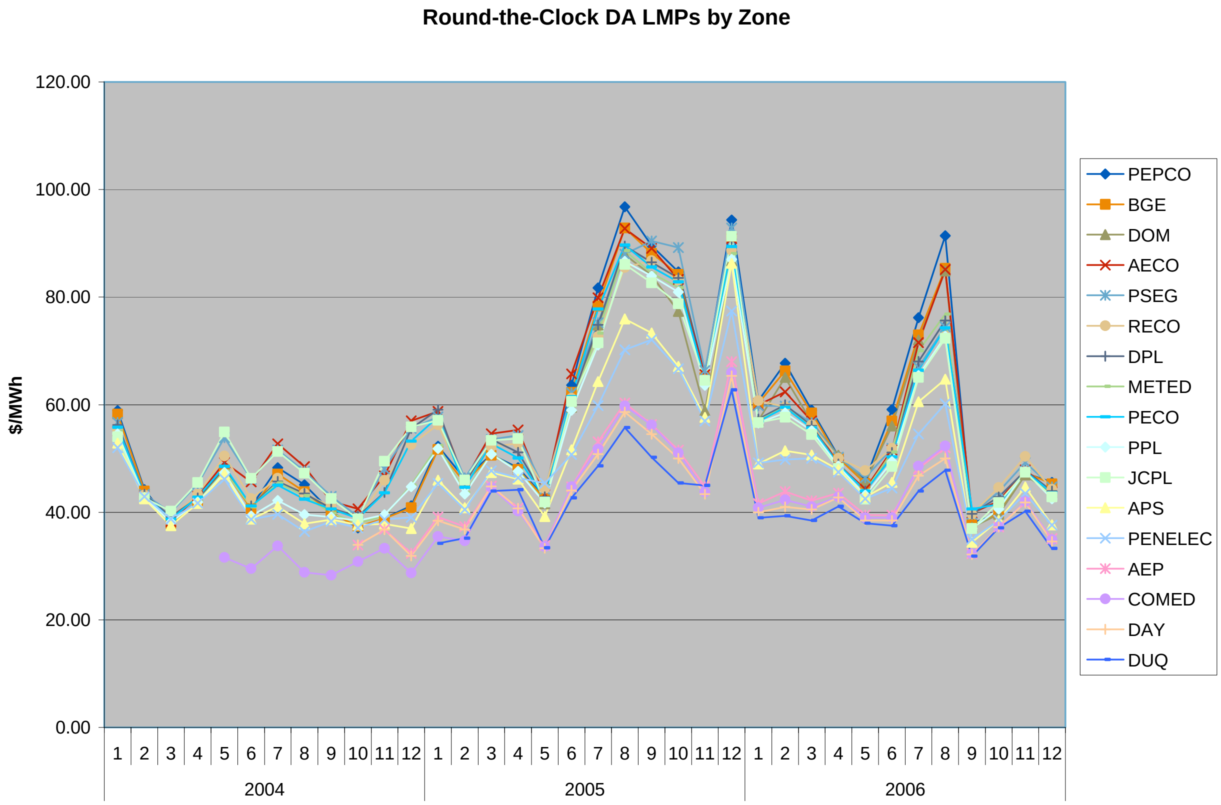
To:	Poonum Agrawal, US DOE	CRA No.	DOE 07-1
From:	Alex Rudkevich, Richard Tabors, CRA International		
Date:	December 18, 2006, Revised March 2, 2007		
cc:	Stephen Henderson, Ira Shavel, CRA International		
Subject:	**ANALYSIS OF IMPLICATIONS OF TRANSMISSION CONGESTION IN PJM AND NYISO**		

Historical and Simulated Spot Prices in PJM

In this section, we discuss both historically observed and simulated spot prices for PJM known in that market as Locational Marginal Prices or LMPs. We consider historical prices over the period of 2004 through 2006. CRA simulated prices are derived from the Base Case simulation scenario for 2008. Simulated and historical prices show similar geographical patterns: higher prices in Eastern and southern parts of PJM, lower prices in western PJM.

Figure 1-PJM below depicts monthly average (round-the-clock) historical LMPs for each load zone in PJM. For numerical data underlying this and other figures, refer to Attachment 1 to this memorandum.

Figure 1-PJM. Historical Round the Clock Monthly Day-Ahead LMPs by PJM Zone (2004-2006)



All zones are sorted in order of average LMPs over the last 12 months. Thus, PEPCO has the highest average LMP over that period, Baltimore Gas & Electric (BGE) – second highest and Duquesne (DUQ) – has the lowest LMP. Note that not all price data are available for the entire period: Commonwealth Edison (COMED) joined PJM in May of 2004, American Electric Power (AEP) and Dayton Power and Light (DAY) joined in October of that year, Duquesne (DUQ) joined in January of 2005 and Dominion in May of that year.

What Figure 1-PJM illustrates is that there is a significant disparity in wholesale spot prices of electricity within the PJM market. In some months, the price differential between two geographical zones in PJM could be in excess of $45/MWh, such as in August-October of 2005 and in August of 2006 between PEPCO and Duquesne. Although they are participating in the same electricity market, consumers in different parts of PJM end up paying very different electricity prices. Significantly higher than elsewhere prices are in PEPCO, Baltimore Gas and Electric (BGE), Dominion (DOM), Atlantic Electric (AECO), Public Service Electric and Gas (PSEG), Rockland Electric (RECO), Delmarva Power & Light (DPL), Jersey City Power and Light (JCPL), Metropolitan Edison (METED), and PECO. These zones represent eastern and southern geographical part of PJM serving large metropolitan areas surrounding Washington, DC, Baltimore, Philadelphia, and New Jersey outskirts of New York City.

The same group sees the highest prices during on-Peak hours, as shown in Figure 2-PJM, and during off-Peak hours, as shown on Figure 3-PJM, although the order within the group changes. Thus, the price disparity is always present.

At the same time, LMPs in zones such as American Electric Power (AEP), Commonwealth Edison (COMED), Dayton Power and Light (DAY) and Duquesne (DUQ) enjoy prices that are systematically lower than elsewhere in PJM. These zones represent western geographical areas in PJM spreading between Illinois, Western Pennsylvania, Ohio, West Virginia and Kentucky.

On-Peak hours are defined as blocks of 16 hours (7 AM through 10 PM) during each weekday (Monday through Friday). The remaining 8 hours on each weekday and entire weekend days are categorized as off-peak hours.

Figure 2-PJM. Historical On-Peak Monthly Day Ahead LMPs by PJM Zone (2004-2006)

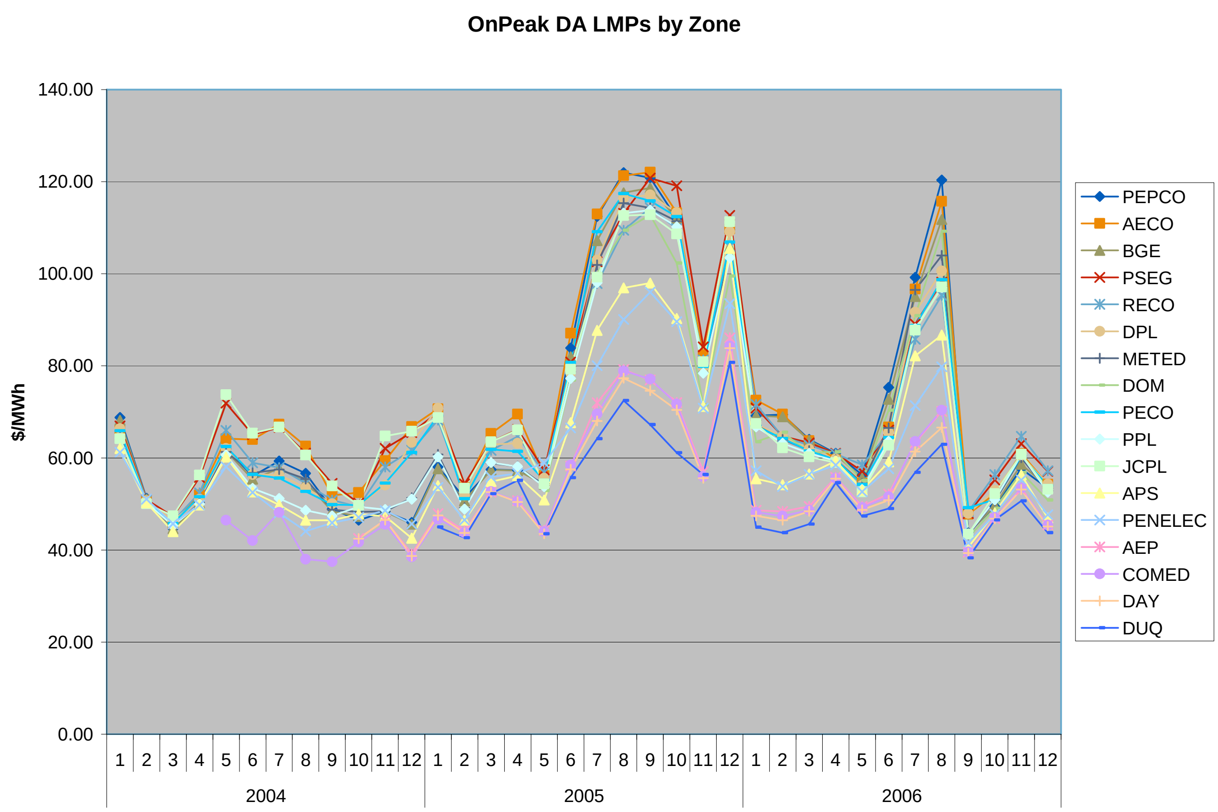
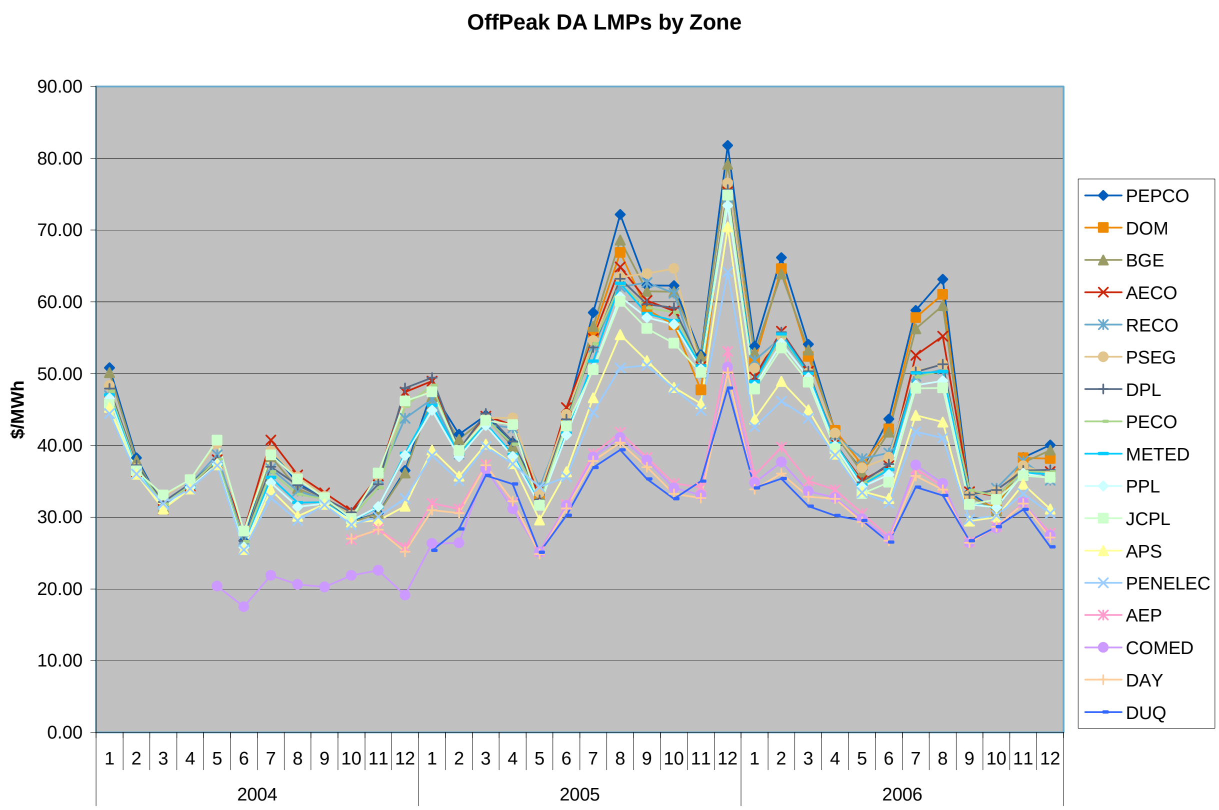


Figure 3-PJM. Historical Off-Peak Monthly Day Ahead LMPs by PJM Zone (2004-2006)



Similar patterns of price disparity between PJM zones are observed for Real-time Prices as shown on Figures 4-PJM through 6-PJM.

Figure 4-PJM. Historical Round the Clock Monthly Real-time LMPs by PJM Zone (2004-2006)

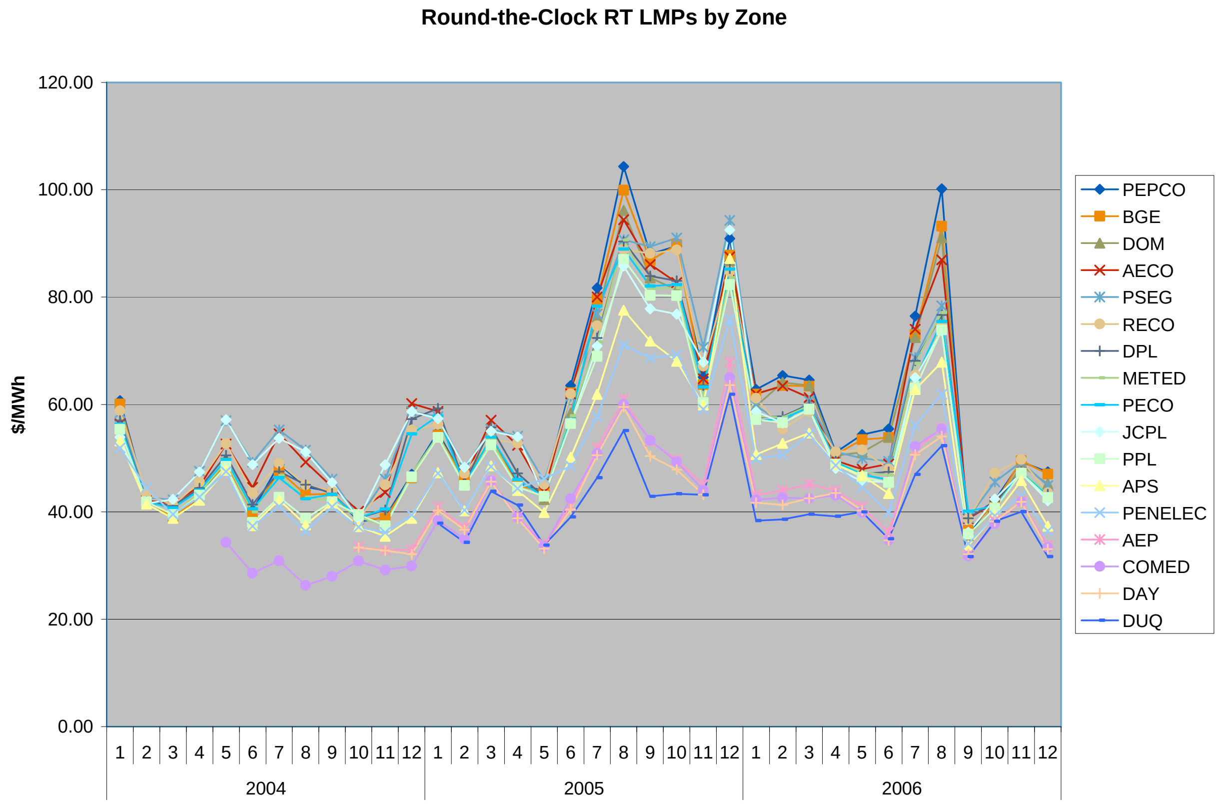


Figure 5-PJM. Historical OnPeak Monthly Real-time LMPs by PJM Zone (2004-2006)

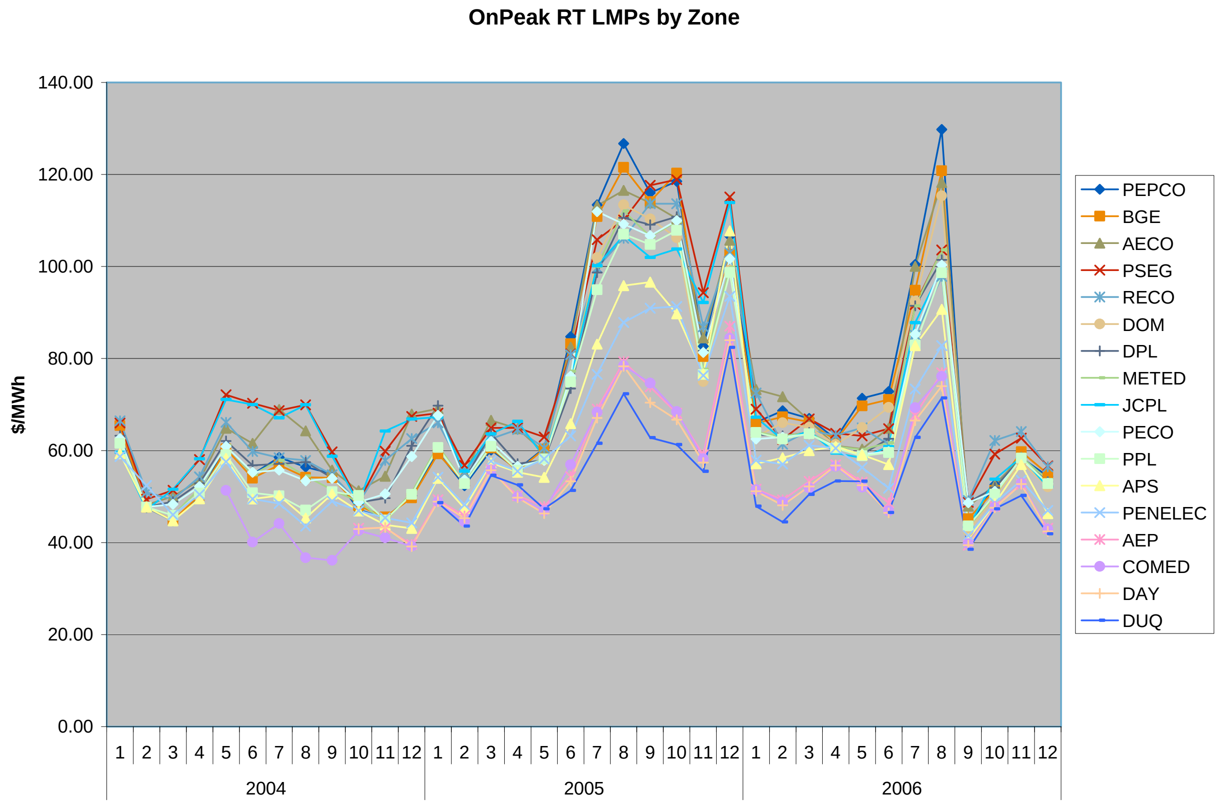
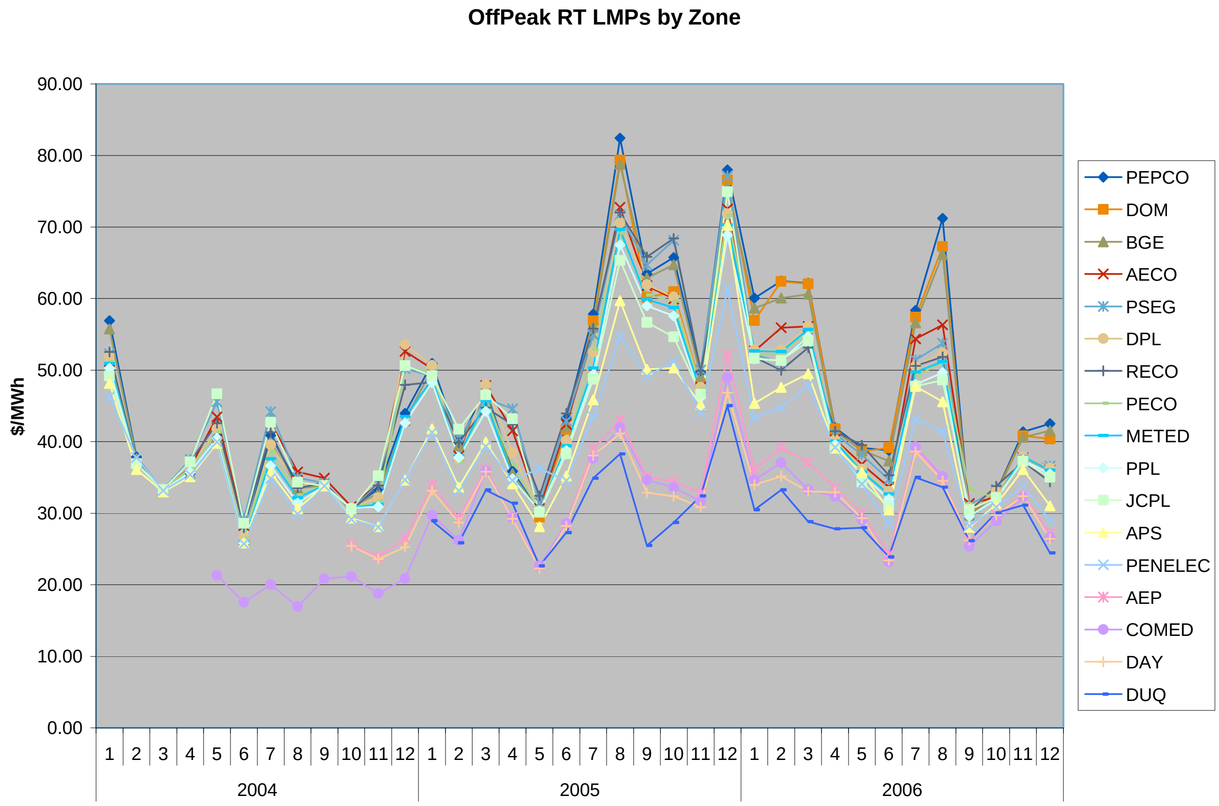
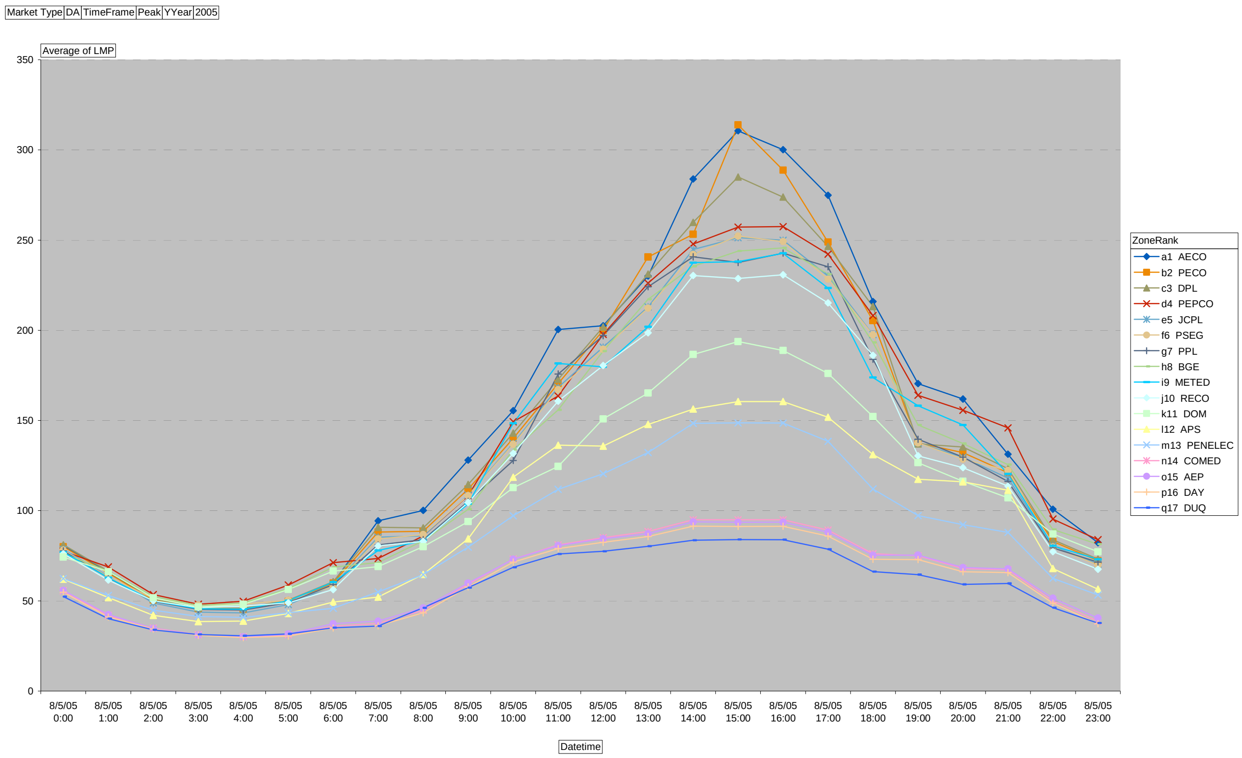


Figure 6-PJM. Historical OffPeak Monthly Real-time LMPs by PJM Zone (2004-2006)



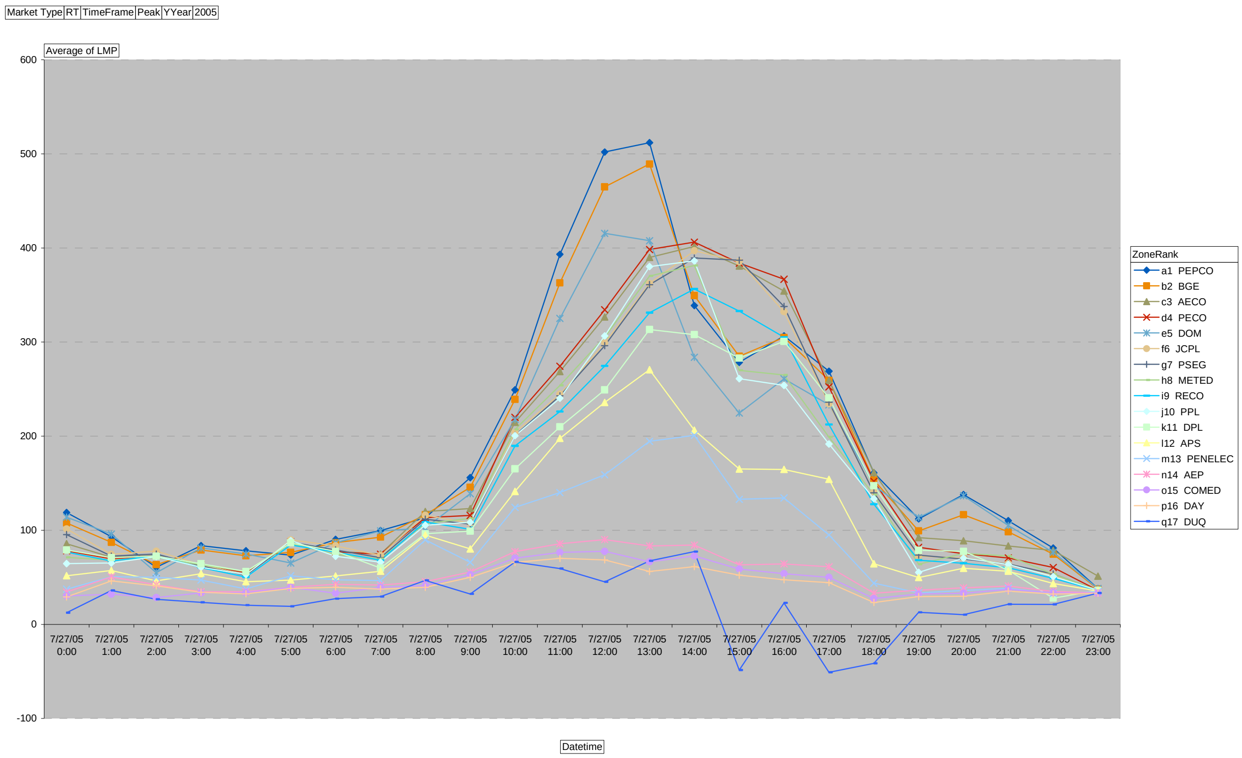
Figures 7-PJM through 10-PJM below depict hourly LMPs in PJM during selected dates in the summers of 2005 and 2006 – dates with the highest observed price disparity. These hourly patterns further illustrate the magnitude of the impact of transmission congestion on consumers that is embedded in the cost of the energy that they must purchase.

Figure 7-PJM. Day Ahead LMPs by PJM Zone on August 8, 2005



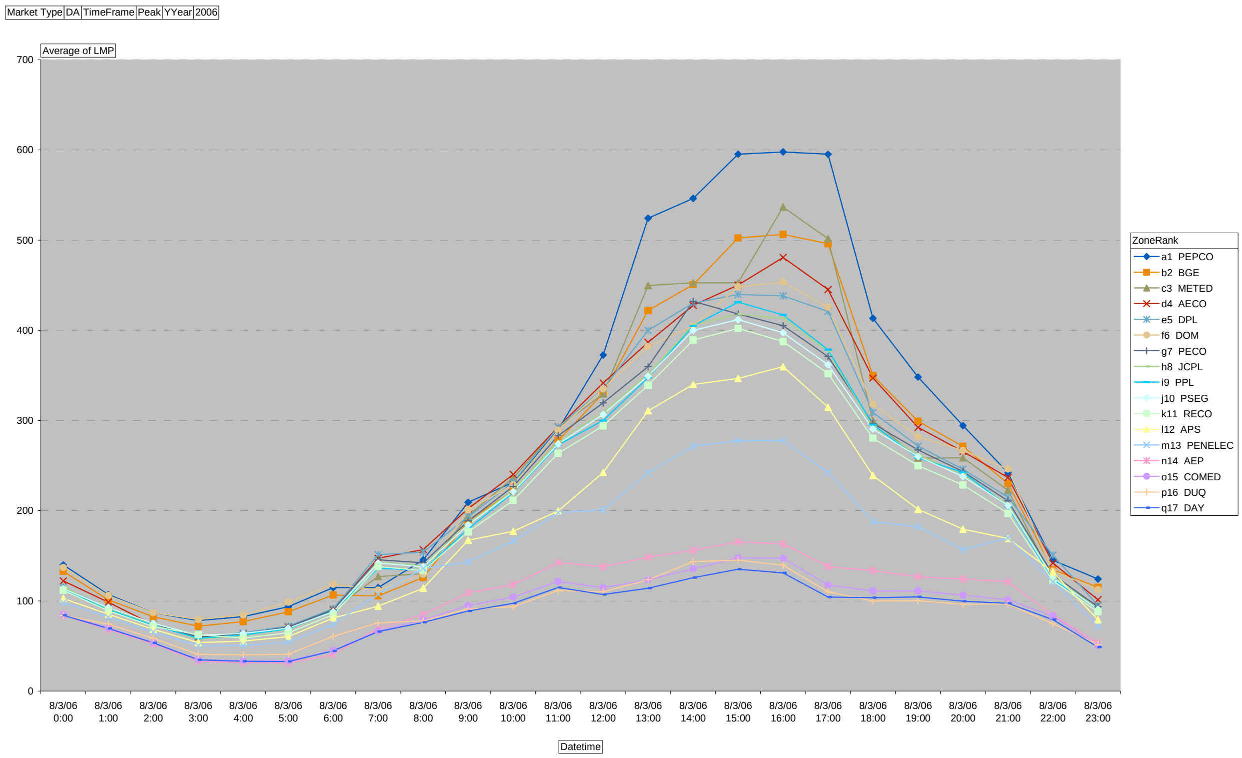
The 8th of August was the day in 2005 with the highest spread in Day Ahead LMPs between PJM zones. As shown on Figure 7-PJM, LMPs at Atlantic Electric and PECO Energy exceeded the $300/MWh mark whereas prices in Western PJM, although high, remained under $100/MWh, creating an over 270% price differential within PJM market. A significant price spread was observed during off-peak hours also. Thus, at 11 PM, price at Duquesne was $37/MWh, LMP at PEPCO was $84/MWh, creating a 125% price differential.

Figure 8-PJM. Real Time LMPs by PJM Zone on July 27, 2005



The 27th of July was the day in 2005 with the highest spread in Real Time LMPs between PJM zones. As shown on Figure 8-PJM, LMPs at PECO Energy exceeded the $500/MWh mark whereas price in Duquesne zone was $45/MWh, creating an over 1000% price differential within PJM market. A significant price spread was observed during off-peak hours also. Thus, at midnight, the price at Duquesne was $12/MWh, LMP at PEPCO was $118/MWh, creating an 860% price differential.

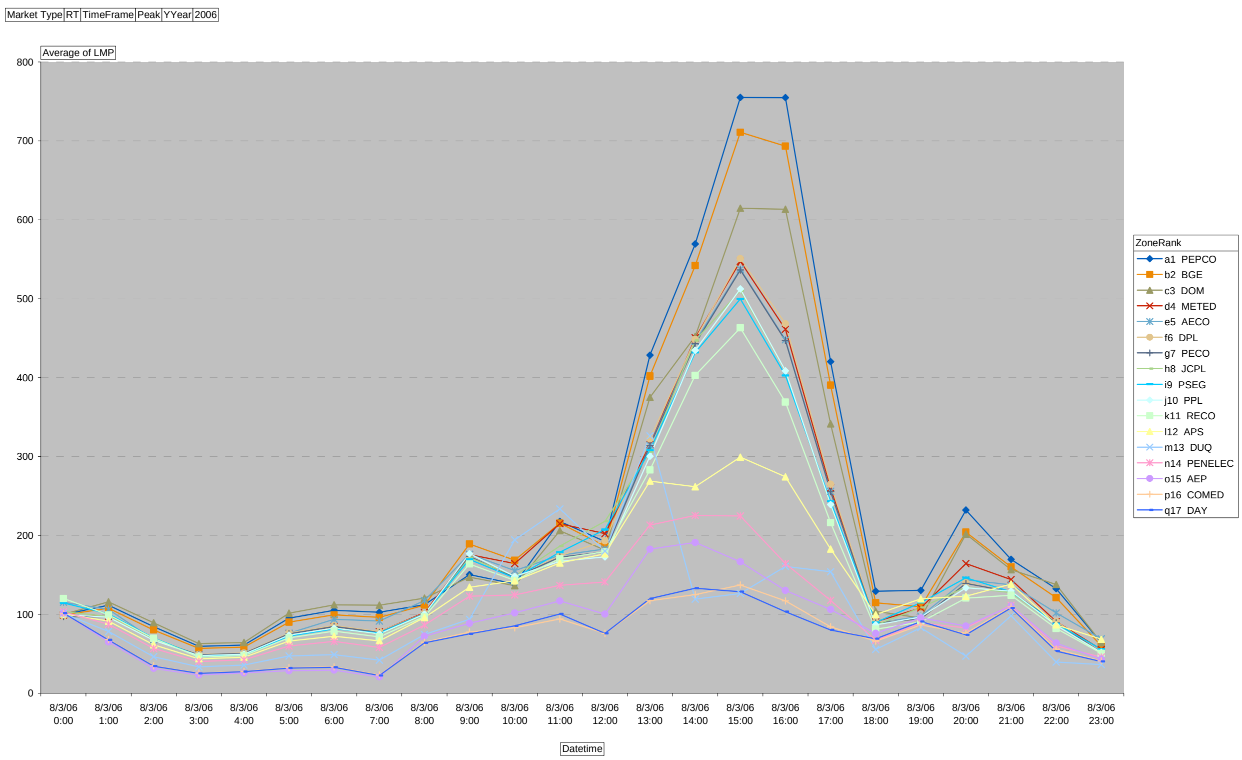
Figure 9-PJM. Day Ahead LMPs by PJM Zone on August 3, 2006



The 3rd of August was the day in 2006 with the highest spread in Day Ahead and in Real Time LMPs between PJM zones. As shown on Figure 9-PJM, LMPs at PEPCO approached the $600/MWh mark whereas price in Dayton zone was $104/MWh, creating a 470% price differential within PJM market. A significant price spread was also observed during off-peak hours. Thus, at 5 AM, the price at AEP was $31/MWh, while LMP values at Dominion were $98/MWh, creating a 215% price differential.

A similar pattern of Real Time LMPs is shown on Figure 10-PJM. LMPs at PEPCO approached the $750/MWh mark whereas price in Dayton zone was $103/MWh, creating a 630% price differential within PJM market. Significant price spread was observed during off-peak hours also. At 6 AM, price at AEP was $29/MWh, LMP at Dominion was $101/MWh, creating a 254% price differential.

Figure 10-PJM. Real Time LMPs by PJM Zone on August 3, 2006



The LMPs reported in CRA simulations for 2008 show similar geographical price patterns. Table 2-PJM below presents a summary of the most significant sink (net consuming) nodes in PJM identified by the CRA simulation analysis. These sink nodes are electrically homogenous conglomerates of load and generation centers with significant energy supply deficiency. Thus, they must rely on transmission to deliver power from relatively remote areas. Table 2-PJM presents all sink nodes in PJM with the maximum observed deficiency of at least 1000 MW. Nodes are sorted in a descending order of their simulated LMPs (Base Case for 2008). As shown on this table, CRA simulations identified the same high price areas as observed historically, areas in the eastern and southern parts of PJM. Similarly, areas in western parts of PJM show the lowest prices in PJM[1], again, consistent with historical data.

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[1] Note that abbreviations used in Table 2 and in Figures 1 through 3 are not consistent. VAP in Table 2 refers to Virginia Power = Dominion or DOM on Figure 1; DPL in Table 2 stands for Dayton Power and Light = DAY on Figure 1, NI in Table 2 stands for Northern Illinois = COMED on Figure 1,

Table 2-PJM. Major Sink Hubs in PJM

Market Area	Hub Name	Sink Hrs	Gen Weight (MW)	Load Weight (MW)	Avg net injection (MW)	Max Net injection (MW)	Price ($/MWh)
PJM	PECO_5_MSA_Philadelphia_L	6653	1,656	2,510	-406	-2,442	68.54
PJM	PSEG_8_MSA_NewYork_G	8784	3,860	3,654	-1,122	-2,398	62.55
PJM	PSEG_3_MSA_NewYork_L	8784	1,843	2,275	-951	-1,856	62.39
PJM	JCPL_1_MSA_NewYork_L	8784	-	1,792	-862	-1,934	62.32
PJM	JCPL_3_MSA_NewYork_L	8784	1,315	2,735	-672	-1,985	62.09
PJM	PSEG_5_MSA_Philadelphia_L	8784	2,143	2,766	-1,072	-2,213	61.65
PJM	BGE_9_MSA_Baltimore-Towson_L	8784	-	1,186	-681	-1,226	61.38
PJM	PEPCO_1_MSA_DC_L	8784	-	1,439	-847	-1,492	61.10
PJM	BGE_10_MSA_Baltimore-Towson_L	8784	845	1,565	-571	-1,411	60.97
PJM	BGE_5_MSA_Baltimore-Towson_L	8784	263	1,462	-750	-1,299	60.83
PJM	AP_8_MSA_DC-VA-MD_L	8784	-	1,097	-798	-1,144	60.64
PJM	PL_7_MSA_Allentown_L	8784	245	1,051	-643	-1,025	60.45
PJM	VAP_33_MSA_DC_L	8784	910	2,983	-1,730	-2,599	60.40
PJM	VAP_27_MSA_DC_L	8784	-	1,048	-641	-1,075	60.24
PJM	AP_7_MSA_Hagerstown-Martinsburg_	8784	203	1,153	-661	-1,009	59.93
PJM	VAP_15_MSA_VB-Norfolk_L	8784	435	1,297	-572	-1,149	57.34
PJM	AP_2_GEN_Albright3_L	8784	603	1,748	-1,036	-1,695	47.70
PJM	AEP_2_STA_TN-WV_L	8784	1,284	2,977	-1,557	-2,640	46.65
PJM	AEP_1_MSA_Lynchburg_G	8784	843	2,162	-1,537	-2,299	46.54
PJM	AEP_9_MSA_Canton-Massillon_L	8784	733	2,120	-1,481	-2,058	44.99
PJM	DPL_3_MSA_Dayton_L	8784	1,350	2,652	-1,370	-2,435	44.89
PJM	AEP_3_MSA_Columbus_L	7772	10,204	8,244	-999	-3,023	43.57
PJM	NI_13_MSA_Chicago_L	8784	2,396	10,556	-5,366	-9,115	39.56
PJM	NI_3_MSA_Chicago_L	8784	26	1,205	-634	-1,254	39.52

Why do the simulated and historical prices show similar geographical patterns? This is the case because the pattern is due to transmission constraints that limit flow of relatively inexpensive generation from the lower cost areas of the network that, but for the constraint, could serve load in the higher priced areas of the network. For each of these sink nodes[2], CRA analyses identified the transmission pathways along which inexpensive power could be transferred to serve loads in the eastern and southern portions of PJM. CRA defined transmission pathways as complex electrical paths connecting these sink nodes with source nodes. Similar to sink nodes, the source nodes are also homogenous conglomerates of load and generation buses. Unlike sink nodes, however, source nodes have significant excess generation and need to rely on transmission in order to engage in economic transactions of selling that generation to areas where it would be economically

[2] It is important to note that the abbreviated name of the node does not necessarily imply that the node crosses into an administrative boundary of the referenced by the node name metropolitan statistical area. It only implies that the node is in the proximity of the named metropolitan statistical area. CRA relied on the GIS information for generation and load buses that was provided by Professor Overbye of the University of Illinois at Urbana-Champaign. These GIS data are not precise, especially on the load side. GIS data was used to develop a standard naming convention for nodes. These names were constructed by concatenating together the following information: the ACPF area name taken from the MMWG load flow, the unique cluster number assigned by the clustering algorithm, the name of the Metropolitan Statistical Area or County the cluster is predominantly within or the name of the largest generating unit in the cluster, and either "G" or "L" based upon the dominant weight being either the generation or load weight. For example, under this scheme, the node identified on the first row of Table 2 is assigned the designation PECO_5_MSA_Philadelphia_L indicating that the node is formed by generator and load buses in PECO zone (ACPF area in the MMWG load flow case) which formed cluster # 5 within that zone, that based on the GIS data the majority of the buses in that zone are within the proximity of the Philadelphia metropolitan statistical area, and that the peak load (2510 MW) exceeds installed generating capacity in that node (1656 MW).

efficient to sell it, i.e. sink nodes. CRA considered all significant pathways connecting all significant source nodes and sink nodes. For each of these pathways, CRA then identified indices of congestion and determined the transmission constraints that are most limiting with respect to economic transfers of power from source nodes to sink nodes.

The critical conclusion was that according to the CRA analyses, ***all pathways*** leading to the high price sink nodes in PJM are severely constrained as shown in Table 3-PJM below. For each high price sink node, Table 3-PJM presents the average utilization of all pathways capable of bringing significant flows of inexpensive power.

Table 3-PJM. Utilization of Pathways Leading to High Price Destination Markets in PJM

	Average congestion of corridors	
Destination Node	Average U90%	Average utilization
PECO_5_MSA_Philadelphia_L	56%	82%
PSEG_8_MSA_NewYork_G	82%	93%
PSEG_3_MSA_NewYork_L	80%	93%
JCPL_1_MSA_NewYork_L	89%	96%
JCPL_3_MSA_NewYork_L	80%	93%
PSEG_5_MSA_Philadelphia_L	91%	96%
BGE_9_MSA_Baltimore-Towson_L	88%	95%
BGE_10_MSA_Baltimore-Towson_L	88%	95%
PEPCO_1_MSA_DC_L	79%	91%
BGE_5_MSA_Baltimore-Towson_L	87%	95%
AP_8_MSA_DC-VA-MD_L	81%	94%
PL_7_MSA_Allentown_L	97%	99%
VAP_33_MSA_DC_L	84%	94%
VAP_27_MSA_DC_L	76%	86%
AP_7_MSA_Hagerstown-Martinsburg_L	83%	91%

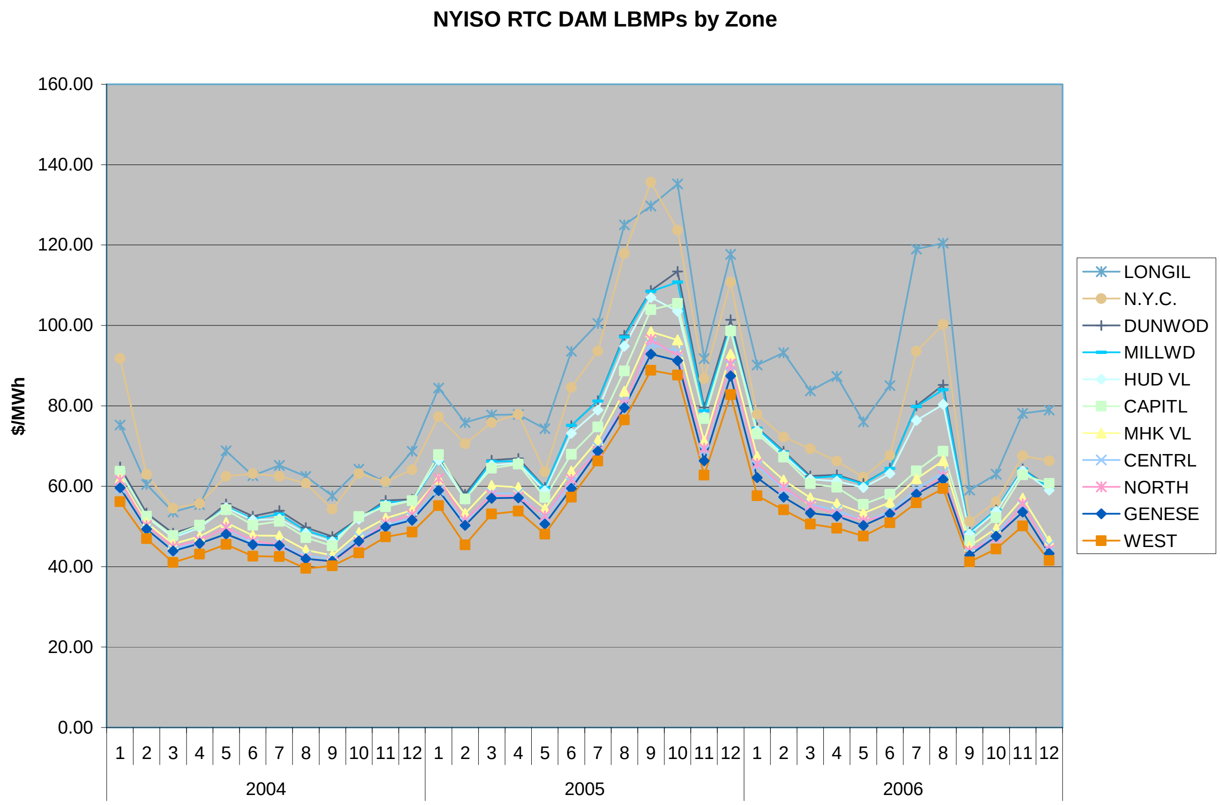
CRA analysis of individual pathways available to transfer power to major sink nodes in PJM indicates that transmission constraints identified in Table 1-PJM above represent the elements in the transmission grid that are most limiting for the economic transfer of power to these destination nodes. Congestion in these transmission elements cause observed price increases in the major metropolitan areas of the Northeastern United States, i.e. Washington, DC, Baltimore, Philadelphia, and New Jersey outskirts of New York City.

Historical and Simulated Spot Prices in NYISO

In this section, we discuss both historically observed and simulated spot prices for NYISO known in that market as Locational-Based Marginal Prices or LBMPs. We consider historical prices over the period of 2004 through November of 2006. CRA simulated prices are derived from the Base Case simulation scenario for 2008. Simulated and historical prices show similar geographical patterns: higher prices in New York City and Long Island, lower prices in Dunwoody, Millwood and Hudson Valley Zones. Low prices are observed in western and northern parts of New York (West, Genesee, Capital, North, Central zones).

Figure 1-NY below depicts monthly average (round-the-clock) historical LBMPs for each load zone in NYISO.

Figure 1-NY. Historical Round the Clock Monthly Day-Ahead LBMPs by NYISO Zone (2004-2006)



All zones are sorted in order of average LBMPs over last 12 months (December 2005 through November 2006). Thus, Long Island has the highest average LBMP over that period, New York City – second highest and the West zone – has the lowest LBMP.

Figure 1-NY illustrates a phenomenon that is similar to that observed for the PJM market -- a significant disparity in wholesale spot prices of electricity within the NY market. In some months, the price differential between two geographical zones in NYISO could be in excess of $60/MWh, such as in July and August of 2006 between Long Island and West zones. Although they are participating in the same electricity market, consumers in different parts of NYISO end up paying very different electricity prices.

The same group sees the highest prices during on-Peak hours, as shown in Figure 2-NY, and during off-Peak hours, as shown on Figure 3-NY, although the order within the group changes. Thus, the prices disparity is constantly present.

At the same time, LBMPs in zones such as West, Genesee, Central, and North enjoy prices that are systematically lower than elsewhere in NYISO. These zones represent western and northern geographical areas in New York State.

On-Peak hours are defined as blocks of 16 hours (7 AM through 10 PM) during each weekday (Monday through Friday). The remaining 8 hours on each weekday and entire weekend days are categorized as off-peak hours.

Figure 2-NY. Historical On-Peak Monthly Day Ahead LBMPs by NYISO Zone (2004-2006)

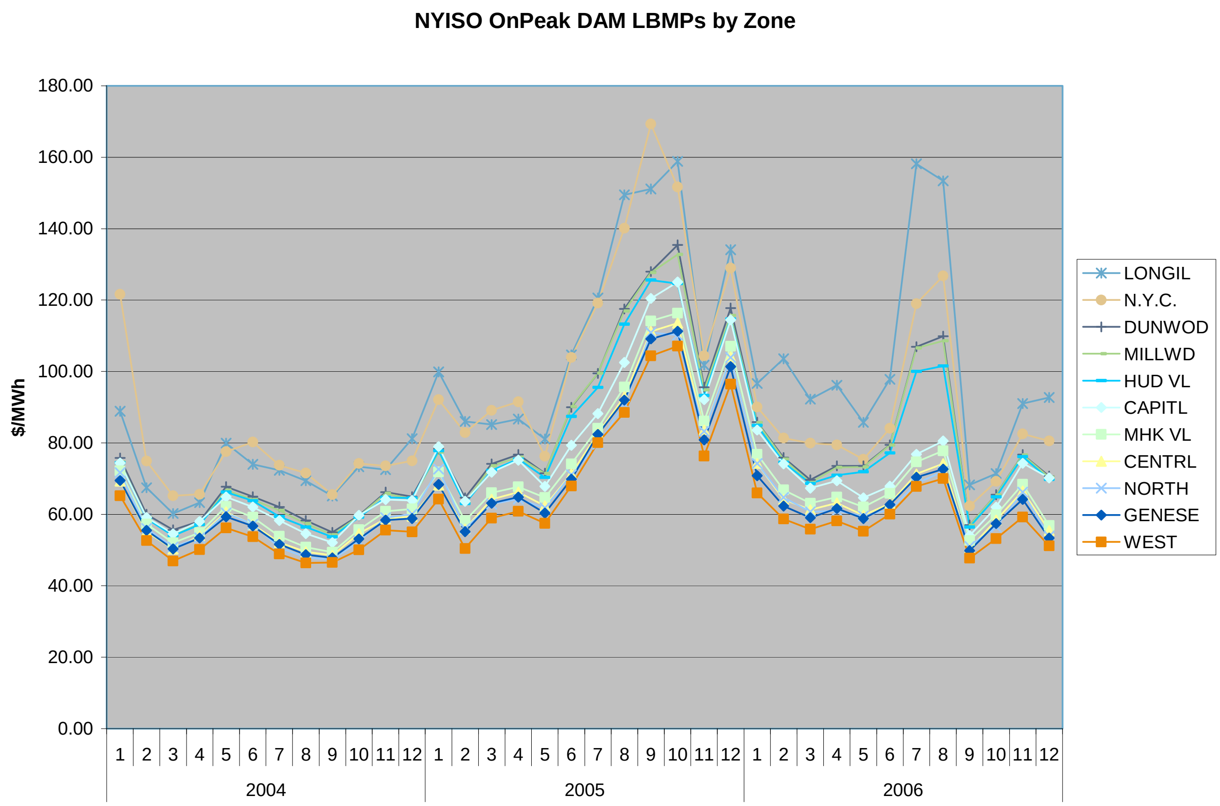
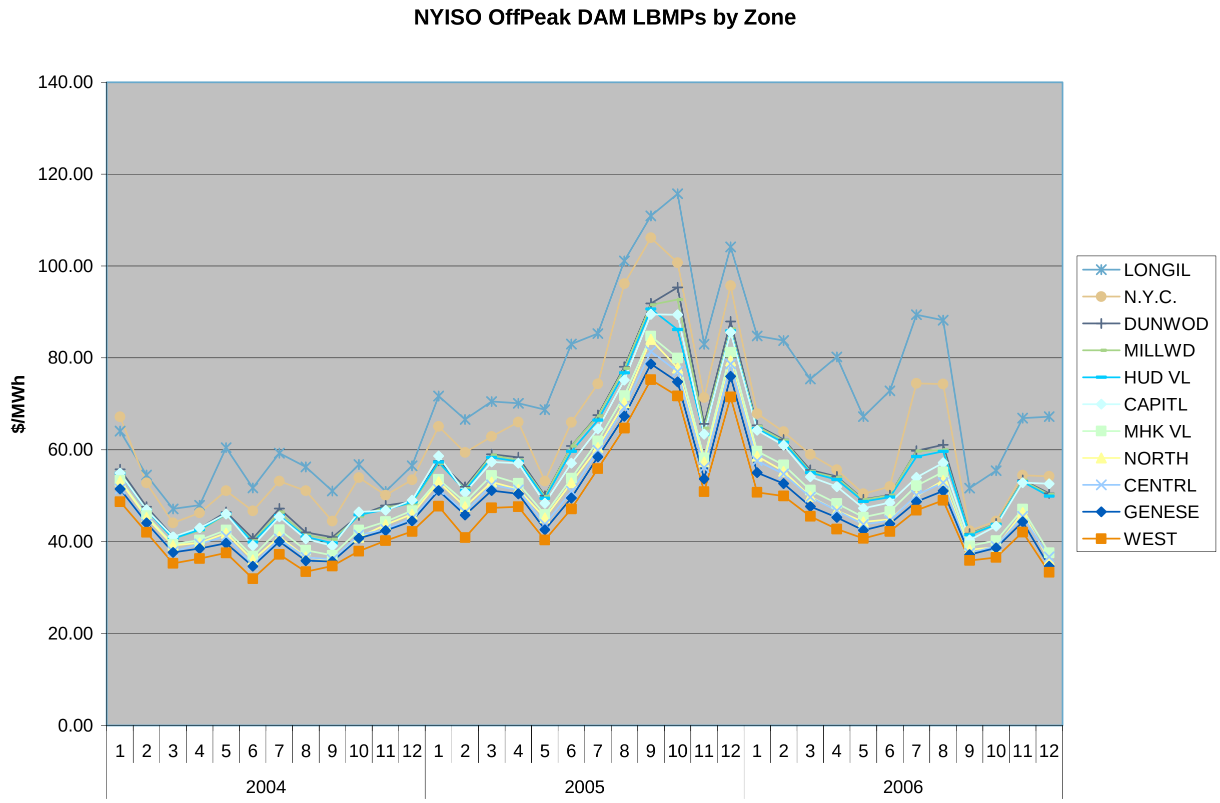


Figure 3-NY. Historical Off-Peak Monthly Day Ahead LBMPs by NYISO Zone (2004-2006)



Similar patterns of price disparity between NYISO zones are observed for Real-time Prices as shown on Figures 4-NY through 6-NY.

Figure 4-NY. Historical Round the Clock Monthly Real-time LBMPs by NYISO Zone (2004-2006)

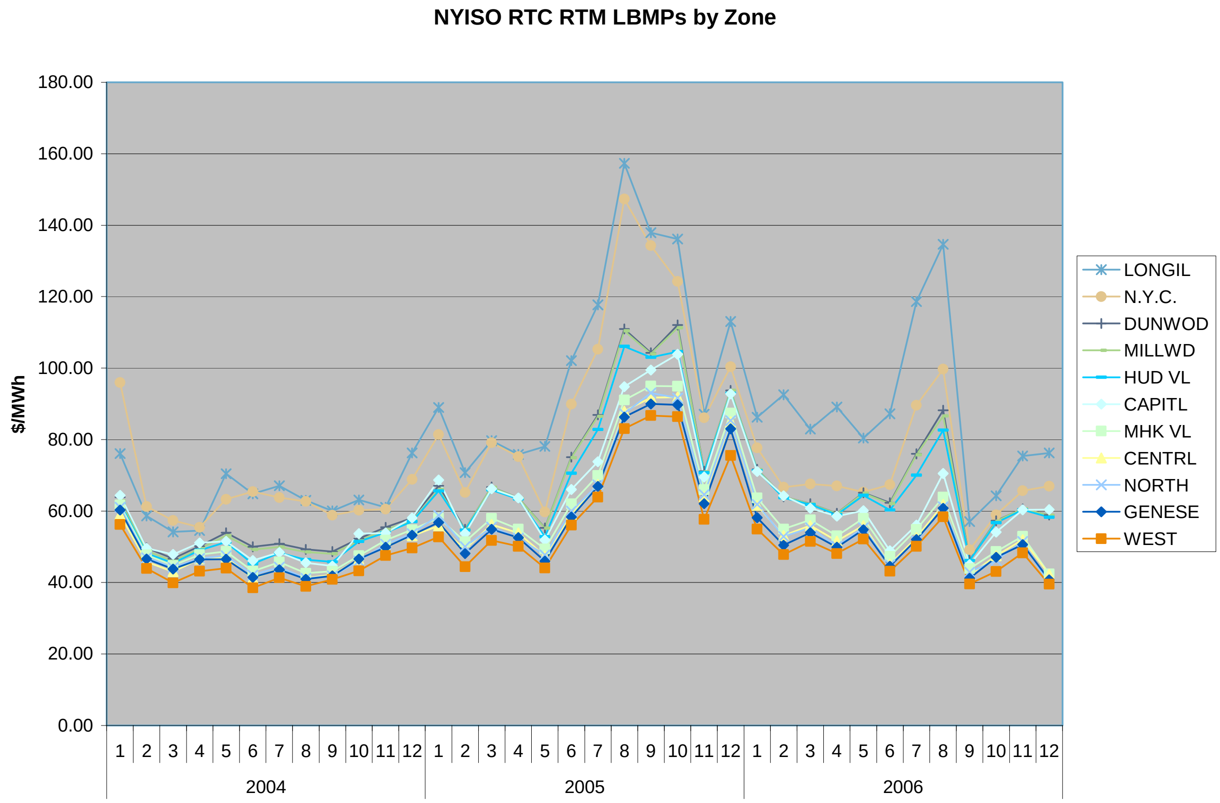


Figure 5-NY. Historical OnPeak Monthly Real-time LBMPs by NYISO Zone (2004-2006)

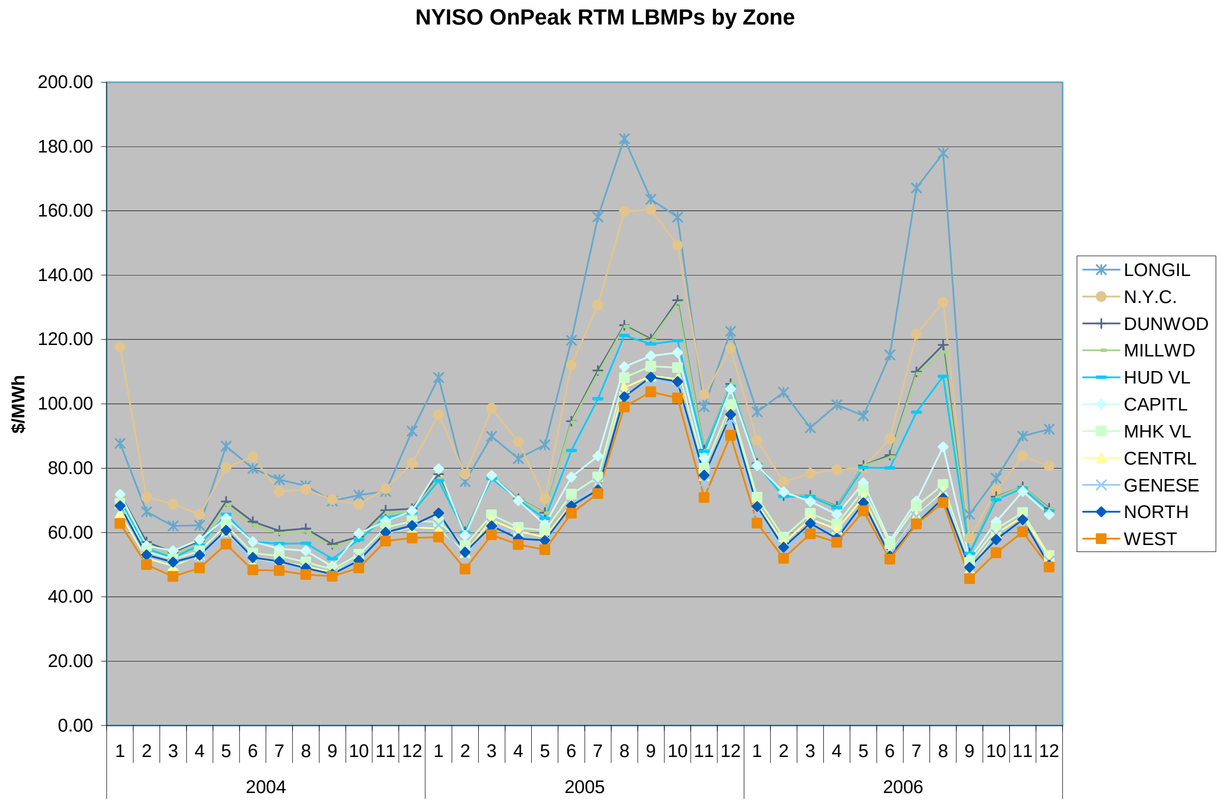
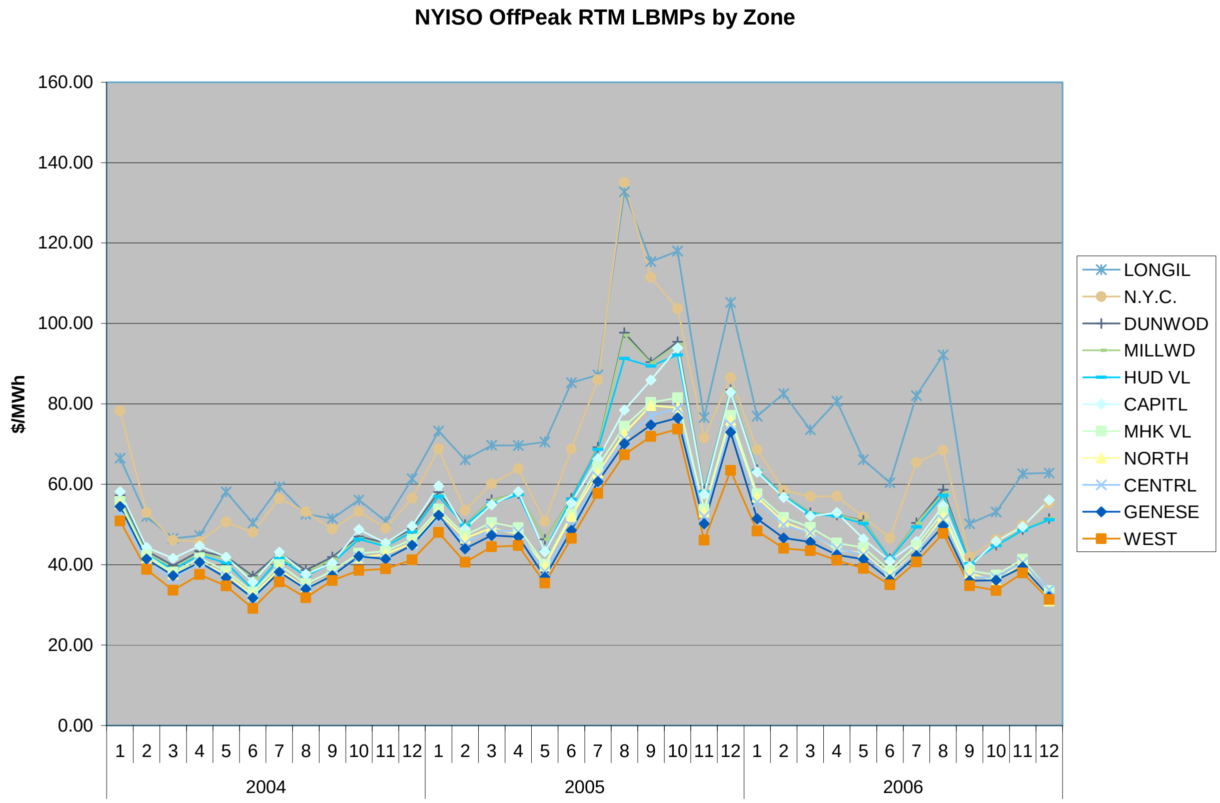
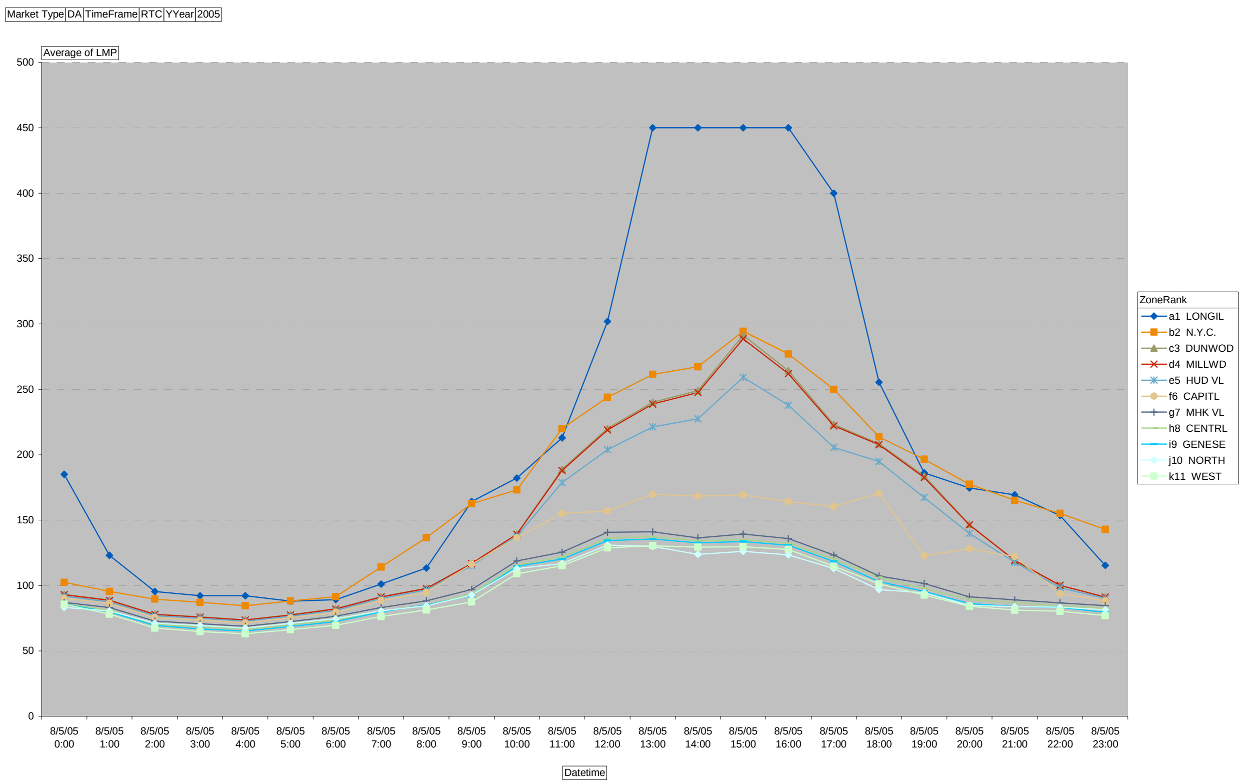


Figure 6-NY. Historical OffPeak Monthly Real-time LBMPs by NY Zone (2004-2006)



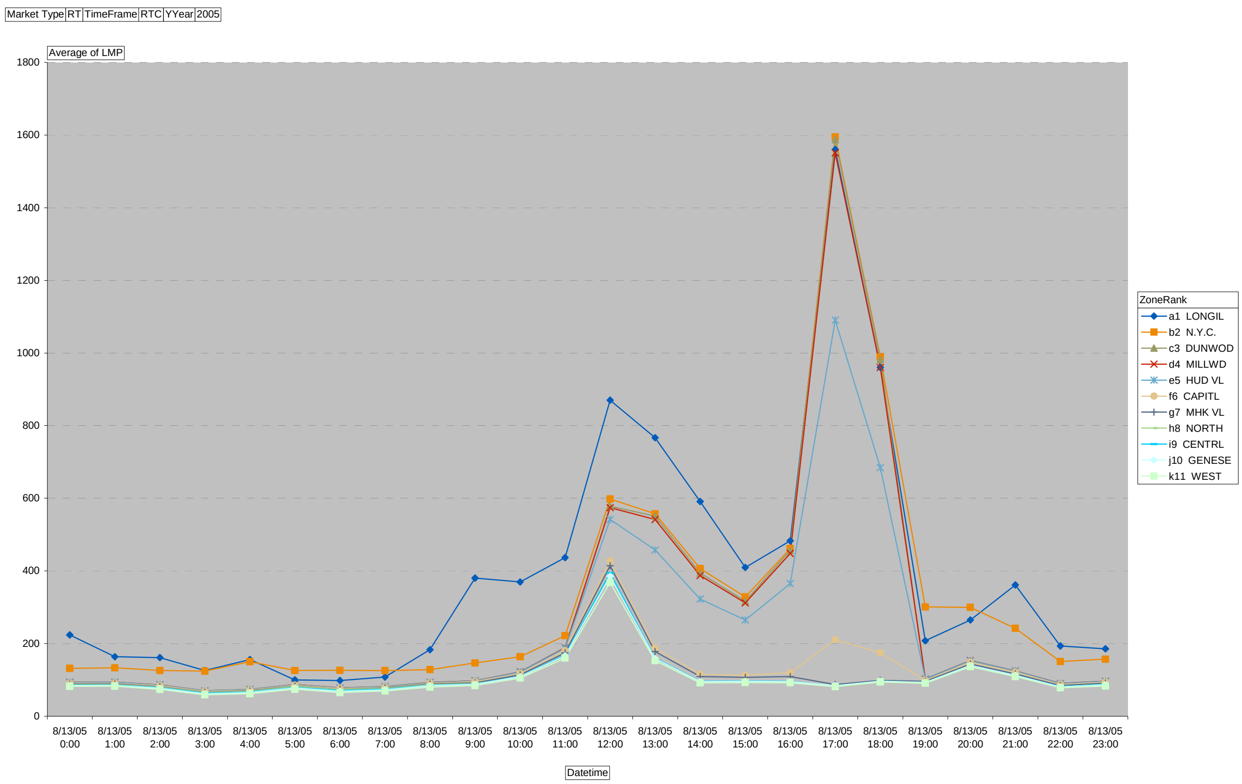
Figures 7-NY though 10-NY below depict hourly LBMPs in NY during selected dates in the summers of 2005 and 2006 – dates with the highest observed price disparity. These hourly patterns further illustrate the magnitude of the impact of transmission congestion on consumers that is embedded in the cost of the energy that they must purchase.

Figure 7-NY. Day Ahead LBMPs by NYISO Zone on August 5, 2005



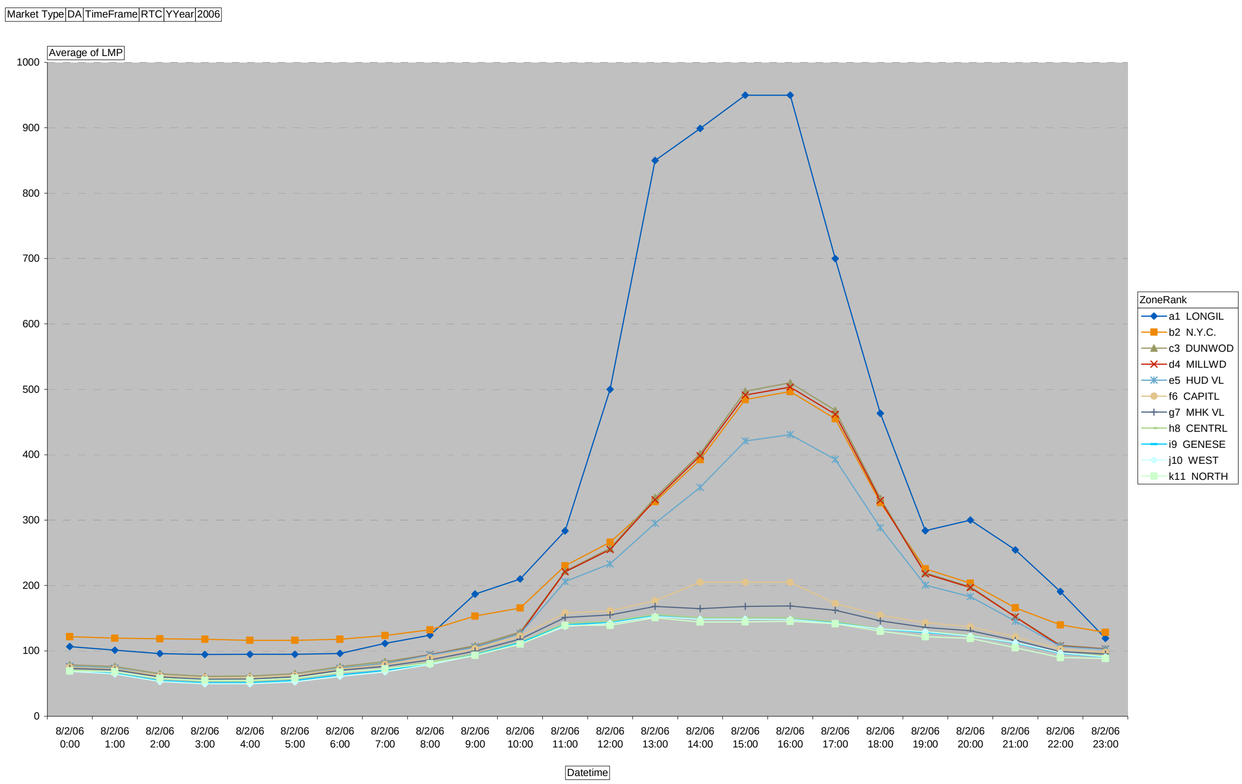
The 5th of August was the day in 2005 with the highest spread in Day Ahead LBMPs between NYISO zones. As shown on Figure 7-NY, LBMPs in Long Island the approach the $450/MWh mark whereas prices in the North although high, remained under $124/MWh, creating an over 265% price differential within NYISO market. Significant price spread was observed during off-peak hours also. Thus, at midnight, the price at the North Zone was $83/MWh, while the LBMP on Long Island was $185/MWh, creating a 122% price differential.

Figure 8-NY. Real Time LBMPs by NYISO Zone on August 13, 2005



The 13th of August was the day in 2005 with the highest spread in Real Time LBMPs between NYISO zones. As shown on Figure 8-NY, LBMPs Long Island, NYC, Millwood and Dunwoody zones approach the $1600/MWh mark whereas the price in the West zone was $81/MWh, creating nearly an 1860% price differential within the NYISO market. A significant price spread was observed during off-peak hours also. Thus, at midnight, the price at the West Zone was $82/MWh, while the LBMP on Long Island was $224/MWh, creating an 281% price differential.

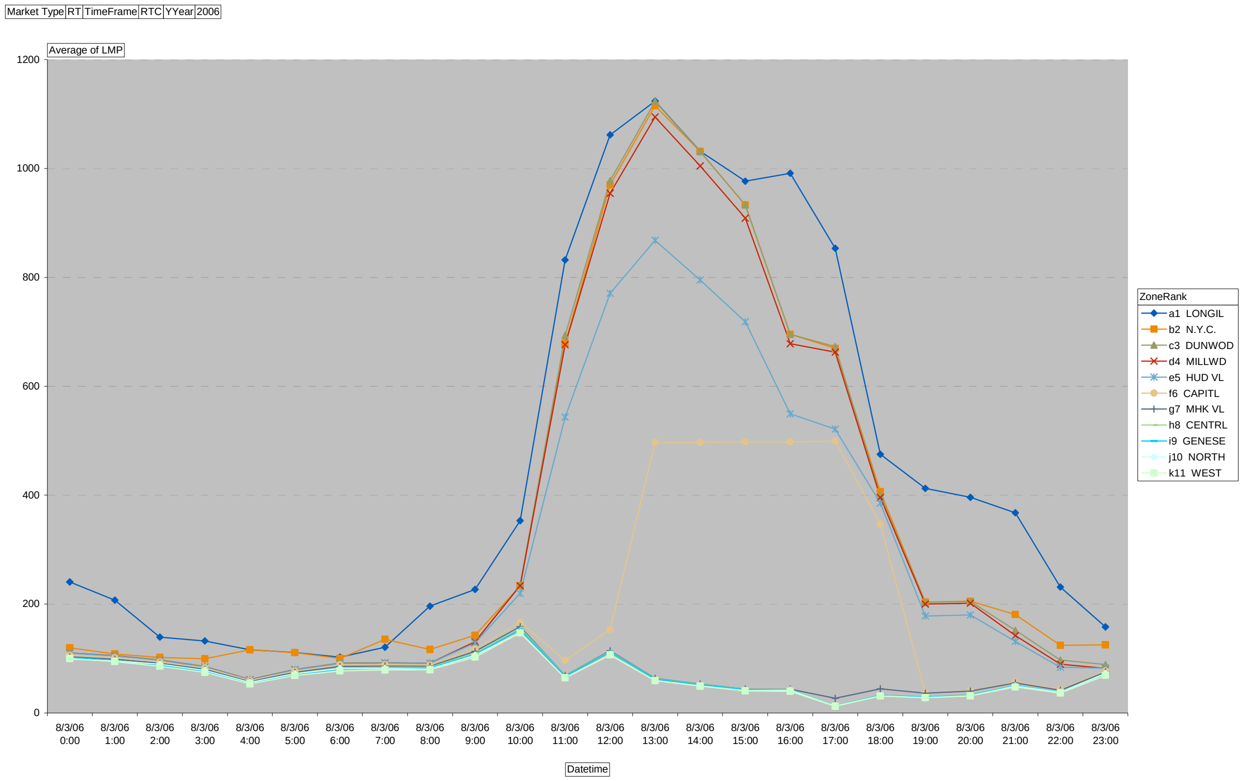
Figure 9-NY. Day Ahead LBMPs by NYISO Zone on August 2, 2006



The 2nd and 3rd of August were the two days in 2006 with the highest spread between NYISO zones in Day Ahead and in Real Time LBMPs, respectively. As shown on Figure 9-NY, DAM LBMPs on Long Island approached the $950/MWh mark whereas price in West and North zones was under $150/MWh, creating a 560% price differential within NYISO market. A significant price spread was also observed during off-peak hours. Thus, at 3 AM, the price in New York City was $118/MWh, while LBMP values in the West were $50/MWh, creating a 138% price differential.

A more dramatic pattern of Real Time LBMPs occurred on August 3 which is shown on Figure 10-NY. LMPs at Long Island, New York City, Dunwoody and Millwood zones exceeded the $1000/MWh mark whereas prices in western and northern zones were around $60/MWh, creating a nearly 2000% price differential within NYISO market. A significant price spread was observed during off-peak hours also. At 11 PM AM, price on Long Island was $231/MWh, LBMP at the West zone was $36/MWh, creating a 532% price differential.

Figure 10-PJM. Real Time LBMPs by NYISO Zone on August 3, 2006



The LBMPs reported in CRA simulations for 2008 show similar geographical price patterns. Table 2-NY below presents a summary of the most significant sink (net consuming) nodes in NYISO identified by the CRA simulation analysis. For New York CRA defined one node for each congestion zone. Table 2-NY presents all sink nodes in NYISO with the maximum observed deficiency of at least 1000 MW. Nodes are sorted in descending order of their simulated LBMPs (Base Case for 2008). As shown on this table, CRA simulations identified the same high price areas as observed historically, New York City, Long Island, Dunwoody Zone (Zone I). CRA analysis shows also high prices in Zone H (Millwood) but it is not a significant sink node in the system. Zone G (Hudson Valley) is relatively moderately congested compare to other downstate zones. Similarly, areas in western parts and Northern parts of NYISO show the lowest prices in NY, again, consistent with historical data.

Table 2-NY. Major Sink Hubs in NYISO

Market Area	Hub Name	Sink Hrs	Gen Weight (MW)	Load Weight (MW)	Avg net injection (MW)	Max Net injection (MW)	Price ($/MWh)
NYPP	NYISO_10_NYJ	8784	10,283	11,493	-3,670	-5,413	68.19
NYPP	NYISO_11_NYK	8784	5,681	5,289	-1,802	-2,670	69.74
NYPP	NYISO_9_NYI	8467	2	1,476	-786	-1,993	66.87
NYPP	NYISO_7_NYG	7979	3,156	2,195	-673	-1,446	62.81
NYPP	NYISO_2_NYB	8784	650	1,759	-710	-1,588	46.16

Why do the simulated and historical prices show similar geographical patterns? The pattern is due to transmission constraints that limit flow of relatively inexpensive generation from the lower cost areas of the network that, but for the constraint, could serve load in the higher priced areas of the network. For each of these sink nodes, CRA analyses identified the transmission pathways along which inexpensive power could be transferred to serve loads in the downstate portions of NYISO. CRA defined transmission pathways as complex electrical paths connecting these sink nodes with source nodes. Similar to sink nodes, the source nodes are also homogenous conglomerates of load and generation buses. Unlike sink nodes, however, source nodes have significant excess generation and need to rely on transmission in order to engage in economic transactions of selling that generation to areas where it would be economically efficient to sell it, i.e. sink nodes. CRA considered all significant pathways connecting all significant source nodes and sink nodes. For each of these pathways, CRA then identified indices of congestion and determined the transmission constraints that are most limiting with respect to economic transfers of power from source nodes to sink nodes.

The critical conclusion was that according to the CRA analyses, ***all pathways*** leading to the high price sink nodes (except those leading to zone G with is only moderately congested) in NYISO are severely constrained as shown in Table 3-NY below. For each high price sink node, Table 3-NY presents the average utilization of all pathways capable of bringing significant flows of inexpensive power.

Table 3-NY. Utilization of Pathways Leading to High Price Destination Markets in NYISO

	Average Congeston of Corridors	
Destination Node	Average U90%	Average Utilization
NYISO_10_NYJ	95%	98%
NYISO_11_NYK	97%	99%
NYISO_7_NYG	72%	90%
NYISO_9_NYI	91%	97%

CRA analysis of individual pathways available to transfer power to major sink nodes in NYISO indicates that transmission constraints identified in Table 1-NY above represent the elements in the transmission grid that are most limiting for the economic transfer of power to these destination nodes. Congestion in these transmission elements causes observed price increase in the downstate areas of NYISO, especially in Long Island and New York City.

AR/ar

Attachment to A.1

PJM LMPs: Round the Clock

DA Prices		PEPCO	BGE	DOM	AECO	PSEG	RECO	DPL	METED	PECO	PPL	JCPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	58.92	58.27		55.10	56.72	55.31	56.24	55.04	55.81	54.56	54.03	52.86	52.02				
	2	44.22	43.94		42.97	43.31	43.19	43.38	42.93	43.17	42.80	42.67	42.52	42.91				
	3	37.94	37.93		38.27	39.98	39.05	39.18	38.13	38.71	38.17	40.18	37.49	38.70				
	4	42.15	42.05		42.95	45.27	43.32	42.66	42.01	42.79	41.89	45.52	41.67	41.71				
	5	48.04	47.79		49.25	53.89	50.43	48.31	47.66	48.52	47.40	54.91	47.13	46.19		31.61		
	6	41.04	40.62		45.65	46.14	42.53	41.19	40.99	41.15	39.28	46.30	38.74	38.69		29.53		
	7	48.31	47.12		52.73	51.58	46.32	45.74	45.43	45.03	42.18	51.32	41.03	39.62		33.76		
	8	45.12	43.80		48.49	47.63	43.49	43.48	43.10	42.42	39.56	47.27	37.85	36.41		28.85		
	9	40.14	39.85		42.00	42.96	41.09	40.73	39.86	40.59	39.13	42.57	38.64	38.32		28.29		
	10	37.11	37.39		40.63	39.25	38.72	39.26	37.95	38.88	38.45	38.78	37.65	37.11	33.91	30.83	33.97	
	11	38.87	38.83		46.78	48.04	45.95	43.68	39.32	43.62	39.53	49.49	37.82	38.68	36.82	33.30	36.78	
	12	41.19	40.82		57.01	55.58	52.63	55.58	45.03	53.23	44.76	55.88	36.98	39.05	32.39	28.72	31.87	
2005	1	52.29	51.68		58.74	57.72	56.27	59.08	52.41	57.77	51.82	57.08	45.97	45.36	39.13	35.52	38.44	34.22
	2	46.20	45.51		45.99	46.43	45.33	45.36	43.70	44.64	43.41	46.01	40.82	40.50	37.33	34.70	36.82	35.17
	3	50.75	50.58		54.59	53.56	52.19	53.57	50.85	52.72	50.78	53.37	47.41	47.73	44.86	44.62	44.81	43.93
	4	48.30	47.98		55.32	54.28	52.82	51.13	47.81	50.10	47.65	53.72	46.18	46.40	40.74	40.23	40.73	44.19
	5	42.72	42.50	41.57	43.27	44.25	44.37	42.86	41.89	42.57	41.69	41.88	39.20	45.38	33.82	33.64	33.30	33.40
	6	63.65	62.32	59.54	65.70	62.17	61.20	60.67	59.81	61.50	58.95	60.58	51.63	50.72	44.70	44.74	44.07	42.68
	7	81.71	78.34	74.79	79.88	75.23	72.69	74.85	73.31	77.78	71.09	71.48	64.29	59.82	53.09	51.77	50.80	48.63
	8	96.80	92.83	87.91	92.78	88.00	85.49	89.52	88.66	89.65	86.65	86.08	75.94	70.22	60.29	59.79	58.64	55.75
	9	89.60	88.15	84.06	89.06	90.45	86.79	86.48	84.47	85.59	83.94	82.65	73.35	72.07	56.33	56.23	54.53	50.21
	10	84.71	84.21	77.31	83.32	89.21	83.14	83.57	81.74	82.83	80.93	78.75	67.10	66.69	51.53	51.04	50.01	45.44
	11	65.43	65.02	58.82	65.59	66.34	64.62	64.55	63.87	64.45	63.59	64.49	57.64	56.95	44.80	43.76	43.36	44.98
	12	94.33	91.21	86.74	90.87	92.86	88.67	90.75	88.09	89.39	87.00	91.31	86.27	77.40	67.98	65.97	65.36	62.76
2006	1	60.74	60.24	57.03	59.92	59.82	60.77	57.32	57.10	56.88	56.59	56.68	48.99	49.19	41.60	40.83	39.98	38.98
	2	67.71	66.28	65.05	62.38	59.73	59.56	59.98	59.57	59.50	58.48	57.66	51.41	49.78	43.85	42.31	41.02	39.35
	3	59.00	58.47	56.73	56.96	56.62	56.23	56.07	55.75	55.66	55.16	54.44	50.66	50.03	42.16	41.05	40.53	38.49
	4	50.39	50.10	50.63	48.87	50.26	50.03	48.97	48.83	48.83	48.59	48.14	47.92	47.47	43.59	42.90	42.76	41.07
	5	45.94	45.35	45.69	44.31	46.43	47.77	43.92	43.95	43.94	43.14	42.41	42.78	42.51	39.50	38.96	38.48	37.96
	6	59.13	56.95	56.01	51.59	51.88	51.89	51.11	51.20	50.27	49.44	48.49	45.56	44.49	39.46	39.00	38.48	37.51
	7	76.19	72.95	72.03	71.53	66.98	65.17	68.05	70.03	66.40	65.45	65.05	60.53	54.57	48.14	48.57	46.77	43.92
	8	91.43	85.35	84.86	85.13	74.47	72.71	75.67	76.83	74.26	72.74	72.30	64.74	60.19	51.98	52.33	50.02	47.82
	9	38.00	37.68	37.23	39.86	39.64	39.66	39.71	36.95	40.60	36.97	36.95	34.41	34.96	32.30	32.27	32.15	31.84
	10	39.69	39.76	39.63	42.07	43.82	44.60	42.84	40.46	41.50	40.59	41.81	38.53	38.54	37.26	37.26	37.24	37.10
	11	47.32	47.40	46.94	47.87	49.25	50.37	47.70	47.32	47.58	47.57	47.44	44.73	43.49	41.83	42.04	41.80	40.20
	12	45.57	45.27	43.41	43.76	44.71	44.27	43.94	43.00	43.59	42.52	42.82	37.67	37.62	35.09	34.90	34.58	33.25
2006 Average		56.76	55.48	54.60	54.52	53.64	53.59	52.94	52.58	52.42	51.44	51.18	47.33	46.07	41.40	41.03	40.32	38.96

RT Prices

		PEPCO	BGE	DOM	AECO	PSEG	RECO	DPL	METED	PECO	JCPL	PPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	60.72	60.11		56.39	58.48	58.82	57.00	55.81	56.33	53.89	55.37	53.21	51.88				
	2	42.33	42.24		42.12	42.69	43.40	41.94	41.85	41.92	41.60	41.87	41.44	44.49				
	3	38.85	38.90		41.58	42.24	41.22	41.07	39.49	40.72	42.33	39.49	38.79	39.53				
	4	42.71	42.75		44.73	47.57	45.55	44.40	43.59	44.01	47.45	43.09	42.15	42.77				
	5	49.41	49.07		52.65	57.00	52.70	50.50	49.35	49.74	57.18	48.49	47.75	47.51		34.30		
	6	40.27	39.82		44.54	49.25	43.53	41.38	40.00	40.55	48.81	38.05	37.40	37.34		28.58		
	7	48.85	47.61		54.54	55.27	49.03	47.48	46.74	46.34	53.70	42.74	42.25	41.01		30.90		
	8	44.63	43.25		49.25	51.51	45.02	45.06	42.71	42.43	51.19	38.79	37.59	36.37		26.31		
	9	43.75	43.34		44.64	46.09	43.82	43.40	42.08	43.26	45.47	41.87	41.62	40.91		27.98		
	10	38.14	38.56		40.12	38.79	38.59	38.86	38.95	38.87	38.72	39.51	37.24	37.18	33.51	30.83	33.32	
	11	38.95	38.76		43.60	46.12	45.06	40.33	37.46	40.50	48.76	37.43	35.44	36.14	32.84	29.17	32.78	
	12	47.02	46.29		60.20	58.71	55.20	57.29	47.14	54.52	58.66	46.52	38.82	39.41	32.95	29.91	32.12	
2005	1	54.84	54.33		58.73	57.73	56.31	59.28	54.28	57.86	57.35	53.86	47.30	47.15	40.92	38.39	40.26	37.86
	2	45.85	45.93		46.11	48.25	47.16	45.27	45.11	44.97	48.30	44.94	40.20	40.33	37.09	34.93	36.62	34.30
	3	53.58	53.66		57.10	55.36	53.56	55.72	53.34	53.90	54.99	52.45	48.54	48.42	45.89	45.76	45.63	43.81
	4	45.23	44.92		52.39	54.11	52.75	47.16	44.61	46.03	53.99	44.58	43.99	44.35	39.14	39.00	38.80	41.26
	5	43.88	43.78	42.27	43.73	45.69	45.14	42.80	42.94	42.73	43.00	42.89	39.88	46.16	34.02	33.59	33.14	33.78
	6	63.54	62.20	58.39	62.00	61.51	61.97	56.44	57.91	57.26	56.56	56.45	50.18	48.55	41.08	42.43	40.49	39.05
	7	81.72	79.58	76.26	80.01	76.84	74.67	72.39	71.66	78.30	70.87	68.97	61.88	57.71	51.86	50.86	50.56	46.36
	8	104.35	99.93	96.19	94.41	90.68	88.88	90.36	90.64	88.94	85.81	87.04	77.58	71.11	61.00	60.00	59.54	55.13
	9	88.00	86.79	83.59	86.08	89.40	88.14	83.91	81.61	82.05	77.80	80.35	71.80	68.64	53.16	53.32	50.39	42.90
	10	89.52	89.80	81.38	82.71	91.04	88.79	83.04	81.73	82.33	76.82	80.24	68.06	69.29	49.64	49.32	47.86	43.39
	11	65.07	63.70	60.44	64.81	70.68	67.15	63.51	61.18	63.24	67.89	60.34	59.88	59.10	45.07	44.06	43.22	43.16
	12	90.90	87.80	86.79	87.51	94.28	84.79	85.32	83.60	85.21	92.50	82.33	87.19	75.87	67.91	64.99	63.61	61.90
2006	1	62.79	61.94	59.67	61.97	59.76	61.16	57.62	57.79	56.86	58.66	57.17	50.68	49.91	43.08	42.26	41.72	38.35
	2	65.42	63.51	64.12	63.44	56.48	55.39	57.77	57.61	57.37	56.56	56.64	52.75	50.61	43.99	42.65	41.31	38.60
	3	64.54	63.40	63.52	61.29	60.69	58.66	59.98	59.79	59.47	59.10	59.12	54.68	54.44	45.11	42.47	42.52	39.52
	4	51.10	50.66	50.49	49.52	51.16	51.16	49.42	49.29	49.30	48.09	48.86	48.84	48.68	43.96	43.10	43.51	39.18
	5	54.38	53.43	51.10	47.94	50.00	51.55	47.06	47.35	46.96	45.71	46.48	46.79	44.60	40.97	39.92	40.28	39.97
	6	55.44	53.81	53.92	48.90	49.40	47.99	47.46	46.84	45.93	45.58	45.46	43.40	39.88	36.18	34.76	34.67	34.96
	7	76.47	73.05	72.48	74.00	68.77	65.43	68.13	67.64	64.71	64.98	63.03	62.81	56.12	51.35	52.20	50.62	46.98
	8	100.16	93.19	91.05	86.95	78.40	74.60	76.66	77.11	75.43	73.74	73.88	67.88	61.88	55.63	55.44	54.05	52.32
	9	35.85	36.56	35.54	38.71	38.93	38.68	38.81	35.70	40.13	36.21	35.82	33.70	34.13	32.09	31.77	32.11	31.65
	10	42.20	41.52	40.95	41.79	45.57	47.23	42.03	40.60	41.13	42.39	40.69	39.38	39.25	38.34	37.80	38.18	38.22
	11	49.32	49.53	48.61	47.49	49.27	49.75	47.48	47.58	47.28	47.20	47.20	45.83	42.99	41.91	41.89	41.86	40.03
	12	47.45	47.04	45.21	43.18	44.90	43.54	43.29	43.32	43.02	42.07	42.63	37.35	36.44	33.76	33.36	33.05	31.67
2006 Average		58.76	57.30	56.39	55.43	54.44	53.76	52.98	52.55	52.30	51.69	51.42	48.67	46.58	42.20	41.47	41.16	39.29

PJM LMPs: OnPeak

Peak DA		PEPCO	AECO	BGE	PSEG	RECO	DPL	METED	DOM	PECO	PPL	JCPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	68.77	66.09	68.15	66.92	65.50	66.35	64.77		65.87	64.25	64.16	62.04	61.22				
	2	51.20	50.78	51.03	50.95	50.85	50.63	50.36		50.48	50.31	50.01	50.22	51.01				
	3	44.61	45.63	44.62	47.26	46.23	46.39	45.11		45.76	45.20	47.42	43.99	45.70				
	4	50.24	51.93	50.11	55.74	52.41	51.01	50.21		51.53	49.97	56.25	49.73	49.79				
	5	61.99	64.18	61.48	71.90	65.99	62.04	61.31		62.46	60.65	73.75	60.15	58.10		46.47		
	6	56.02	64.00	55.36	65.09	58.92	56.34	56.72		56.39	53.35	65.37	52.60	52.52		42.04		
	7	59.30	67.31	57.68	66.59	57.89	56.33	57.44		55.62	51.16	66.69	49.80	48.03		48.19		
	8	56.65	62.53	54.74	61.01	54.47	53.51	55.42		52.71	48.60	60.61	46.46	44.09		37.98		
	9	48.89	51.84	48.40	54.45	50.84	50.04	48.75		49.82	47.40	53.87	46.46	45.90		37.47		
	10	46.46	52.48	47.28	50.18	49.37	49.71	48.26		49.77	49.34	49.70	47.81	47.08	42.50	41.72	42.45	
	11	48.37	59.41	48.33	62.07	58.02	54.07	48.39		54.51	48.77	64.74	47.32	48.53	46.51	45.54	46.53	
	12	45.98	66.80	45.59	65.49	61.70	63.34	51.31		61.18	51.03	65.81	42.55	45.64	39.16	38.51	38.69	
2005	1	58.01	70.64	57.63	69.94	68.22	70.79	60.73		69.17	60.23	68.76	54.00	53.60	47.88	46.68	47.51	44.98
	2	51.34	53.54	50.65	54.37	52.51	51.89	49.15		51.14	48.89	53.42	46.44	46.48	44.17	43.81	43.69	42.65
	3	57.45	65.32	57.42	63.52	61.64	62.89	58.82		61.86	58.96	63.50	54.83	55.82	52.55	52.70	52.54	52.24
	4	57.32	69.52	57.21	66.18	64.67	63.17	58.15		61.41	58.12	66.08	56.13	56.65	50.68	50.57	50.41	55.13
	5	54.37	56.18	54.25	57.42	56.83	55.57	53.99	52.89	55.14	53.77	54.35	50.86	58.94	44.28	43.98	43.52	43.50
	6	83.87	87.06	81.98	80.83	79.40	78.46	78.75	76.88	80.74	77.25	79.28	67.63	66.51	58.24	58.44	57.50	55.68
	7	112.46	112.95	107.19	102.56	97.88	102.95	101.92	100.06	109.13	98.05	99.25	87.69	80.01	71.98	69.54	68.01	64.19
	8	121.95	121.30	117.57	113.09	109.43	116.41	115.32	109.42	117.40	113.17	112.64	96.91	90.08	79.17	78.87	77.32	72.47
	9	120.84	122.07	118.65	120.75	114.33	117.12	114.32	112.79	115.81	113.80	112.81	97.99	96.00	76.92	77.13	74.62	67.23
	10	112.03	113.26	111.96	119.10	109.84	113.28	111.40	102.28	112.39	110.22	108.61	90.24	89.60	72.02	71.71	70.43	61.13
	11	80.07	82.30	79.41	84.10	81.23	79.77	78.52	71.51	79.81	78.41	80.88	71.17	70.78	56.98	55.95	55.60	56.38
	12	109.54	109.73	105.86	112.67	105.89	109.14	104.56	99.49	106.85	103.48	111.28	105.51	93.49	86.06	84.29	83.84	80.71
2006	1	69.15	72.54	69.15	70.81	71.60	67.30	67.11	63.51	66.88	66.75	67.43	55.46	57.23	48.59	48.16	47.41	44.96
	2	69.42	69.50	68.94	64.70	64.58	64.64	64.04	65.54	64.20	63.15	62.17	54.17	53.80	48.36	47.39	46.45	43.73
	3	64.01	63.73	63.78	63.26	62.73	61.94	61.60	61.17	61.48	61.00	60.20	56.49	56.42	49.45	48.64	48.41	45.59
	4	60.99	59.67	60.72	60.99	60.86	59.75	59.57	61.32	59.58	59.38	58.96	59.38	58.47	55.81	55.61	55.51	54.62
	5	56.33	54.58	55.58	57.08	58.50	54.03	54.48	55.08	54.20	53.11	52.61	53.00	52.64	49.48	49.20	48.69	47.38
	6	75.29	66.67	72.73	66.05	65.41	65.46	66.48	70.38	64.42	63.58	62.74	59.13	57.64	52.18	51.56	50.78	48.98
	7	99.23	96.68	95.07	89.06	85.77	91.65	96.47	90.87	88.73	88.06	87.73	82.17	71.36	63.28	63.53	61.38	56.82
	8	120.35	115.70	111.77	98.14	95.29	100.56	103.96	109.20	98.67	97.01	97.13	86.70	79.79	70.13	70.35	66.58	62.94
	9	43.69	47.76	43.57	47.93	48.30	47.92	43.29	42.70	49.18	43.45	43.42	40.62	41.54	39.50	39.57	39.30	38.27
	10	49.48	52.20	49.64	55.23	56.38	52.91	50.67	49.03	50.97	50.87	52.24	48.03	47.77	46.82	47.04	46.80	46.50
	11	57.65	60.91	58.61	63.09	64.70	60.52	60.03	56.84	60.41	60.69	60.79	56.33	55.17	53.08	53.45	53.15	50.66
	12	53.41	54.26	53.70	57.10	57.21	54.33	52.95	50.85	53.92	52.57	53.16	46.93	47.67	45.46	45.41	45.10	43.73
2006 Average		68.25	67.85	66.94	66.12	65.95	65.08	65.05	64.71	64.39	63.30	63.21	58.20	56.62	51.84	51.66	50.80	48.68

Peak RT

YYear	MMonth	PEPCO	BGE	AECO	PSEG	RECO	DOM	DPL	METED	JCPL	PECO	PPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	65.34	65.42	62.64	66.00	66.44		63.21	61.75	59.60	62.59	61.57	59.34	58.69				
	2	47.59	47.63	48.16	49.40	50.89		47.74	47.59	47.12	47.75	47.70	47.71	52.39				
	3	44.71	44.80	50.02	51.38	49.36		48.87	45.90	51.54	48.31	45.89	44.71	46.03				
	4	50.20	50.25	53.47	58.05	54.26		52.91	51.75	58.15	52.19	50.75	49.49	50.46				
	5	61.05	60.36	64.83	72.12	66.10		62.05	61.10	71.07	60.86	59.07	58.29	57.54		51.32		
	6	54.81	54.00	61.55	70.26	59.80		56.78	54.76	69.97	55.25	50.81	49.48	49.47		40.09		
	7	58.52	56.83	68.95	68.69	58.39		57.06	57.82	67.07	55.72	50.14	50.21	48.46		44.11		
	8	56.42	54.15	64.24	69.91	57.85		57.47	54.47	69.94	53.40	47.03	45.31	43.58		36.69		
	9	54.96	54.09	55.74	59.71	54.74		54.09	51.48	58.75	53.94	51.02	50.53	49.00		36.12		
	10	47.11	47.98	51.28	48.84	48.66		48.70	48.89	48.61	48.78	50.22	46.86	46.95	43.11	42.62	42.94	
	11	45.30	45.54	54.40	59.86	57.85		49.66	44.58	64.24	50.57	44.87	43.82	45.38	43.14	41.04	43.29	
	12	50.17	49.70	67.93	67.39	62.61		61.05	50.87	66.85	58.68	50.48	43.06	44.25	39.57	39.17	39.12	
2005	1	59.58	59.27	69.07	68.10	66.03		69.73	61.07	67.25	67.67	60.65	53.95	54.22	49.33	48.90	48.90	48.67
	2	52.38	53.05	55.01	56.78	55.17		53.67	52.90	55.50	53.58	52.81	47.40	48.24	45.73	44.49	45.33	43.57
	3	60.10	60.54	66.56	64.91	62.57		63.68	61.15	63.59	61.99	60.87	57.34	57.69	55.83	55.80	55.68	54.62
	4	55.88	55.60	64.76	64.93	64.55		57.11	55.65	66.29	56.56	55.71	55.25	55.48	50.19	49.95	49.72	52.51
	5	60.51	60.30	59.59	62.91	60.57	57.84	57.93	58.36	58.62	57.82	58.16	54.15	58.17	47.82	46.87	46.32	47.33
	6	84.72	83.20	82.46	80.97	80.82	75.83	73.47	77.23	75.68	76.19	74.95	65.86	63.18	54.30	56.92	53.33	51.32
	7	113.38	110.81	113.19	105.83	99.68	101.92	98.68	99.97	100.17	111.92	94.92	83.11	76.53	68.97	68.37	67.08	61.56
	8	126.72	121.52	116.55	110.10	106.09	113.38	110.57	112.07	106.72	109.19	107.00	95.84	87.83	79.31	78.44	78.32	72.32
	9	116.02	114.09	113.83	117.65	113.63	110.35	109.04	106.48	101.94	106.67	104.77	96.57	90.92	73.85	74.62	70.40	62.81
	10	118.49	120.31	110.39	118.88	113.61	106.25	110.80	109.71	103.80	109.95	107.82	89.70	91.30	68.10	68.46	66.70	61.26
	11	82.65	80.38	84.48	94.31	86.87	74.97	81.69	77.65	92.15	81.32	76.50	76.68	76.30	59.05	58.22	57.34	55.45
	12	106.60	102.61	105.68	115.11	103.02	99.18	101.63	99.76	113.84	101.69	98.70	107.72	93.51	87.02	84.41	83.97	82.40
2006	1	66.10	65.92	73.28	68.98	72.51	62.96	63.43	63.99	67.19	62.49	63.94	57.13	57.90	51.60	51.47	51.14	47.89
	2	68.65	67.31	71.69	62.42	61.34	66.01	63.19	63.13	62.29	62.88	62.49	58.42	57.01	49.26	48.79	48.07	44.45
	3	66.99	66.22	66.56	66.90	64.29	65.01	63.91	63.99	64.20	63.62	63.66	59.96	61.14	53.32	51.82	52.19	50.46
	4	62.51	62.17	61.04	63.73	63.28	61.33	60.90	60.84	59.39	60.78	60.49	60.86	60.53	56.93	56.55	56.75	53.37
	5	71.35	69.71	60.30	63.18	64.94	64.98	59.19	60.24	58.41	59.15	58.84	59.10	56.32	53.14	52.05	52.48	53.33
	6	72.85	71.05	64.83	64.76	61.24	69.36	62.53	61.64	60.85	59.73	59.53	56.94	51.77	48.60	46.85	46.46	46.52
	7	100.45	94.85	100.02	91.72	85.09	92.42	91.42	91.38	87.78	85.26	82.94	82.80	73.34	67.66	69.32	66.52	62.84
	8	129.74	120.82	118.24	103.57	97.82	115.35	101.43	103.59	99.39	100.30	98.64	90.66	82.77	76.90	76.14	74.00	71.42
	9	43.27	45.16	47.89	48.77	49.12	42.48	48.76	43.43	43.36	48.66	43.60	40.80	41.49	39.43	39.76	39.43	38.53
	10	52.56	51.36	52.46	59.21	62.19	49.98	51.94	50.22	53.74	51.10	50.45	48.46	48.59	47.83	47.68	47.57	47.32
	11	58.39	59.72	58.60	62.69	64.12	57.52	58.38	58.61	58.54	58.13	58.37	56.94	53.52	52.59	52.89	52.69	50.21
	12	54.41	54.86	53.33	56.65	56.47	52.07	53.16	53.64	52.08	52.91	52.78	46.29	46.96	43.14	42.88	42.43	41.88
2006 Average		70.61	69.10	69.02	67.71	66.87	66.62	64.85	64.56	63.93	63.75	62.98	59.86	57.61	53.37	53.02	52.48	50.68

PJM LMPs: OffPeak

offpeak DA		PEPCO	DOM	BGE	AECO	RECO	PSEG	DPL	PECO	METED	PPL	JCPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	50.81		50.14	46.05	46.92	48.33	47.92	47.52	47.03	46.57	45.69	45.29	44.44				
	2	38.28		37.90	36.32	36.67	36.82	37.22	36.95	36.60	36.40	36.43	35.97	36.02				
	3	31.40		31.38	31.07	32.02	32.85	32.12	31.80	31.29	31.28	33.09	31.14	31.86				
	4	34.38		34.32	34.34	34.61	35.22	34.65	34.41	34.15	34.14	35.23	33.94	33.96				
	5	37.51		37.45	37.99	38.69	40.29	37.95	38.00	37.36	37.41	40.70	37.30	37.20		20.40		
	6	26.71		26.52	28.09	26.86	28.02	26.69	26.58	25.93	25.83	28.05	25.48	25.45		17.53		
	7	39.26		38.42	40.73	36.79	39.22	37.02	36.30	35.53	34.79	38.66	33.81	32.69		21.87		
	8	34.75		33.99	35.89	33.62	35.61	34.46	33.17	32.03	31.44	35.30	30.13	29.51		20.64		
	9	32.49		32.38	33.39	32.55	32.91	32.59	32.52	32.08	31.90	32.67	31.79	31.70		20.26		
	10	29.43		29.27	30.90	29.97	30.28	30.68	29.93	29.49	29.51	29.80	29.30	28.92	26.85	21.89	27.00	
	11	30.55		30.51	35.74	35.38	35.76	34.59	34.09	31.38	31.45	36.13	29.51	30.07	28.34	22.58	28.25	
	12	36.50		36.16	47.44	43.75	45.89	47.97	45.44	38.89	38.61	46.16	31.54	32.59	25.77	19.13	25.19	
2005	1	47.58		46.77	48.94	46.43	47.66	49.44	48.38	45.55	44.90	47.46	39.36	38.58	31.94	26.34	30.97	25.36
	2	41.52		40.85	39.12	38.80	39.21	39.43	38.74	38.74	38.43	39.27	35.71	35.06	31.12	26.41	30.58	28.37
	3	44.19		43.88	44.08	42.94	43.80	44.44	43.78	43.06	42.77	43.46	40.15	39.81	37.32	36.71	37.24	35.79
	4	40.38		39.89	42.86	42.42	43.84	40.56	40.17	38.73	38.47	42.87	37.45	37.41	32.02	31.17	32.23	34.60
	5	33.13	32.25	32.82	32.64	34.11	33.41	32.40	32.22	31.94	31.75	31.62	29.59	34.21	25.20	25.12	24.88	25.09
	6	44.31	42.96	43.51	45.27	43.79	44.32	43.65	43.10	41.70	41.46	42.70	36.33	35.61	31.75	31.63	31.22	30.24
	7	58.51	55.72	56.57	54.92	53.68	54.60	53.64	54.13	51.72	50.75	50.53	46.64	44.58	38.84	38.35	37.81	36.90
	8	72.18	66.85	68.61	64.86	62.07	63.44	63.19	62.48	62.57	60.70	60.07	55.42	50.78	41.81	41.12	40.36	39.38
	9	62.27	58.92	61.47	60.18	62.70	63.94	59.67	59.16	58.35	57.81	56.27	51.80	51.14	38.31	37.94	36.96	35.32
	10	62.26	56.80	61.42	58.73	61.20	64.65	59.16	58.54	57.39	56.87	54.23	48.08	47.88	34.70	34.07	33.24	32.55
	11	52.61	47.72	52.42	50.96	50.08	50.79	51.23	51.01	51.05	50.62	50.15	45.80	44.86	34.15	33.10	32.65	35.00
	12	81.80	76.24	79.15	75.33	74.48	76.54	75.61	75.02	74.52	73.43	74.86	70.43	64.15	53.09	50.89	50.14	47.98
2006	1	53.82	51.69	52.91	49.53	51.85	50.77	49.10	48.65	48.86	48.22	47.82	43.67	42.56	35.85	34.80	33.86	34.05
	2	66.16	64.61	63.86	55.91	55.00	55.21	55.75	55.23	55.51	54.24	53.57	48.91	46.13	39.75	37.69	36.08	35.36
	3	54.09	52.38	53.28	50.33	49.87	50.13	50.32	49.96	50.03	49.44	48.80	44.95	43.77	35.03	33.62	32.83	31.53
	4	41.91	42.09	41.60	40.23	41.38	41.67	40.34	40.23	40.24	39.96	39.48	38.75	38.67	33.81	32.72	32.56	30.22
	5	36.62	37.27	36.15	35.09	38.14	36.87	34.84	34.72	34.50	34.20	33.26	33.60	33.41	30.53	29.75	29.32	29.50
	6	43.67	42.27	41.85	37.17	38.95	38.33	37.38	36.74	36.58	35.92	34.86	32.59	31.91	27.28	26.98	26.71	26.53
	7	58.81	57.81	56.26	52.55	49.62	50.31	50.24	49.55	50.07	48.39	47.94	44.20	41.90	36.71	37.27	35.74	34.19
	8	63.13	61.04	59.49	55.21	50.61	51.31	51.30	50.36	50.28	48.98	47.99	43.25	41.01	34.22	34.69	33.81	33.03
	9	33.45	32.85	32.97	33.55	32.74	33.01	33.14	33.74	31.88	31.79	31.78	29.44	29.70	26.54	26.43	26.44	26.69
	10	30.89	31.18	30.88	32.96	34.03	33.57	33.79	32.99	31.30	31.36	32.45	29.99	30.25	28.68	28.48	28.66	28.66
	11	38.29	38.28	37.60	36.45	37.83	37.15	36.49	36.35	36.19	36.09	35.76	34.58	33.26	31.98	32.05	31.88	31.06
	12	40.03	38.15	39.33	36.34	35.14	35.97	36.60	36.30	35.98	35.43	35.52	31.13	30.52	27.78	27.48	27.16	25.86
2006 Average		46.74	45.80	45.52	42.94	42.93	42.86	42.44	42.07	41.79	41.17	40.77	37.92	36.93	32.35	31.83	31.25	30.56

offpeak RT

YYear	MMonth	PEPCO	DOM	BGE	AECO	PSEG	DPL	RECO	PECO	METED	PPL	JCPL	APS	PENELEC	AEP	COMED	DAY	DUQ
2004	1	56.91		55.75	51.24	52.28	51.88	52.55	51.18	50.92	50.27	49.20	48.16	46.28				
	2	37.85		37.65	36.97	36.98	37.00	37.02	36.96	36.98	36.92	36.90	36.11	37.76				
	3	33.10		33.12	33.31	33.30	33.43	33.26	33.28	33.20	33.22	33.31	32.99	33.17				
	4	35.53		35.57	36.35	37.52	36.24	37.19	36.16	35.76	35.75	37.18	35.11	35.39				
	5	40.62		40.55	43.46	45.59	41.78	42.58	41.34	40.49	40.50	46.69	39.79	39.93		21.31		
	6	26.35		26.25	28.27	29.16	26.65	27.96	26.50	25.88	25.84	28.58	25.84	25.73		17.57		
	7	40.89		40.01	42.67	44.21	39.59	41.32	38.61	37.62	36.65	42.69	35.70	34.87		20.03		
	8	34.04		33.47	35.79	35.00	33.92	33.50	32.57	32.16	31.39	34.35	30.65	29.90		16.98		
	9	33.93		33.93	34.93	34.18	34.05	34.27	33.92	33.87	33.86	33.85	33.83	33.82		20.85		
	10	30.77		30.83	30.95	30.54	30.77	30.32	30.74	30.78	30.71	30.60	29.33	29.15	25.62	21.15	25.42	
	11	33.38		32.82	34.15	34.10	32.17	33.87	31.69	31.23	30.92	35.22	28.11	28.05	23.82	18.78	23.58	
	12	43.95		42.95	52.63	50.22	53.61	47.94	50.45	43.48	42.64	50.65	34.66	34.67	26.47	20.85	25.27	
2005	1	50.94		50.26	50.22	49.20	50.67	48.30	49.79	48.69	48.27	49.20	41.83	41.32	33.99	29.72	33.14	28.96
	2	39.92		39.45	38.02	40.50	37.63	39.88	37.14	38.03	37.79	41.76	33.65	33.14	29.24	26.23	28.71	25.87
	3	47.19		46.93	47.84	46.01	47.94	44.75	45.98	45.69	44.22	46.57	39.93	39.35	36.16	35.94	35.80	33.23
	4	35.88		35.55	41.53	44.61	38.43	42.40	36.80	34.93	34.81	43.19	34.11	34.58	29.44	29.38	29.21	31.39
	5	30.18	29.44	30.18	30.67	31.50	30.34	32.43	30.31	30.24	30.32	30.13	28.13	36.27	22.65	22.64	22.28	22.63
	6	43.28	41.72	42.10	42.42	42.89	40.15	43.94	39.16	39.43	38.75	38.28	35.20	34.56	28.43	28.57	28.20	27.30
	7	57.83	56.89	56.02	54.98	54.97	52.54	55.80	52.93	50.30	49.38	48.75	45.86	43.51	38.96	37.65	38.08	34.89
	8	82.45	79.36	78.79	72.74	71.69	70.58	72.03	69.12	69.67	67.51	65.35	59.71	54.75	43.08	41.96	41.15	38.30
	9	63.48	60.18	62.90	61.79	64.69	61.93	65.83	60.50	59.85	58.99	56.68	50.12	49.14	35.05	34.68	32.88	25.48
	10	65.73	60.94	64.74	59.97	68.17	60.23	68.40	59.64	58.74	57.58	54.66	50.29	51.21	34.47	33.60	32.38	28.71
	11	49.68	47.74	49.11	47.61	50.01	47.60	49.90	47.42	46.77	46.21	46.66	45.19	44.06	32.83	31.67	30.86	32.40
	12	77.98	76.59	75.60	72.54	77.13	71.88	69.77	71.63	70.29	68.85	74.92	70.28	61.34	52.16	48.99	46.85	45.03
2006	1	60.06	56.96	58.66	52.65	52.16	52.83	51.81	52.23	52.68	51.59	51.64	45.37	43.33	36.07	34.68	33.96	30.49
	2	62.47	62.40	60.06	55.93	51.08	52.85	49.98	52.35	52.58	51.32	51.34	47.59	44.78	39.20	37.07	35.15	33.27
	3	62.14	62.06	60.63	56.13	54.60	56.13	53.15	55.41	55.68	54.68	54.11	49.51	47.88	37.08	33.33	33.05	28.82
	4	41.97	41.82	41.46	40.30	41.11	40.24	41.46	40.12	40.06	39.56	39.06	39.22	39.20	33.59	32.33	32.92	27.83
	5	39.15	38.64	38.82	36.84	38.17	36.18	39.53	36.01	35.78	35.38	34.31	35.74	34.07	30.03	29.03	29.32	27.97
	6	38.79	39.15	37.31	33.67	34.72	33.05	35.31	32.74	32.69	32.00	30.97	30.46	28.52	24.30	23.19	23.40	23.90
	7	58.36	57.42	56.60	54.36	51.45	50.54	50.59	49.19	49.73	48.00	47.77	47.72	43.13	39.05	39.27	38.62	35.02
	8	71.21	67.27	66.16	56.33	53.77	52.41	51.87	51.10	51.19	49.65	48.63	45.59	41.45	34.81	35.18	34.52	33.62
	9	29.91	29.99	29.68	31.37	31.06	30.84	30.33	33.30	29.51	29.60	30.48	28.03	28.24	26.21	25.38	26.25	26.15
	10	32.90	32.83	32.68	32.21	33.32	33.13	33.80	32.17	31.97	31.92	32.20	31.23	30.85	29.81	28.92	29.76	30.04
	11	41.39	40.82	40.61	37.77	37.53	37.94	37.18	37.79	37.93	37.44	37.28	36.11	33.78	32.56	32.26	32.39	31.12
	12	42.53	40.37	41.52	36.03	36.61	36.33	34.41	36.04	36.03	35.47	35.00	31.04	29.01	27.14	26.65	26.43	24.46
2006 Average		48.41	47.48	47.02	43.63	42.96	42.71	42.45	42.37	42.15	41.38	41.07	38.97	37.02	32.49	31.44	31.31	29.39

NYISO LBMPs

DA Offpeak		OP										
YYear	**MMonth**	**LONGIL**	**N.Y.C.**	**DUNWOD**	**MILLWD**	**HUD VL**	**CAPITL**	**MHK VL**	**NORTH**	**CENTRL**	**GENESE**	**WEST**
2004	1	64.06	67.19	55.76	54.99	54.90	54.93	53.38	53.17	51.48	51.46	48.69
	2	54.51	52.81	47.59	46.98	46.87	46.96	45.65	45.27	43.81	44.08	42.05
	3	47.10	44.06	41.14	40.65	40.67	41.06	39.42	39.19	37.83	37.67	35.26
	4	47.95	46.26	42.92	42.41	42.59	42.99	40.39	39.76	39.50	38.49	36.34
	5	60.46	51.07	46.46	45.89	46.02	46.04	42.49	41.86	41.19	39.66	37.54
	6	51.68	46.68	40.72	40.16	39.87	39.13	36.84	36.02	34.95	34.65	31.93
	7	59.25	53.18	47.20	46.39	45.63	45.43	42.59	41.06	40.62	40.05	37.21
	8	56.26	51.07	42.01	41.41	41.02	40.61	38.11	36.70	36.61	35.84	33.45
	9	51.05	44.48	40.98	40.53	39.71	39.10	37.03	35.82	36.13	35.71	34.70
	10	56.79	53.92	45.71	45.49	45.84	46.48	42.50	40.94	41.46	40.75	37.93
	11	50.94	50.12	47.89	47.49	46.96	46.84	44.39	43.72	42.65	42.42	40.23
	12	56.51	53.44	48.72	48.23	48.61	49.02	46.75	45.97	45.15	44.52	42.24
2005	1	71.69	65.08	57.62	57.01	57.30	58.66	53.56	53.02	51.34	51.11	47.69
	2	66.58	59.43	51.94	51.50	51.14	50.70	48.61	47.60	46.46	45.78	40.88
	3	70.51	62.89	59.04	58.83	58.29	57.34	54.42	52.96	52.36	51.11	47.35
	4	70.12	66.03	58.35	57.74	57.44	57.07	52.71	51.39	51.29	50.40	47.59
	5	68.73	53.15	49.98	49.85	49.41	48.39	45.91	45.15	43.80	42.59	40.37
	6	83.02	65.99	60.83	60.79	59.64	57.06	53.77	52.83	50.95	49.52	47.12
	7	85.30	74.37	67.53	67.34	66.44	64.55	61.95	60.51	59.87	58.44	55.87
	8	101.13	96.14	78.07	77.74	76.76	75.18	71.80	70.22	69.22	67.32	64.69
	9	110.89	106.14	91.87	91.54	90.65	89.48	84.71	84.00	81.38	78.71	75.27
	10	115.74	100.74	95.37	92.70	86.17	89.41	79.97	77.80	77.03	74.79	71.67
	11	82.96	71.36	65.62	64.68	63.30	63.40	58.21	57.38	56.12	53.64	50.89
	12	104.15	95.74	87.91	86.28	85.86	85.60	81.20	79.37	78.70	75.95	71.51
2006	1	84.78	67.90	65.32	65.06	64.62	64.26	59.69	58.58	57.59	55.01	50.76
	2	83.77	63.94	62.22	62.04	61.58	60.99	56.69	55.31	54.72	52.65	49.95
	3	75.40	58.96	55.58	55.25	55.03	54.12	51.24	49.86	49.71	47.65	45.53
	4	80.19	55.67	54.19	54.00	53.51	51.97	48.30	46.73	46.76	45.25	42.74

	5	67.21	50.42	49.23	49.11	48.73	47.28	45.32	44.32	43.72	42.47	40.71
	6	72.85	51.98	50.12	50.07	49.70	48.51	46.55	44.84	44.62	43.91	42.23
	7	89.41	74.45	59.77	59.67	58.51	53.97	52.18	49.95	50.13	48.71	46.86
	8	88.22	74.31	61.08	59.96	59.63	57.18	55.18	53.31	52.83	51.03	48.98
	9	51.64	42.39	41.76	41.68	41.47	40.38	39.09	38.26	37.51	37.17	35.89
	10	55.44	44.44	43.94	43.89	43.74	43.38	40.25	38.80	38.98	38.66	36.57
	11	66.90	54.47	53.39	53.33	53.05	52.86	47.06	46.35	45.52	44.32	42.07
	12	67.22	54.23	50.52	50.26	49.88	52.59	37.54	35.97	36.71	34.66	33.31
2006 Average		73.59	57.76	53.93	53.69	53.29	52.29	48.26	46.86	46.57	45.12	42.97

RT Offpeak

YYear	MMonth	LONGIL	N.Y.C.	DUNWOD	MILLWD	HUD VL	CAPITL	MHK VL	NORTH	CENTRL	GENESE	WEST
2004	1	66.50	78.21	57.24	56.35	55.85	58.15	55.70	55.13	53.25	54.47	50.87
	2	51.94	52.95	43.43	42.78	42.43	44.29	42.39	41.74	40.52	41.40	38.81
	3	46.49	46.06	39.75	39.18	38.78	41.54	38.06	37.65	36.52	37.29	33.63
	4	47.20	45.75	43.36	42.74	42.39	44.66	41.61	40.74	40.51	40.57	37.54
	5	58.09	50.58	42.02	41.43	40.45	41.88	38.47	37.57	37.09	36.73	34.70
	6	50.34	48.03	37.17	36.66	33.83	35.71	33.19	32.39	31.47	31.73	29.12
	7	59.37	56.43	42.93	42.01	41.53	43.06	39.97	38.86	38.06	38.14	35.70
	8	52.56	53.14	38.61	38.02	37.14	37.61	35.28	34.16	33.83	33.92	31.79
	9	51.49	48.86	41.91	41.38	40.46	40.41	38.38	37.31	37.36	37.25	36.08
	10	56.10	53.17	47.02	46.48	46.29	48.73	42.79	41.70	41.83	42.05	38.60
	11	50.78	49.11	45.44	44.95	44.57	45.38	43.36	42.60	41.50	41.39	38.96
	12	61.34	56.47	48.92	48.23	48.15	49.59	46.30	45.39	44.70	44.84	41.20
2005	1	73.21	68.84	58.05	57.18	56.94	59.54	53.80	52.91	51.52	52.27	47.99
	2	66.12	53.53	50.01	49.96	49.79	48.85	47.33	46.58	45.21	43.96	40.58
	3	69.70	60.09	56.14	56.08	55.26	54.92	50.51	49.12	48.68	47.27	44.47
	4	69.61	63.88	57.66	57.64	57.39	58.18	49.20	47.58	48.12	46.88	44.70
	5	70.51	50.78	46.28	46.28	43.40	43.25	40.12	39.65	38.32	36.89	35.43
	6	85.24	68.78	56.51	56.42	56.24	55.34	52.54	52.03	49.55	48.54	46.52
	7	87.18	86.02	69.20	69.04	68.66	66.25	64.41	62.86	61.87	60.65	57.70
	8	132.75	135.06	97.73	97.08	91.27	78.45	74.44	72.69	71.23	70.08	67.37

	9	115.39	111.48	90.39	90.13	89.36	85.91	80.37	79.59	76.99	74.76	71.86
	10	118.02	103.67	95.41	94.79	92.18	93.90	81.50	79.03	78.83	76.48	73.70
	11	76.58	71.55	58.35	58.25	58.07	57.56	53.81	53.12	52.04	50.16	46.08
	12	105.21	86.56	83.53	83.49	82.76	82.93	77.17	75.93	74.78	72.95	63.44
2006	1	76.94	68.61	63.57	63.50	63.27	62.99	57.61	56.77	55.52	51.42	48.39
	2	82.52	58.46	57.27	57.24	57.03	56.73	51.76	50.58	49.88	46.65	44.06
	3	73.56	56.97	52.87	52.80	52.68	52.06	49.31	47.99	47.86	45.66	43.49
	4	80.66	57.02	52.33	52.28	52.07	52.96	45.39	43.74	44.03	42.41	41.05
	5	66.12	51.91	51.01	50.87	50.24	46.39	44.25	42.89	42.46	41.36	39.06
	6	60.41	46.62	41.53	41.47	41.40	40.86	38.51	37.54	37.02	36.25	35.01
	7	82.03	65.42	50.38	50.26	49.32	45.75	44.79	43.23	43.10	42.27	40.67
	8	92.17	68.43	58.64	57.76	57.22	54.69	53.12	51.99	51.14	49.61	47.74
	9	50.15	41.94	40.36	40.28	40.28	39.50	38.49	37.91	36.94	35.98	34.74
	10	53.07	46.23	44.87	44.88	44.71	45.81	37.46	35.87	36.73	36.11	33.58
	11	62.59	49.88	48.74	48.77	48.52	49.46	41.37	40.56	40.56	39.39	37.91
	12	62.78	55.29	51.48	51.51	51.11	56.07	33.58	30.95	33.73	32.00	31.33
2006 Average		70.25	55.57	51.09	50.97	50.65	50.27	44.64	43.33	43.25	41.59	39.75

DA Peak

YYear	MMonth	LONGIL	N.Y.C.	DUNWOD	MILLWD	HUD VL	CAPITL	MHK VL	CENTRL	NORTH	GENESE	WEST
2004	**1**	**88.86509**	**121.6207**	**75.77405**	**74.67747**	**74.42676**	**74.34012**	**72.16747**	**69.30098**	**71.68702**	**69.49164**	**65.16515**
	2	67.43	74.91	59.99	59.14	58.84	59.11	57.26	55.16	56.08	55.52	52.66
	3	60.25	65.20	55.66	54.25	53.97	54.52	52.01	50.25	50.87	50.29	46.94
	4	63.29	65.61	58.08	57.21	57.08	57.99	54.90	54.00	53.46	53.37	50.14
	5	79.92	77.54	67.75	66.77	66.20	64.85	62.20	60.66	60.39	59.32	56.17
	6	74.01	80.24	64.97	64.14	63.79	62.04	59.18	57.09	57.20	56.75	53.76
	7	72.33	73.73	62.07	61.10	59.36	58.28	53.83	52.06	50.72	51.56	48.90
	8	69.38	71.54	58.29	57.41	56.41	54.57	50.83	49.51	47.94	48.70	46.38
	9	65.14	65.48	54.94	54.30	53.68	52.09	49.42	48.55	47.22	47.81	46.49
	10	73.34	74.26	59.65	59.45	59.17	59.72	55.72	54.60	52.37	53.12	50.07
	11	72.52	73.59	66.25	65.85	64.77	64.12	60.82	58.75	59.04	58.40	55.57
	12	81.14	74.99	64.97	64.29	64.54	63.92	61.50	59.42	60.10	58.81	55.10
2005	1	99.89	92.12	78.32	77.45	77.78	78.95	71.84	68.21	72.65	68.34	64.29

	2	86.02	82.85	64.62	63.26	62.99	63.67	58.21	55.95	56.05	55.15	50.40
	3	85.13	89.10	74.10	73.59	72.29	71.77	66.04	64.18	62.85	63.07	58.94
	4	86.65	91.49	76.72	76.02	75.44	75.14	67.70	66.20	64.25	64.79	60.85
	5	81.12	76.26	71.48	71.43	70.32	67.84	64.70	62.36	61.83	60.36	57.46
	6	104.64	103.91	90.00	90.15	87.37	79.35	74.11	71.28	71.12	69.81	67.92
	7	120.59	119.14	99.46	99.55	95.56	88.21	84.11	82.69	79.65	82.37	80.03
	8	149.46	140.07	117.49	116.92	113.25	102.52	95.64	92.89	90.87	92.01	88.53
	9	151.14	169.30	127.98	127.69	125.58	120.44	114.13	111.24	110.90	109.10	104.37
	10	158.85	151.68	135.42	132.73	124.63	125.02	116.36	113.54	110.14	111.26	107.11
	11	101.80	104.35	95.58	94.83	93.25	92.14	86.12	83.61	83.24	80.85	76.33
	12	134.10	128.98	117.76	115.66	114.71	114.42	107.07	104.08	103.95	101.33	96.48
2006	1	96.63	90.02	85.79	85.67	84.90	83.62	76.81	74.26	74.24	70.81	65.95
	2	103.54	81.34	75.88	75.47	74.57	74.11	66.82	64.19	64.75	62.34	58.68
	3	92.21	79.92	69.68	68.92	68.62	67.32	63.11	61.27	60.73	59.05	55.81
	4	96.17	79.43	73.57	73.17	70.96	69.43	64.84	63.17	61.01	61.62	58.12
	5	85.73	75.39	73.55	73.27	71.90	64.64	62.06	59.71	59.47	58.83	55.29
	6	97.77	84.09	79.45	79.39	77.19	67.90	65.88	63.06	61.26	62.76	60.01
	7	158.14	118.97	106.90	106.56	100.00	76.80	74.68	71.31	68.62	70.39	67.83
	8	153.36	126.74	109.84	108.58	101.53	80.53	77.78	74.16	72.02	72.63	70.03
	9	68.22	62.31	57.01	56.92	56.43	54.06	52.64	50.38	51.07	49.81	47.77
	10	71.40	69.24	65.50	65.40	64.86	62.01	59.85	58.39	56.51	57.41	53.16
	11	90.99	82.51	76.78	76.65	76.14	74.29	68.40	66.52	66.25	64.18	59.25
	12	92.69	80.57	70.67	70.37	69.79	70.22	56.86	55.48	53.87	53.36	51.19
2006 Average		100.57	85.88	78.72	78.36	76.41	70.41	65.81	63.49	62.48	61.93	58.59

RT Peak

YYear	MMonth	LONGIL	N.Y.C.	DUNWOD	MILLWD	HUD VL	CAPITL	MHK VL	CENTRL	GENESE	NORTH	WEST
2004	1	87.71	117.57	71.98	70.80	69.89	71.89	69.04	65.92	67.38	68.29	62.80
	2	66.46	71.02	57.06	56.14	54.96	55.80	54.03	51.93	52.60	53.04	50.00
	3	62.00	68.83	53.83	52.92	52.16	54.33	51.60	49.64	50.40	50.82	46.33
	4	62.20	65.58	57.35	56.46	56.00	57.78	54.26	52.91	52.56	52.99	48.94
	5	86.81	80.15	69.65	68.61	65.63	64.39	62.28	60.32	59.55	60.69	56.35
	6	79.90	83.61	63.41	62.31	57.11	57.10	53.60	51.40	51.56	52.21	48.35

	7	76.43	72.72	60.55	59.62	56.54	54.97	52.69	50.77	50.20	50.98	48.12
	8	74.55	73.35	61.20	60.22	56.67	54.36	50.81	49.49	48.78	48.97	46.93
	9	69.76	70.15	56.38	55.65	51.82	49.41	48.55	47.62	47.17	47.03	46.37
	10	71.64	68.83	58.68	57.95	57.72	59.70	53.19	52.15	52.15	51.27	48.94
	11	72.76	73.60	66.89	66.14	64.75	63.48	61.57	59.73	59.64	60.04	57.35
	12	91.52	81.49	67.42	66.39	66.10	66.71	63.50	61.62	61.87	62.17	58.28
2005	1	108.17	96.61	78.11	76.81	76.10	79.78	63.34	61.18	62.32	66.05	58.52
	2	75.81	78.04	60.28	60.21	59.98	59.09	55.92	53.72	52.62	53.88	48.61
	3	89.87	98.54	77.56	77.47	76.77	77.75	65.52	63.93	62.76	61.99	59.24
	4	82.95	88.19	70.52	70.44	70.14	69.90	61.55	60.40	59.12	58.05	56.25
	5	87.27	70.54	66.14	66.05	64.31	62.40	60.60	58.56	56.99	57.53	54.58
	6	119.75	112.00	94.57	94.28	85.49	77.23	71.90	68.91	68.59	68.29	65.99
	7	158.10	130.73	110.36	109.55	101.56	83.81	77.26	74.84	75.21	73.26	72.10
	8	182.43	159.80	124.44	124.04	121.22	111.51	108.12	105.01	102.86	102.18	99.03
	9	163.62	160.37	120.15	119.79	118.62	114.89	111.65	108.65	107.41	108.35	103.67
	10	158.05	149.29	132.22	131.32	119.61	115.94	111.27	107.73	105.83	106.89	101.82
	11	99.08	102.81	85.66	85.48	85.17	83.15	79.94	77.71	75.71	77.83	70.84
	12	122.56	117.15	106.19	106.20	105.40	104.68	99.77	97.42	95.22	96.71	90.15
2006	1	97.52	88.69	81.53	81.48	81.09	80.80	70.94	68.87	66.35	68.05	62.88
	2	103.58	75.73	71.46	71.49	71.12	72.60	58.50	56.72	54.59	55.42	51.92
	3	92.55	78.37	71.48	71.42	71.20	69.66	65.90	64.19	62.39	62.81	59.59
	4	99.70	79.52	68.13	68.00	67.65	65.63	62.57	60.97	59.24	58.15	56.89
	5	96.30	80.19	80.88	80.76	80.17	75.40	73.17	70.89	69.71	69.22	66.69
	6	115.23	89.09	84.06	83.54	80.06	57.31	56.50	53.62	53.30	52.73	51.67
	7	167.14	121.65	109.96	109.38	97.37	69.76	68.18	65.16	64.95	62.67	62.61
	8	178.00	131.59	118.34	116.08	108.53	86.65	74.87	72.71	72.17	70.66	69.32
	9	65.60	58.21	53.61	53.52	53.44	51.84	50.59	48.50	47.65	49.17	45.62
	10	76.82	73.09	71.11	70.94	70.18	63.33	61.15	59.56	59.34	57.79	53.66
	11	90.00	83.75	74.19	74.17	73.80	72.79	66.14	64.94	63.39	63.96	60.21
	12	92.15	80.69	67.55	67.34	66.70	65.55	52.84	52.33	51.10	49.84	49.20
2006 Average		106.21	86.71	79.36	79.01	76.78	69.28	63.45	61.54	60.35	60.04	57.52

DA RTC

YYear	MMonth	LONGIL	N.Y.C.	DUNWOD	MILLWD	HUD VL	CAPITL	MHK VL	CENTRL	NORTH	GENESE	WEST
2004	1	75.26	91.77	64.80	63.88	63.72	63.69	61.86	59.53	61.54	59.60	56.13
	2	60.45	62.97	53.29	52.57	52.38	52.55	50.99	49.03	50.24	49.34	46.93
	3	53.61	54.52	48.32	47.38	47.25	47.72	45.65	43.98	44.97	43.92	41.04
	4	55.46	55.73	50.34	49.66	49.68	50.33	47.49	46.60	46.47	45.78	43.09
	5	68.83	62.45	55.62	54.87	54.70	54.13	50.97	49.57	49.83	48.11	45.55
	6	62.60	63.09	52.57	51.88	51.57	50.33	47.76	45.77	46.38	45.45	42.60
	7	65.16	62.46	53.91	53.04	51.83	51.23	47.67	45.78	45.42	45.25	42.49
	8	62.47	60.75	49.71	48.98	48.30	47.21	44.13	42.71	42.02	41.92	39.57
	9	57.62	54.28	47.49	46.96	46.23	45.16	42.81	41.93	41.14	41.36	40.20
	10	64.25	63.10	52.00	51.79	51.85	52.45	48.46	47.39	46.10	46.33	43.41
	11	61.01	61.07	56.46	56.06	55.27	54.90	52.06	50.16	50.87	49.88	47.39
	12	68.69	64.10	56.75	56.17	56.49	56.39	54.05	52.21	52.96	51.59	48.60
2005	1	84.42	77.29	66.97	66.24	66.55	67.82	61.82	58.96	61.89	58.89	55.19
	2	75.84	70.58	57.98	57.10	56.78	56.87	53.18	50.98	51.63	50.24	45.41
	3	77.74	75.85	66.49	66.13	65.22	64.48	60.17	58.20	57.85	57.03	53.08
	4	77.84	77.93	66.94	66.28	65.85	65.51	59.71	58.26	57.40	57.13	53.79
	5	74.32	63.59	59.69	59.60	58.85	57.17	54.39	52.18	52.68	50.61	48.09
	6	93.59	84.53	75.09	75.14	73.20	67.96	63.72	60.89	61.77	59.44	57.29
	7	100.48	93.63	81.26	81.19	78.96	74.72	71.48	69.68	68.74	68.73	66.26
	8	125.03	117.87	97.57	97.12	94.81	88.70	83.59	80.93	80.43	79.54	76.48
	9	129.68	135.61	108.72	108.41	106.96	103.93	98.44	95.31	96.56	92.89	88.85
	10	135.18	123.72	113.43	110.75	103.52	105.47	96.38	93.50	92.38	91.24	87.65
	11	91.75	86.75	79.60	78.75	77.27	76.81	71.24	68.95	69.45	66.34	62.76
	12	117.68	110.75	101.39	99.55	98.89	98.62	92.88	90.16	90.47	87.41	82.79
2006	1	90.13	77.89	74.57	74.37	73.78	73.00	67.43	65.12	65.65	62.15	57.62
	2	93.18	72.22	68.72	68.43	67.76	67.24	61.51	59.23	59.81	57.26	54.11
	3	83.72	69.33	62.56	62.01	61.75	60.65	57.11	55.43	55.24	53.29	50.61
	4	87.30	66.24	62.82	62.53	61.28	59.74	55.66	54.06	53.09	52.53	49.59
	5	75.98	62.23	60.74	60.54	59.69	55.49	53.24	51.29	51.49	50.21	47.61
	6	85.03	67.68	64.46	64.40	63.14	57.99	56.00	53.63	52.87	53.13	50.93

	7	118.97	93.60	80.04	79.84	76.36	63.79	61.86	59.24	57.98	58.03	55.88
	8	120.44	100.24	85.20	84.01	80.36	68.73	66.36	63.38	62.57	61.71	59.39
	9	59.01	51.24	48.54	48.45	48.11	46.46	45.11	43.23	43.95	42.79	41.17
	10	62.98	56.16	54.13	54.05	53.72	52.18	49.51	48.15	47.17	47.52	44.41
	11	78.15	67.56	64.31	64.21	63.83	62.86	57.02	55.32	55.64	53.59	50.09
	12	78.93	66.34	59.79	59.50	59.04	60.70	46.42	45.34	44.20	43.26	41.53
2006 Average		86.15	70.90	65.49	65.20	64.07	60.74	56.44	54.45	54.14	52.96	50.24

RT RTC

YYear	MMonth	LONGIL	N.Y.C.	DUNWOD	MILLWD	HUD VL	CAPITL	MHK VL	CENTRL	NORTH	GENESE	WEST
2004	1	76.08	95.99	63.90	62.87	62.19	64.36	61.72	58.97	61.07	60.30	56.26
	2	58.61	61.26	49.70	48.92	48.19	49.58	47.74	45.77	46.94	46.55	43.95
	3	54.16	57.32	46.71	45.98	45.40	47.87	44.76	43.01	44.16	43.77	39.91
	4	54.54	55.46	50.21	49.46	49.05	51.08	47.80	46.58	46.74	46.44	43.12
	5	70.44	63.30	53.90	53.12	51.28	51.56	48.71	47.08	47.51	46.54	44.01
	6	64.79	65.42	50.00	49.20	45.21	46.16	43.17	41.21	42.08	41.43	38.52
	7	67.07	63.79	50.89	49.97	48.31	48.44	45.72	43.80	44.33	43.59	41.31
	8	62.96	62.70	49.30	48.53	46.38	45.53	42.63	41.24	41.17	40.95	38.95
	9	60.01	58.79	48.66	48.04	45.76	44.61	43.13	42.15	41.85	41.88	40.88
	10	63.11	60.23	52.28	51.65	51.44	53.68	47.48	46.48	46.02	46.60	43.26
	11	61.04	60.54	55.45	54.84	53.99	53.83	51.86	50.01	50.74	49.91	47.54
	12	76.27	68.84	58.07	57.21	57.03	58.05	54.81	53.07	53.69	53.26	49.65
2005	1	89.00	81.38	67.11	66.04	65.59	68.68	58.11	55.88	58.84	56.81	52.75
	2	70.73	65.20	54.90	54.84	54.64	53.73	51.42	49.26	50.06	48.09	44.41
	3	79.68	79.11	66.74	66.66	65.90	66.21	57.93	56.22	55.49	54.93	51.77
	4	75.84	75.24	63.67	63.62	63.35	63.65	54.97	53.86	52.47	52.60	50.10
	5	78.08	59.71	55.25	55.21	52.84	51.90	49.37	47.46	47.73	45.97	44.08
	6	102.11	89.91	75.12	74.92	70.54	66.04	62.00	59.02	59.98	58.34	56.04
	7	117.69	105.25	86.90	86.46	82.81	73.81	69.94	67.45	67.33	66.91	63.89
	8	157.32	147.30	110.94	110.41	106.08	94.80	91.10	87.94	87.27	86.30	83.03
	9	137.90	134.30	104.28	103.97	103.02	99.43	94.97	91.76	93.01	90.00	86.71
	10	136.10	124.27	112.04	111.29	104.57	103.84	94.94	91.88	91.62	89.73	86.40
	11	87.08	86.14	71.10	70.96	70.72	69.50	66.00	64.02	64.65	62.08	57.63

	12	113.04	100.37	93.76	93.74	92.98	92.76	87.38	85.01	85.32	83.01	75.51
2006	1	86.23	77.68	71.68	71.62	71.32	71.04	63.63	61.55	61.87	58.17	54.93
	2	92.54	66.68	64.02	64.02	63.74	64.29	54.97	53.14	52.89	50.43	47.81
	3	82.95	67.56	62.08	62.01	61.84	60.77	57.52	55.94	55.32	53.94	51.45
	4	89.14	67.03	59.36	59.28	59.01	58.60	53.04	51.57	50.15	49.90	48.10
	5	80.40	65.29	65.14	65.01	64.40	60.11	57.93	55.91	55.34	54.77	52.13
	6	87.21	67.38	62.32	62.03	60.30	48.90	47.31	45.14	44.96	44.58	43.15
	7	118.64	89.60	76.01	75.69	69.99	56.08	54.85	52.59	51.59	52.03	50.11
	8	134.62	99.67	88.17	86.60	82.60	70.50	63.88	61.81	61.22	60.77	58.42
	9	57.02	49.17	46.25	46.17	46.13	44.99	43.87	42.08	42.92	41.16	39.57
	10	64.29	58.92	57.26	57.19	56.74	54.09	48.65	47.52	46.23	47.09	43.07
	11	75.38	65.69	60.62	60.63	60.32	60.35	52.93	51.94	51.48	50.59	48.31
	12	76.29	66.97	58.87	58.79	58.28	60.43	42.44	42.28	39.64	40.78	39.55
2006 Average		87.06	70.14	64.32	64.09	62.89	59.18	53.42	51.79	51.13	50.35	48.05

A.2.

Memorandum

To: David Meyer, Poonum Agrawal CRA No. DOE 07-3

From: Alex Rudkevich

Date: January 17, 2007, Revised March 2, 2007

cc:

Subject: **IMPACT OF CONGESTION ON THE EFFICIENCY OF THE DISPATCH OF GENERATION CAPACITY IN PJM AND NEW YORK**

PJM

In this discussion, we divide PJM into two parts, East and West. PJM West includes AEP, APS, COMED, DAY, DUQ and PENELEC zones; PJM East includes the rest of the system (perhaps East and South PJM would be a more precise term to use). Thus defined PJM East and PJM West have approximately the same level of installed generation capacity. However, generation costs in PJM West are significantly lower than in PJM East as shown on Figure 1 which depicts supply curves for PJM East and PJM West based on CRA model data used for the year 2008 Base Case. As shown on that curve, for example, in PJM East approximately 40,000 MW is available at a cost of generation below $50/MWh. In the PJM West, over 60,000 MW is available below that same level.

Figure 1. PJM East and West Supply Curves (Using 2008 Model Data)

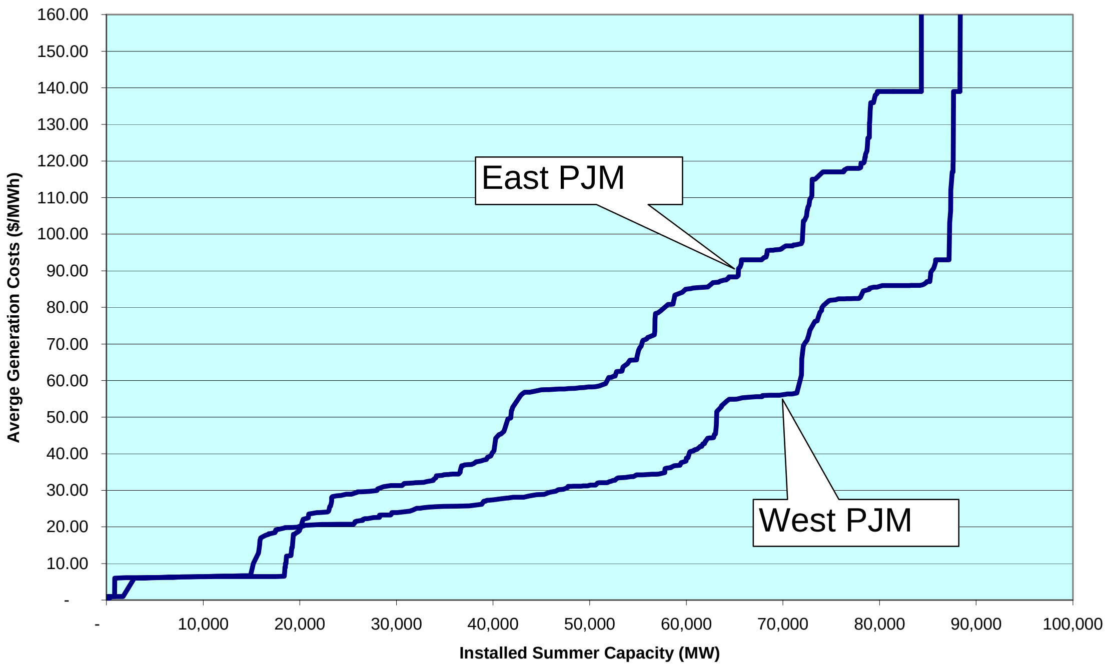
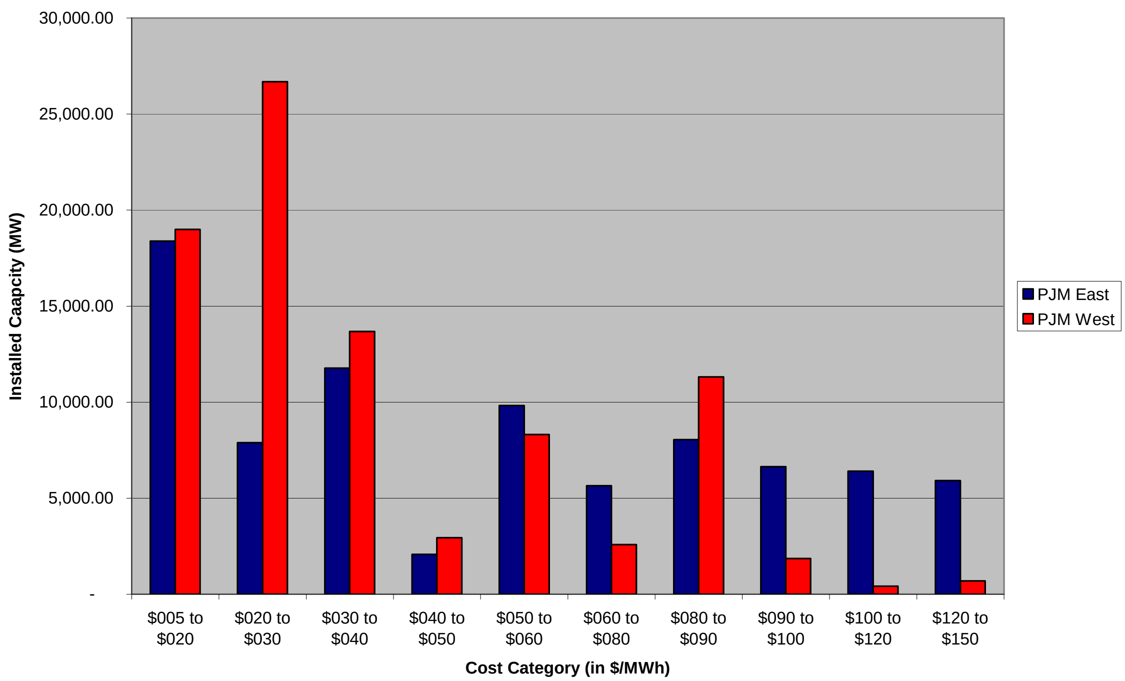


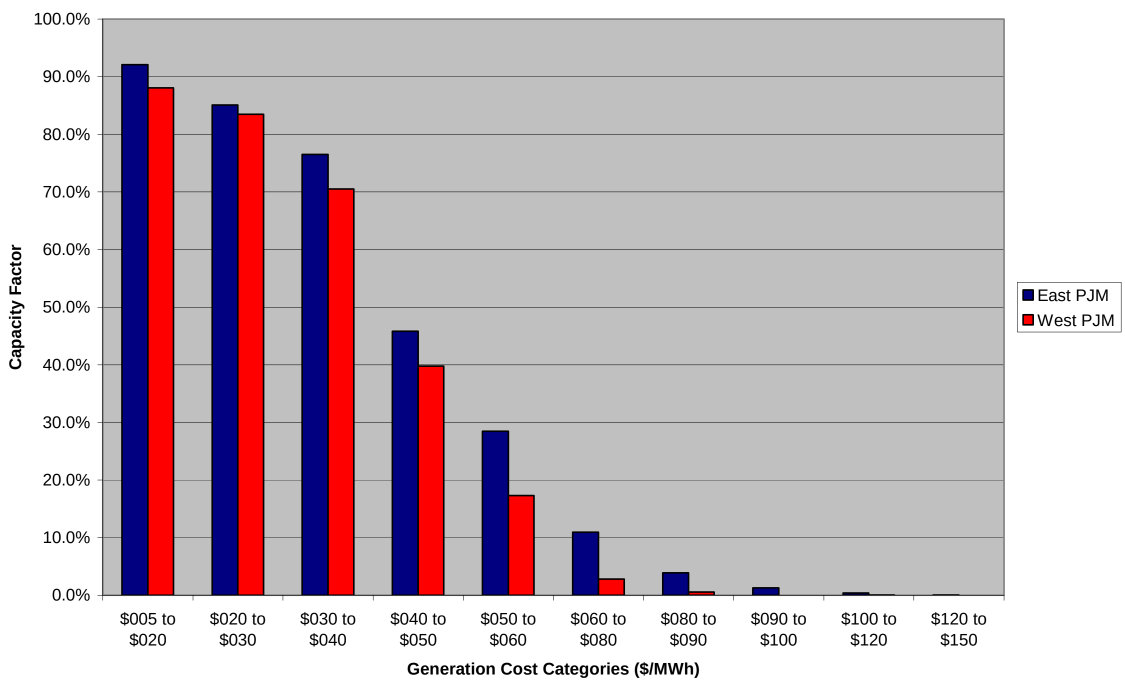
Figure 2 breaks installed capacity by cost category. As shown on that Figure, PJM East and West have nearly the same level of thermal capacity in the $5/MWh to $20/MWh cost category. PJM West dwarfs PJM East in the $20 to $30 range by nearly 20,000 MW of installed capacity. In the range of $30 to $90 both regions have comparable levels of installed capacity. In the over $90/MWh category, PJM East dominates PJM West by approximately 20,000 MW.

Figure 2. Installed Capacity by Cost Category PJM East vs. West



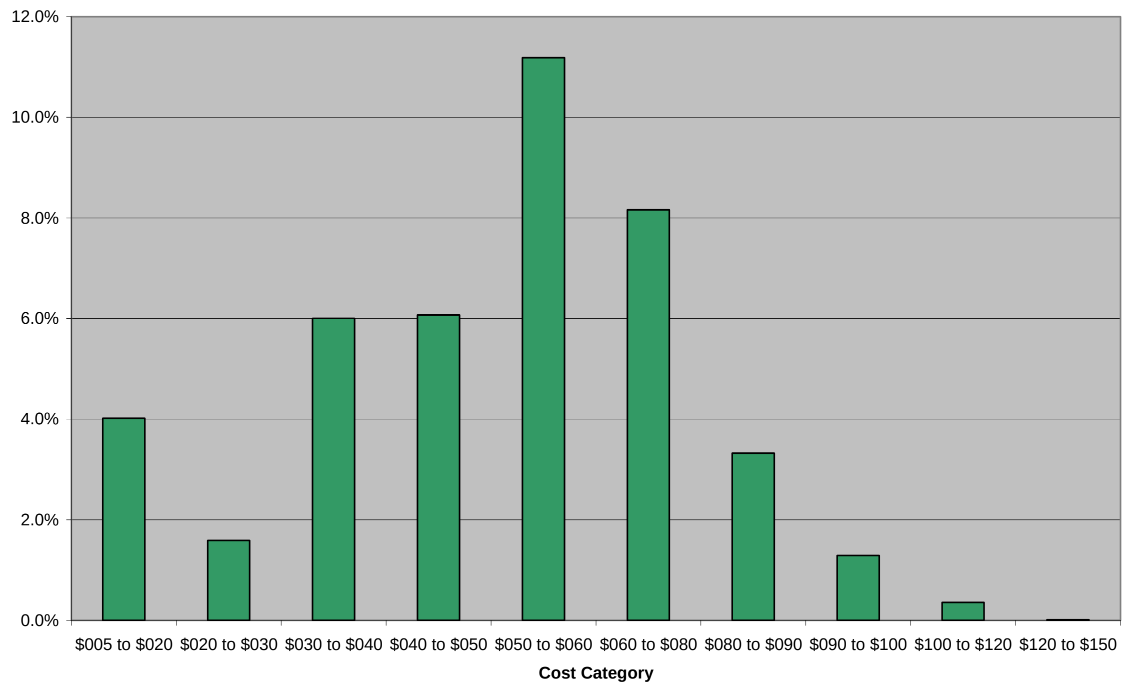
At the same time, the utilization of generation in the same costs category in PJM East is higher than in PJM West as shown on Figure 3 below which depicts capacity factors for PJM East and PJM West by cost category.

Figure 3. Capacity Factor by Resource Category: West PJM vs. East PJM



To highlight the difference in capacity factors, we plot the differentials by cost category in Figure 4.

Figure 4. Difference in Capacity Factors (PJM East minus PJM West)



The 4 per centage point difference in the "Under $20" category is not attributable to congestion but to the difference in maintenance scheduling for nuclear power plants between PJM East and PJM West. In the category of $20 to $30, there seems not to be much of a difference in capacity factors between in PJM East and PJM West, the dispatch of these generating units appears not to be affected by congestion. However, with the generation cost in excess of $30/MWh the difference in capacity factors between PJM East and PJM West is quite significant indicating that PJM East has to dispatch more relatively expensive generation whereas less expensive generation in PJM West is utilized less. This is a direct result of transmission congestion which prevents less expensive (and more efficient) generation in Western part of PJM from reaching consumers in Eastern PJM. They are then served by more expensive (and less efficient) generation installed in the Eastern part of the system.
These modeling results are supported by available actual dispatch data as shown in Tables 1a and 1b below. In Table 1a, we selected a set of all large (over 200 MW) coal-fired plants in PJM West that fall in the $30 to $40/MWh cost category for which actual generation data were available through CEMS. The total capacity in this sample adds to over 9000 MW (out of approximately 13,700 MW in that category).

As shown in this table, CRA simulations correctly reflect the under-utilization of these generating units compared to actual performance.

Table 1a. Simulated vs. Actual Capacity Factors for a Sample of Large Coal Fired Generating Plants in PJM West

Plant	Zone	Capacity (MW)	Simulated Capacity Factor	Actual Capacity Factor -2004	Actual Capacity Factor -2005	Actual Capacity Factor -2006
Armstrong	APS	343	57%	69%	67%	61%
Cardinal	AEP	1800	77%	68%	71%	69%
Conesville	AEP	1695	70%	53%	44%	66%
Hatfield's Ferry	APS	1466	70%	60%	62%	69%
J M Stuart	DAY	2340	68%	71%	70%	74%
Kanawha River	AEP	390	63%	58%	61%	62%
Muskingum River	AEP	790	58%	62%	56%	59%
Willow Island	APS	235	39%	29%	29%	34%
Subtotal	West PJM	9059	68%	63%	61%	67%

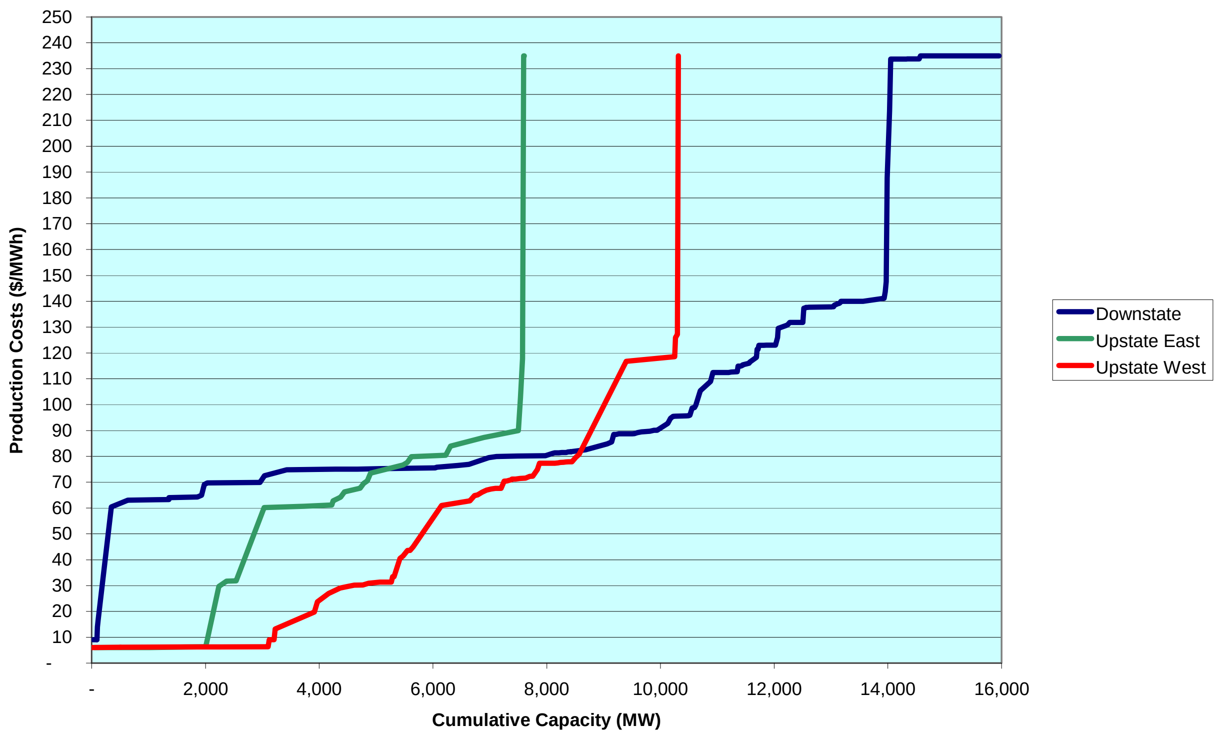
Similarly, in Table 1b we selected a set of large (over 200 MW) coal-fired plants in Eastern PJM that fall in the $30 to $40/MWh cost category for which actual generation data were available through CEMS. The total capacity in this sample adds to over 7,000 MW (out of approximately 11,700 MW in that category).
As shown in this table, CRA simulations correctly reflect the utilization level of these generating units compared to their historical actual performance as well as a comparative performance of these generating plants against similar assets in Western PJM. Simulation data show that for these two samples, units in the east have average capacity factor higher than the units in the west by 11 per cent points. Similar comparisons for 2004, 2005 and 2006 indicate the difference of 11 per cent points, 18 per cent points and 10 per cent points, respectively.

Plant	Zone	Capacity (MW)	Simulated Capacity Factor	Actual Capacity Factor -2004	Actual Capacity Factor -2005	Actual Capacity Factor -2006
Brandon	BGE	1300	77%	75%	75%	81%
Chalk Point	PEPCO	683	75%	71%	67%	62%
Chesterfield	DOM	1250	73%	66%	75%	73%
Dickerson	PEPCO	546	78%	69%	70%	64%
Keystone	PENELEC	1700	80%	83%	91%	82%
Montour	PPL	1495	85%	75%	85%	87%
Wagner	BGE	324	84%	64%	78%	59%
Subtotal	East PJM	7298	79%	74%	79%	77%

New York

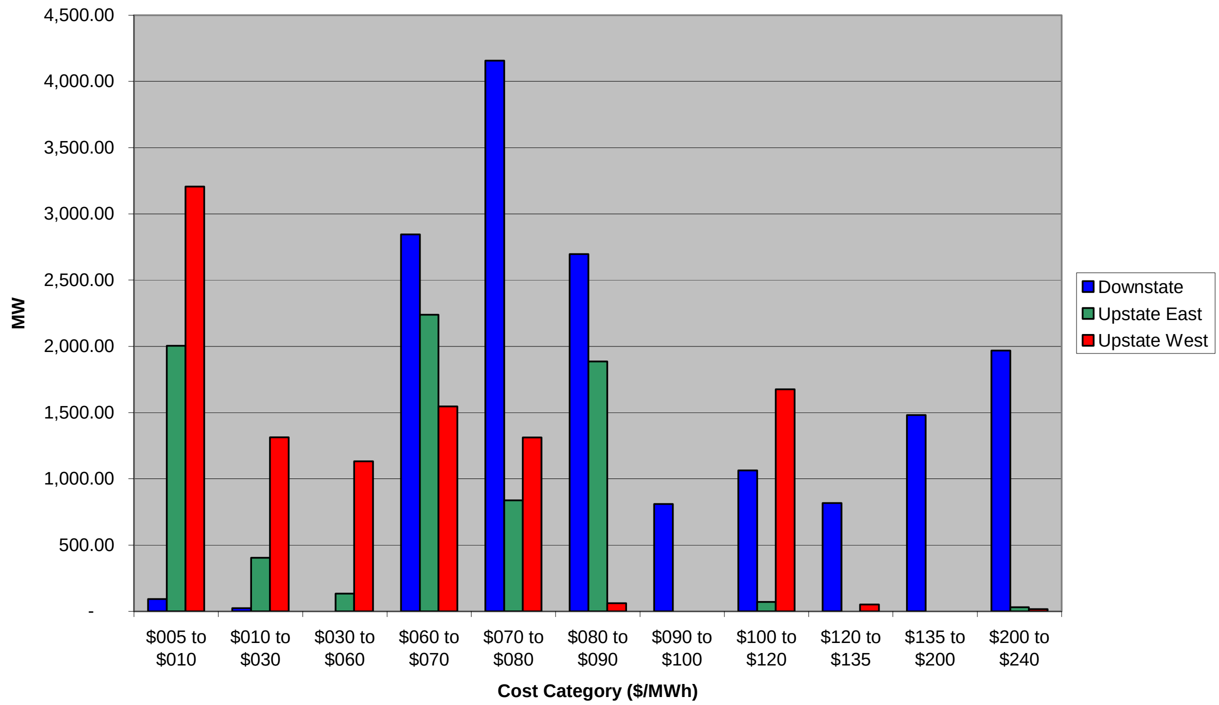
Transmission congestion in New York is complicated. In order to analyze the patterns or under-utilized generation due to congestion, it is helpful to consider three regions: Upstate West (zones A through E), Upstate East (Zones F through I), Downstate (Zones J and K). Figure 5 presents supply curves for these three regions based on CRA model data used for the year 2008 Base Case.

Figure 5. NYISO Supply Curves (Excluding Hydro) Using 2008 Model Data



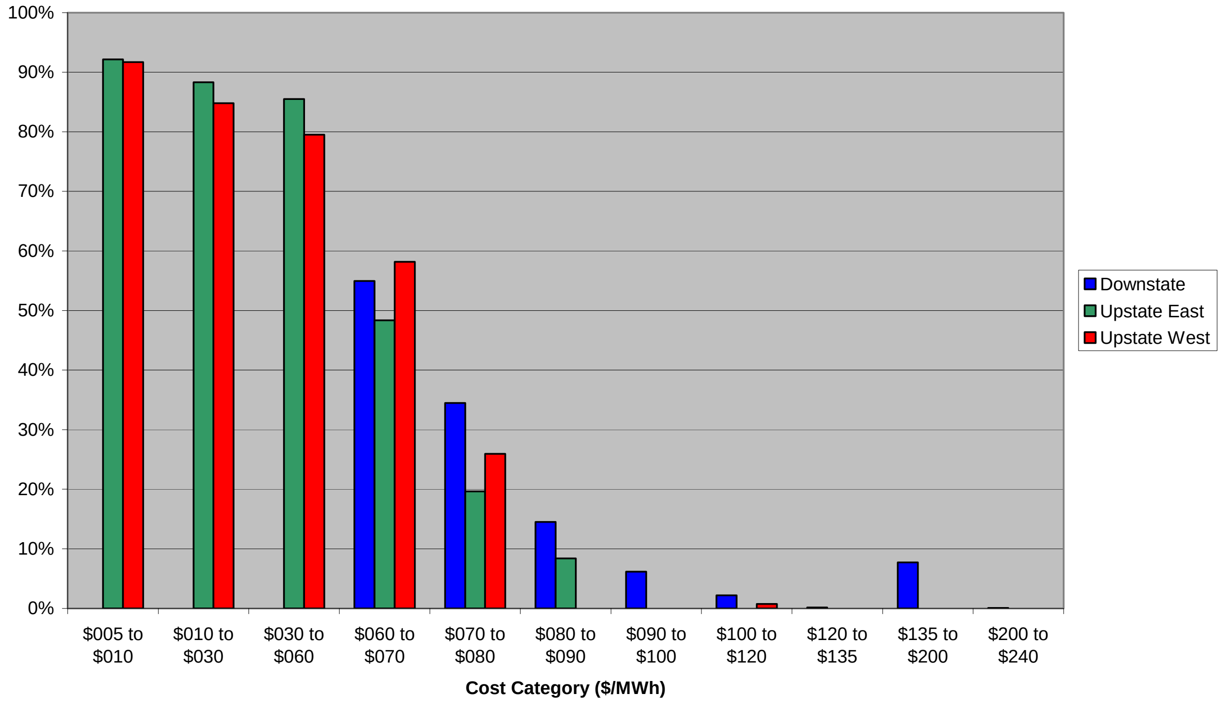
As shown on that Figure, Downstate New York has almost no generation capacity in the under $60/MWh cost range. Upstate West has approximately 5600 MW of non-hydro capacity in that range, Upstate East has another 2500 MW of “under $60/MWh” non-hydro capacity. A more detailed analysis of non-hydro capacity by regions by cost category is presented on Figure 6.

Figure 6. NYISO: Installed Thermal Capacity by Region and by Cost Category (Using 2008 Base Case Model Data)



The $5 to $10 category corresponds to approximately 5000 MW of nuclear capacity located in the Upstate regions (~2000 MW in the East and ~3000 MW in the West), and a small level of biomass/refuse generating capacity spread over the system. Upstate dominates the supply in the $10 to $30 and $30 to $60 cost categories. Downstate essentially dominates the market in almost every cost category starting at the level of $60/MWh and above. The degree of congestion in the system is visible through the comparison of capacity factors by region by cost category presented on Figure 7.

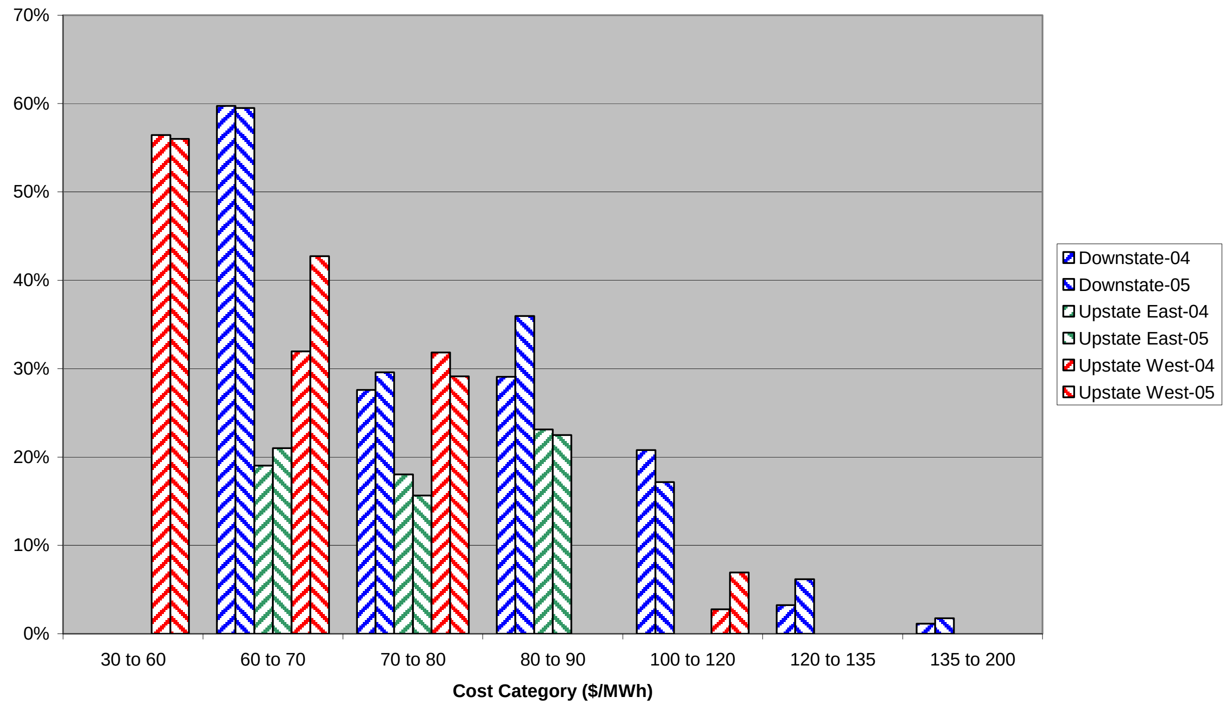
Figure 7. NYISO: Capacity Factor by Region and by Cost Category (Using 2008 Base Case Model Data)



Capacity in the "5 to 10" cost category is dispatched at over 90% capacity factor both in East and West, no congestion problems here. Generation in the "10 to 30" category is also dispatched everywhere at capacity factors above 85% and does not appear to be affected by congestion. We begin to detect congestion impact in the "30 to 60" cost category with generation in the West operating at a capacity factor under 80%, i.e. below the level explained by assumed outage rates and maintenance schedules. Next we see congestion between Upstate East and Downstate in the "60 to 70" cost category. Congestion is even more visible in the higher cost categories (over $70/MWh).

In general the same patterns shown in the modeled 2008 congestion pattern can be observed in reality as shown on Figure 8 which depicts actual capacity factors for years 2004 and 2005 based on a sample of the largest plants in each of the cost categories with $30/MWh and higher.

Figure 8. NYISO: Capacity Factors by Region and by Cost Category (Based on Sample 2004 and 2005 Data)



As shown on Figure 8, historical congestion in 2004-2005 appears more pronounced than that modeled for 2008. This is understandable, because the 2008 model results include a large number of changes to the system in comparison to conditions observed over the 2004-2005 period. These include approximately 2300 MW of new generating capacity added (or assumed to be added) between 2005 and 2008 . Of these about 1000 MW of new generation has been added in New York City in 2006 (Poletti Expansion and SCS Astoria 1), and another 250 MW (Spagnoli Road) is assumed to be added in Long Island in 2008; 700 MW of Bethlehem Combined Cycle capacity was added in Zone F (Upstate East) in the middle of 2005. In addition, by 2008 we assumed the Neptune DC Cable has become operational. These changes are expected to reduce congestion between Upstate East and Downstate regions compared to that observed historically for 2004-2005.

In sum, both the actual data and simulation results indicate that generating capacity in Upstate New York is under-utilized due to transmission congestion and not always available to serve consumers in Downstate New York. We observe under-utilized capacity in the low cost category (30 to 60) in Upstate West, in the “60 to 70” and “70 to 80” cost category both in East and West Upstate, in “80 to 90” cost category in East Upstate.

In addition, transmission congestion in New York, constraints between New York and PJM, and between New York and Ontario limit the availability of low cost generation in Northern Pennsylvania (PENELEC) and in Ontario to serve consumers in New York.

/ar

A.3.

Memorandum

To:	Poonum Agrawal and David Meyer	CRA No.	DOE 07-2
From:	Alex Rudkevich		
Date:	January 18, 2006, Revised March 2, 2007		
cc:			
Subject:	**ICAP AND TRANSMISSION IN NYISO**		

The NYISO Capacity Markets

The NYISO operates a number of capacity markets under its FERC tariff. The objective of these capacity markets is to ensure that New York is able to meet the reliability standards set up by the New York State Reliability Council (NYSRC). The NYSRC was created by New York State law and is charged with setting the reliability standards to be used by the NYISO in operating its markets.

The capacity product in New York is called Unforced Capacity (UCAP). In simplified terms, for any capacity resource selling power its installed capacity (ICAP) is adjusted by the effective forced outage rate to calculate UCAP. Since this proportion is fixed then ICAP and UCAP generally differ by a multiplicative factor of approximately 5% for NYC and the New York Control Area (NYCA) as a whole and 4% for Long Island (LI).

Under the FERC tariff, every load-serving entity is required to meet its proportion of the state's minimum UCAP requirement by either contracting with suppliers, or purchasing capacity in the NYISO-administered auctions. For the state, the NYISO sets the total amount of installed capacity to be purchased at 118% of the forecast peak load for the year[3]. This is then converted into a UCAP value. Sellers make offers to supply UCAP at prices expressed in $/kW-month. The NYISO then clears the offers to buy or sell in a single clearing price auction.

UCAP is sold through a series of sequential auctions. A strip auctions take place at the beginning of each summer or winter 6-months capability period and covers the entire period. These are followed by monthly auctions, each covering the remaining portion of the capability period and then by spot auctions, covering only the immediate month. Prices in the strip and monthly auctions are driven purely by demand bids and supply offers.

In the spot auction, the NYISO has implemented a demand curve methodology for setting UCAP prices. The demand curve reflects the fact that the marginal economic value of additional capacity reserves is not zero just above the set target of peak plus the specified reserve margin, and the value of reserves below that level is not indefinite. The demand curve fixes a reference price at the target value that is a maximum value for UCAP set to be revised every three years in accordance with the NYISO Services Tariff. The reference and maximum price parameters of the demand curve are currently established through the 2007/08 Capability Year; after that the parameters will be established by an independent review panel. These values will be revised

[3] The reserve margin requirements are reset annually by NYSRC

based on the assessed local levelized cost of a gas turbine unit.

Locational ICAP Requirements

Substantial transmission constraints often prevent power from flowing from upstate New York to the New York City and Long Island regions. If load-serving entities (LSEs) could contract for capacity across the NYISO, without reference to location, then reliability could be imperiled as there would be no assurance that all of the capacity could actually be delivered on the transmission system. To account for these major transmission constraints the NYISO has implemented special locational UCAP requirements for New York City and Long Island.

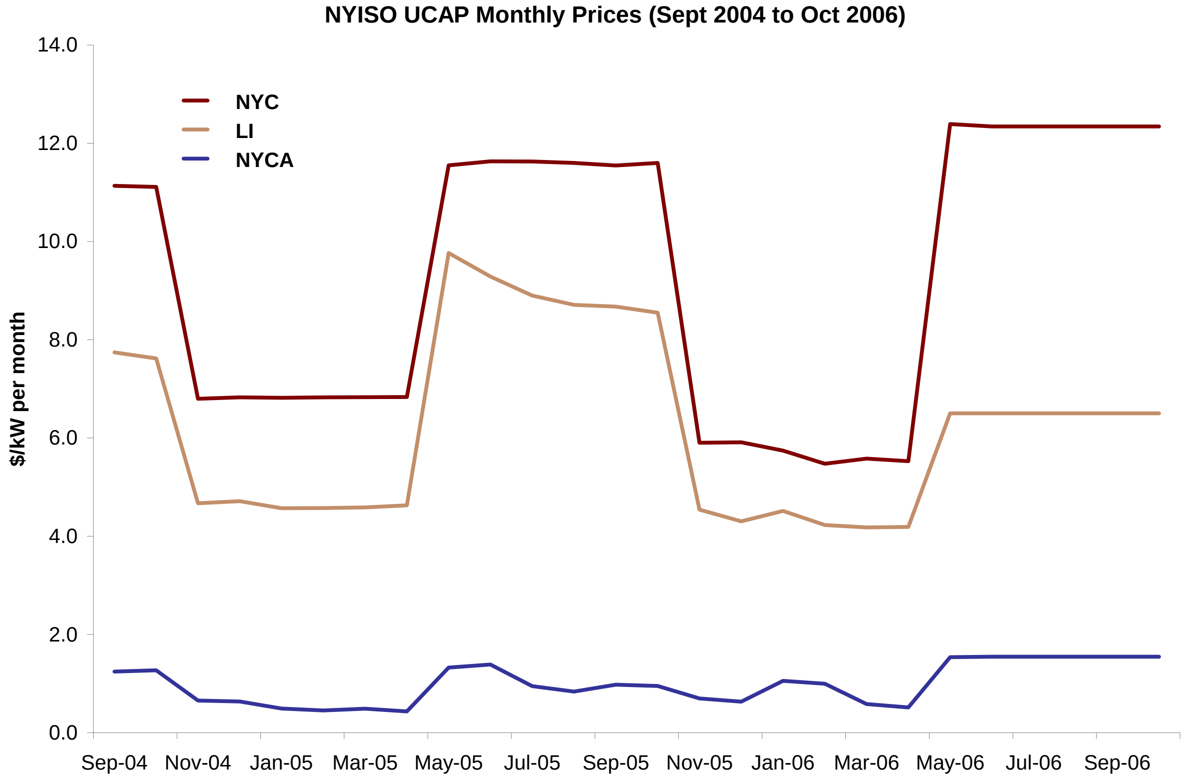
For these two zones, NYISO rules require that local LSEs must procure a fixed percentage of their total capacity requirement from suppliers within their zone. For New York City, LSEs are required to purchase 80% of their peak load requirements from local suppliers. For example, if the peak demand in New York City is 12,000 MW, the overall ICAP requirement for local LSEs for NYC load is 14,160 MW (118% of 12,000) of which they will be required to purchase 9,600 MW (80% of 12,000) of capacity from suppliers electrically located in New York City. In other words, approximately 2/3 (80/118) of In-City ICAP requirements must be procured from In-City generation, the remaining ~1/3 (38/118) could be procured elsewhere.

For Long Island 99% of peak load must be met from local supplies. These locational requirements are established by the NYISO in the Locational Installed Capacity Requirements Study based on a probabilistic analysis carried out with the use of the GE-MARS model.

This constraint requires the NYISO to clear three separate markets in the UCAP auctions: the New York Control Area (all of NYISO), New York City, and Long Island. When the constraints bind, UCAP prices in New York City and Long Island are higher than in the Rest of State (ROS) part of the market.

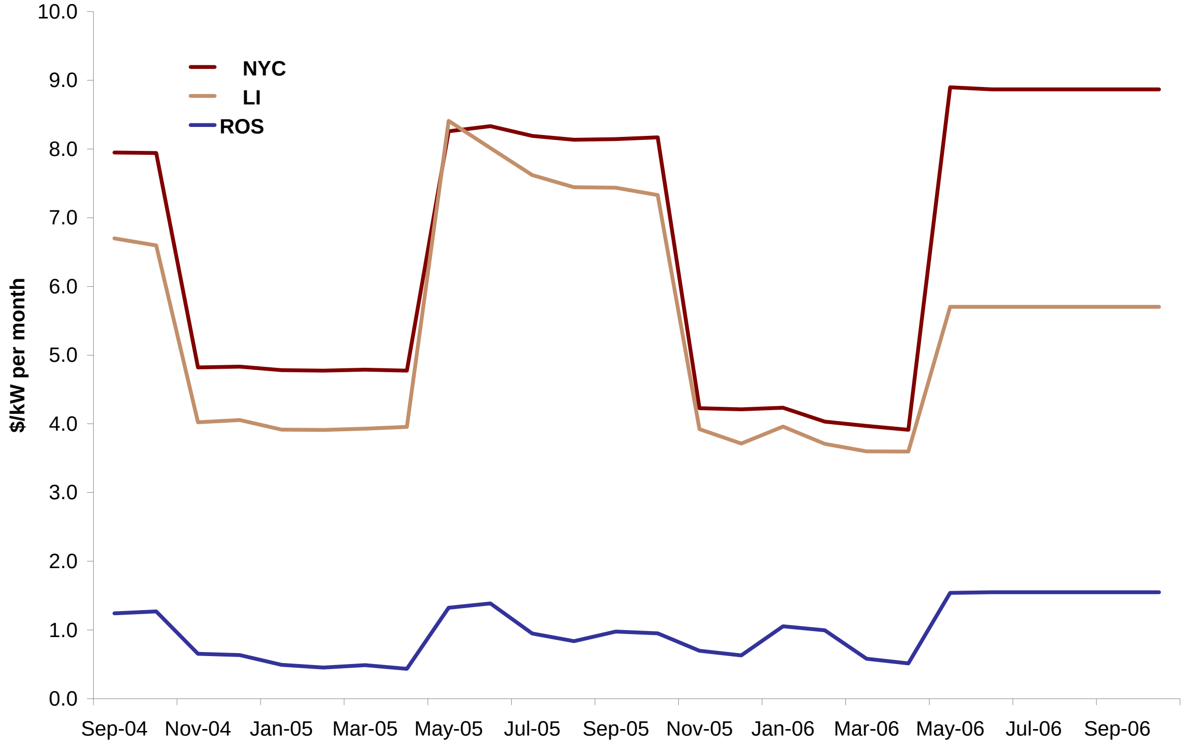
According to the 2006 Revised Locational Installed Capacity Requirements Study, "*In general, all else being equal, as the amount of load in the zone relative to the available transfer capacity into the zone and the amount of supply resources in the zone increases, a point is reached where the locational capacity requirement must increase or the transfer capability into the load zone must be increased – i.e., how long can you continue to meet a MW of load growth with 0.8 MW of capacity before you have to increase transfer capacity into a zone or increase the locational resource requirement? This point has not been reached for the New York City load zone while the Long Island zone has increased from its previous low point.*" Thus, the transfer capability of transmission into the constrained zone is a critical factor in determining the level of local capacity required to meet location ICAP needs.

Locational needs, in turn, create a dramatic spread in the UCAP prices faced by loads served in the three different parts of the market, as shown on the Figure 1 below which depicts average across multiple auctions prices for each locality over the last 26-month period



UCAP auction prices in New York City exceed prices applied to capacity procured from generators in the ROS by factor of 10 during summer months and by factor of 5 during winter months. Thus, loads in New York City would effectively pay a weighted average of approximately 2/3 of the NYC UCAP price and 1/3 of the NYCA UCAP Price. Consumers in Long Island would effectively pay a blended price of 99/118 of the Long Island auction price and 19/118 of the NYCA auction price. Consumers in the ROS would pay the NYCA auction price. A comparison of effective UCAP prices seen by consumers in New York is shown on Figure 2 below. The effective price of capacity in New York City, shown on that Figure, is approximately 6.7 times higher than that in ROS. The effective price of capacity in Long Island, shown on that Figure, is approximately 5.4 times higher than that in ROS.

Figure 2. Effective UCAP Prices by Zone (Sept 2004 to Oct 2006)



Attached Tables 1 and 2 provide numerical data used to develop Figures 1 and 2.

Table 1. Summarized Auction Prices by Locality

Average of UCAP Auction Prices ($.kW-mo)			
Period Start	NYC	LI	NYCA
9/1/04	11.13	7.74	1.24
10/1/04	11.11	7.62	1.27
11/1/04	6.80	4.67	0.65
12/1/04	6.82	4.71	0.64
1/1/05	6.82	4.57	0.50
2/1/05	6.82	4.58	0.45
3/1/05	6.83	4.59	0.49
4/1/05	6.83	4.63	0.44
5/1/05	11.55	9.77	1.32
6/1/05	11.63	9.28	1.39
7/1/05	11.63	8.90	0.95
8/1/05	11.60	8.71	0.84
9/1/05	11.55	8.67	0.98
10/1/05	11.60	8.55	0.95
11/1/05	5.90	4.54	0.70
12/1/05	5.91	4.31	0.63
1/1/06	5.74	4.52	1.06
2/1/06	5.47	4.23	1.00
3/1/06	5.58	4.18	0.58
4/1/06	5.53	4.19	0.52
5/1/06	12.39	6.50	1.54
6/1/06	12.34	6.50	1.55
7/1/06	12.34	6.50	1.55
8/1/06	12.34	6.50	1.55
9/1/06	12.34	6.50	1.55
10/1/06	12.34	6.50	1.55

Table 2. Effective Prices by Zone

Effective UCAP Prices ($/kW-mo)			
	NYC	LI	ROS
9/1/04	$ 7.95	$ 6.70	$ 1.24
10/1/04	$ 7.94	$ 6.60	$ 1.27
11/1/04	$ 4.82	$ 4.02	$ 0.65
12/1/04	$ 4.83	$ 4.06	$ 0.64
1/1/05	$ 4.78	$ 3.91	$ 0.50
2/1/05	$ 4.77	$ 3.91	$ 0.45
3/1/05	$ 4.79	$ 3.93	$ 0.49
4/1/05	$ 4.77	$ 3.95	$ 0.44
5/1/05	$ 8.26	$ 8.41	$ 1.32
6/1/05	$ 8.33	$ 8.01	$ 1.39
7/1/05	$ 8.19	$ 7.62	$ 0.95
8/1/05	$ 8.13	$ 7.44	$ 0.84
9/1/05	$ 8.14	$ 7.43	$ 0.98
10/1/05	$ 8.17	$ 7.33	$ 0.95
11/1/05	$ 4.23	$ 3.92	$ 0.70
12/1/05	$ 4.21	$ 3.71	$ 0.63
1/1/06	$ 4.23	$ 3.96	$ 1.06
2/1/06	$ 4.03	$ 3.71	$ 1.00
3/1/06	$ 3.97	$ 3.60	$ 0.58
4/1/06	$ 3.91	$ 3.60	$ 0.52
5/1/06	$ 8.90	$ 5.70	$ 1.54
6/1/06	$ 8.87	$ 5.70	$ 1.55
7/1/06	$ 8.87	$ 5.70	$ 1.55
8/1/06	$ 8.87	$ 5.70	$ 1.55
9/1/06	$ 8.87	$ 5.70	$ 1.55
10/1/06	$ 8.87	$ 5.70	$ 1.55

A.4.

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2/16/2007

General Approach

- This presentation described how the maps of problem transmission constraints in PJM and NYISO have been developed
- Constraints were grouped in two major categories – source (or supply) driven and sink (or demand) driven. Many constraints are both source and sink driven
- *Source driven constraints* are identified as those that are most limiting transfer of power through pathways originating at source nodes containing generators with under-utilized capacity. See a separate CRA memorandum “Impact of Congestion on the Efficiency of the Dispatch of Generation Capacity in PJM and New York” which describes how these source nodes were identified
- *Sink driven constraints* are identifies as those that are most limiting delivery of power through pathways leading to sink nodes with highest LMPs. See a separate CRA memorandum “Analysis of implications of transmission congestion in PJM and NYISO” which describes how these sink nodes were identified

Geographical attributes and the naming convention for Nodes

- **Geographical coordinates for generator and load buses at the substation level were provided by the University of Illinois**
- **CRA then used a GIS database to identify the state, county and nearest metropolitan statistical area (MSA) for each bus as well as basic population and economic statistics**
- **GIS information was used to develop a naming convention for hubs:**
  - node name =
    ACPF area name +
    unique cluster number +
    identifier such as
      "MSA" if hub weight is predominantly in that MSA, or
      "County" if hub weight is predominantly in that county or
      "STA" if only the state name is apparent or
      "GEN" if cluster is named after the largest generating unit it contains the
    name of the identifier +
    "G" for clusters with higher generation weight and "L" for clusters with higher load weight

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Mapping of Nodes Containing Underused Generators

- **We identified major nodes containing under-utilized generators in PJM**
- **Using GIS data, we identified counties "crossed" by those nodes and identified those counties on the map**
- **We used different colors for different ACPF areas**
- **Some generators did not belong to a major node. For those we identified an ACPF area and a county containing that generator and placed that county on a map with the ACPF color**

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The Top Pathways are Defined Using a Screening Methodology that pares sources and sinks (The Results of Task 2 of the CRA Study)

- **The screening rules applied to the pathways:**
  - All source nodes should have at least 1000 MW of maximum net injection
  - All sink nodes should have at least 1000 MW of maximum net withdrawal
  - Over a year there should be at least a $1/MWh average price differential between a source and a sink

Pathways

- **The following pathways were identified**
- **All pathways originating at nodes containing under-utilized generation in PJM (and Eastern MISO) and NYISO. These are PJM and NYISO Source driven pathways, respectively**
  - The Eastern MISO portion was determined as pathways originating at singinficant source node in MISO and leading to significant sink nodes in PJM
- **We identified all pathways terminating at high price nodes in PJM (PJM sink driven pathways) and in NYISO (NYISO sink driven pathways)**

PJM Source Driven Pathways

Source	Source Node	Sink	Sink Node
PJM	AEP_8_GEN_Amos01_G	PJM	AEP_1_MSA_Lynchburg_G
PJM	AEP_8_GEN_Amos01_G	PJM	AEP_2_STA_TN-WV_L
PJM	AEP_8_GEN_Amos01_G	PJM	AP_7_MSA_Hagerstown-Martinsburg_L
PJM	AEP_8_GEN_Amos01_G	PJM	AP_8_MSA_DC-VA-MD_L
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_27_MSA_DC_L
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_33_MSA_DC_L
PJM	AP_1_County_Harrison_G	PJM	AP_7_MSA_Hagerstown-Martinsburg_L
PJM	AP_1_County_Harrison_G	PJM	AP_8_MSA_DC-VA-MD_L
PJM	AP_1_County_Harrison_G	PJM	PEPCO_1_MSA_DC_L
PJM	AP_1_County_Harrison_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	AP_1_County_Harrison_G	PJM	VAP_27_MSA_DC_L
PJM	AP_1_County_Harrison_G	PJM	VAP_33_MSA_DC_L
PJM	DLCO_7_MSA_Pittsburgh_G	PJM	AEP_9_MSA_Canton-Massillon_L
PJM	DLCO_7_MSA_Pittsburgh_G	PJM	AP_2_GEN_Albright3_L
PJM	DLCO_7_MSA_Pittsburgh_G	PJM	AP_7_MSA_Hagerstown-Martinsburg_L
PJM	DLCO_7_MSA_Pittsburgh_G	PJM	AP_8_MSA_DC-VA-MD_L
PJM	DPL_8_GEN_Killen_G	PJM	AEP_1_MSA_Lynchburg_G
PJM	DPL_8_GEN_Killen_G	PJM	AEP_2_STA_TN-WV_L
PJM	EKPC_8_MSA_Maysville_G	PJM	AEP_2_STA_TN-WV_L
PJM	NI_6_MSA_Chicago_G	PJM	AEP_1_MSA_Lynchburg_G
PJM	NI_6_MSA_Chicago_G	PJM	AEP_2_STA_TN-WV_L

PJM Source Driven Pathways (Cont'd)

Source	Source Node	Sink	Sink Node
PJM	NI_6_MSA_Chicago_G	PJM	AEP_9_MSA_Canton-Massillon_L
PJM	PENELEC_2_MSA_DuBois_G	PJM	PL_7_MSA_Allentown_L
MISO	FE_6_MSA_Pittsburgh_G	PJM	AEP_1_MSA_Lynchburg_G
MISO	FE_6_MSA_Pittsburgh_G	PJM	AEP_2_STA_TN-WV_L
MISO	FE_6_MSA_Pittsburgh_G	PJM	AEP_9_MSA_Canton-Massillon_L
MISO	FE_6_MSA_Pittsburgh_G	PJM	AP_2_GEN_Albright3_L
MISO	FE_6_MSA_Pittsburgh_G	PJM	AP_7_MSA_Hagerstown-Martinsburg_L
MISO	FE_6_MSA_Pittsburgh_G	PJM	AP_8_MSA_DC-VA-MD_L
MISO	FE_9_MSA_Weirton_G	PJM	AEP_1_MSA_Lynchburg_G
MISO	FE_9_MSA_Weirton_G	PJM	AEP_2_STA_TN-WV_L
MISO	FE_9_MSA_Weirton_G	PJM	AP_2_GEN_Albright3_L
MISO	FE_9_MSA_Weirton_G	PJM	AP_2_GEN_Albright3_L
MISO	FE_9_MSA_Weirton_G	PJM	AP_7_MSA_Hagerstown-Martinsburg_L
MISO	FE_9_MSA_Weirton_G	PJM	AP_8_MSA_DC-VA-MD_L
MISO	IPL_2_MSA_Jasper_G	PJM	AEP_1_MSA_Lynchburg_G
MISO	IPL_2_MSA_Jasper_G	PJM	AEP_2_STA_TN-WV_L
MISO	IPL_2_MSA_Jasper_G	PJM	AEP_9_MSA_Canton-Massillon_L
MISO	NIPS_8_MSA_Chicago_G	PJM	AEP_1_MSA_Lynchburg_G
MISO	NIPS_8_MSA_Chicago_G	PJM	AEP_2_STA_TN-WV_L
MISO	NIPS_8_MSA_Chicago_G	PJM	AEP_2_STA_TN-WV_L
MISO	NIPS_8_MSA_Chicago_G	PJM	AEP_9_MSA_Canton-Massillon_L

PJM Sink Driven Pathways

Source	Source Node	Sink	Sink Node
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	BGE_10_MSA_Baltimore-Towson_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	BGE_10_MSA_Baltimore-Towson_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	BGE_5_MSA_Baltimore-Towson_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	BGE_5_MSA_Baltimore-Towson_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	BGE_9_MSA_Baltimore-Towson_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	BGE_9_MSA_Baltimore-Towson_L
PJM	PL_8_MSA_Allentown_G	PJM	JCPL_1_MSA_NewYork_L
PJM	BGE_7_MSA_Baltimore-Towson_G	PJM	PECO_5_MSA_Philadelphia_L
PJM	PJM500_4_MSA_Philadelphia_G	PJM	PECO_5_MSA_Philadelphia_L
PJM	PJM500_7_MSA_York-Hanover_G	PJM	PECO_5_MSA_Philadelphia_L
PJM	AP_1_County_Harrison_G	PJM	PEPCO_1_MSA_DC_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	PEPCO_1_MSA_DC_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	PEPCO_1_MSA_DC_L
PJM	PENELEC_2_MSA_DuBois_G	PJM	PL_7_MSA_Allentown_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	PL_7_MSA_Allentown_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	PL_7_MSA_Allentown_L
NYPP	NYISO_1_NYA	PJM	PSEG_3_MSA_NewYork_L
NYPP	NYISO_3_NYC	PJM	PSEG_3_MSA_NewYork_L
PJM	PJM500_4_MSA_Philadelphia_G	PJM	PSEG_3_MSA_NewYork_L
NYPP	NYISO_1_NYA	PJM	PSEG_5_MSA_Philadelphia_L
NYPP	NYISO_3_NYC	PJM	PSEG_5_MSA_Philadelphia_L

PJM Sink Driven Pathways (cont'd)

Source	Source Node	Sink	Sink Node
NYPP	NYISO_1_NYA	PJM	PSEG_8_MSA_NewYork_G
NYPP	NYISO_3_NYC	PJM	PSEG_8_MSA_NewYork_G
PJM	PJM500_4_MSA_Philadelphia_G	PJM	PSEG_8_MSA_NewYork_G
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	AP_1_County_Harrison_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	VAP_7_G	PJM	VAP_15_MSA_VB-Norfolk_L
VACAR	CPLE_1_MSA_Durham_G	PJM	VAP_15_MSA_VB-Norfolk_L
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_27_MSA_DC_L
PJM	AP_1_County_Harrison_G	PJM	VAP_27_MSA_DC_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	VAP_27_MSA_DC_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	VAP_27_MSA_DC_L
PJM	VAP_1_MSA_Richmond_G	PJM	VAP_27_MSA_DC_L
PJM	VAP_7_G	PJM	VAP_27_MSA_DC_L
VACAR	CPLE_1_MSA_Durham_G	PJM	VAP_27_MSA_DC_L
PJM	AEP_8_GEN_Amos01_G	PJM	VAP_33_MSA_DC_L
PJM	AP_1_County_Harrison_G	PJM	VAP_33_MSA_DC_L
PJM	PJM500_3_MSA_Pittsburgh_G	PJM	VAP_33_MSA_DC_L
PJM	PJM500_9_MSA_Pittsburgh_G	PJM	VAP_33_MSA_DC_L
PJM	VAP_1_MSA_Richmond_G	PJM	VAP_33_MSA_DC_L
PJM	VAP_7_G	PJM	VAP_33_MSA_DC_L
VACAR	CPLE_1_MSA_Durham_G	PJM	VAP_33_MSA_DC_L

NYISO Source Driven Pathways

Source	Source Node	Sink	Sink Node
NYPP	NYISO_1_NYA	NYPP	NYISO_11_NYK
NYPP	NYISO_1_NYA	NYPP	NYISO_10_NYJ
NYPP	NYISO_1_NYA	NYPP	NYISO_9_NYI
NYPP	NYISO_1_NYA	NYPP	NYISO_7_NYG
NYPP	NYISO_3_NYC	NYPP	NYISO_11_NYK
NYPP	NYISO_3_NYC	NYPP	NYISO_10_NYJ
NYPP	NYISO_3_NYC	NYPP	NYISO_9_NYI
NYPP	NYISO_6_NYF	NYPP	NYISO_11_NYK
NYPP	NYISO_6_NYF	NYPP	NYISO_10_NYJ
NYPP	NYISO_6_NYF	NYPP	NYISO_9_NYI
NYPP	NYISO_8_NYH	NYPP	NYISO_11_NYK
NYPP	NYISO_3_NYC	NYPP	NYISO_7_NYG
NYPP	NYISO_8_NYH	NYPP	NYISO_10_NYJ
NYPP	NYISO_8_NYH	NYPP	NYISO_9_NYI
NYPP	NYISO_6_NYF	NYPP	NYISO_7_NYG

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NYISO Sink Driven Pathways

Source	Source Node	Sink	Sink Node
NEPOOL	NEPOOL_2_NH	NYPP	NYISO_10_NYJ
NEPOOL	NEPOOL_5_SEMA	NYPP	NYISO_10_NYJ
NEPOOL	NEPOOL_7_CT	NYPP	NYISO_10_NYJ
NYPP	NYISO_1_NYA	NYPP	NYISO_10_NYJ
NYPP	NYISO_3_NYC	NYPP	NYISO_10_NYJ
NYPP	NYISO_6_NYF	NYPP	NYISO_10_NYJ
NYPP	NYISO_8_NYH	NYPP	NYISO_10_NYJ
ONTARIO	IESO_15_G	NYPP	NYISO_10_NYJ
ONTARIO	IESO_6_G	NYPP	NYISO_10_NYJ
ONTARIO	IESO_7_G	NYPP	NYISO_10_NYJ
PJM	PENELEC_2_MSA_DuBois_G	NYPP	NYISO_10_NYJ
NEPOOL	NEPOOL_2_NH	NYPP	NYISO_11_NYK
NEPOOL	NEPOOL_5_SEMA	NYPP	NYISO_11_NYK
NEPOOL	NEPOOL_7_CT	NYPP	NYISO_11_NYK
NYPP	NYISO_1_NYA	NYPP	NYISO_11_NYK
NYPP	NYISO_3_NYC	NYPP	NYISO_11_NYK
NYPP	NYISO_6_NYF	NYPP	NYISO_11_NYK
NYPP	NYISO_8_NYH	NYPP	NYISO_11_NYK
ONTARIO	IESO_15_G	NYPP	NYISO_11_NYK
ONTARIO	IESO_6_G	NYPP	NYISO_11_NYK
ONTARIO	IESO_7_G	NYPP	NYISO_11_NYK
PJM	PENELEC_2_MSA_DuBois_G	NYPP	NYISO_11_NYK

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NYISO Sink Driven Pathways (Cont'd)

Source	Source Node	Sink	Sink Node
ONTARIO	IESO_15_G	NYPP	NYISO_2_NYB
ONTARIO	IESO_6_G	NYPP	NYISO_2_NYB
ONTARIO	IESO_7_G	NYPP	NYISO_2_NYB
NYPP	NYISO_1_NYA	NYPP	NYISO_7_NYG
NYPP	NYISO_3_NYC	NYPP	NYISO_7_NYG
NYPP	NYISO_6_NYF	NYPP	NYISO_7_NYG
ONTARIO	IESO_15_G	NYPP	NYISO_7_NYG
ONTARIO	IESO_6_G	NYPP	NYISO_7_NYG
ONTARIO	IESO_7_G	NYPP	NYISO_7_NYG
PJM	PENELEC_2_MSA_DuBois_G	NYPP	NYISO_7_NYG
NEPOOL	NEPOOL_2_NH	NYPP	NYISO_9_NYI
NEPOOL	NEPOOL_5_SEMA	NYPP	NYISO_9_NYI
NEPOOL	NEPOOL_7_CT	NYPP	NYISO_9_NYI
NYPP	NYISO_1_NYA	NYPP	NYISO_9_NYI
NYPP	NYISO_3_NYC	NYPP	NYISO_9_NYI
NYPP	NYISO_6_NYF	NYPP	NYISO_9_NYI
NYPP	NYISO_8_NYH	NYPP	NYISO_9_NYI
ONTARIO	IESO_15_G	NYPP	NYISO_9_NYI
ONTARIO	IESO_6_G	NYPP	NYISO_9_NYI
ONTARIO	IESO_7_G	NYPP	NYISO_9_NYI
PJM	PENELEC_2_MSA_DuBois_G	NYPP	NYISO_9_NYI

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Reminder from Task 2: Constraints Limiting Pathways

- **Let F1, F2, …, Fn be flowgates affecting a pathway A→B**
- **The limit each flowgate Fj places on a pathway is given by the formula:**

$$K_j = \frac{L_j - F_j}{PTDF(F_j \mid A \to B)}$$

$L_j -$ flowgate limit

$F_j -$ flowgate flow

$J = \arg\min_j K_j -$ index of the most binding flowgate

- **Using that formula we find the most limiting flowgate for the pathway A→B in each hour**
- **Then we find the second and the third most limiting flowgate**
- **Among these # 1, #2 and #3 most limiting constraints we selected constraints that a) bind in the simulations and b) are limiting for at least 240 simulation hours (equivalent of 10 days)**
- **Constraints that are most limiting for source driven pathways are "source driven constraints"**
- **Constraints that are most limiting for sink driven pathways are "sink driven constraints"**
- **Many constraints are both source and sink driven**

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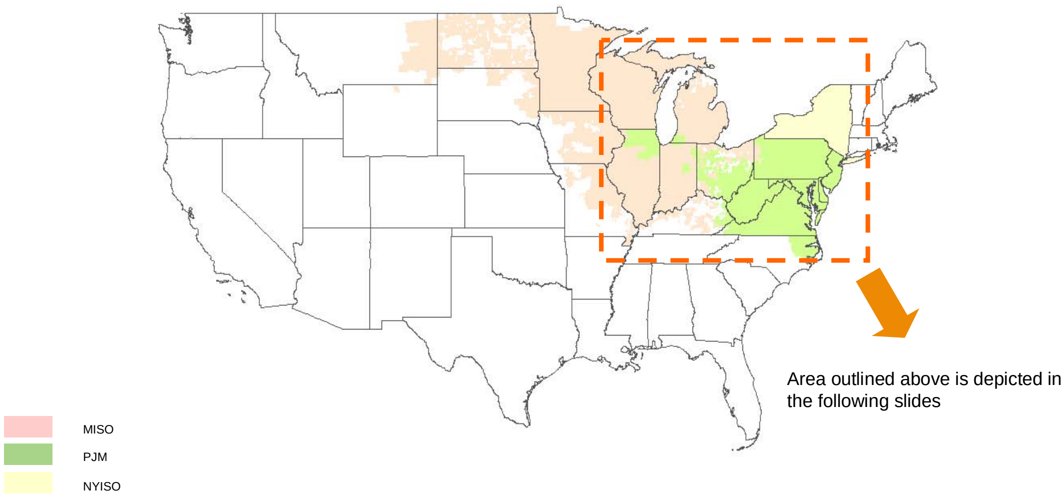
PJM, MISO and NYISO



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Mapping of Nodes Containing Underused Generators

- **We identified major nodes containing under-utilized generators in PJM**
- **Using GIS data, we identified counties "crossed" by those nodes and identified those counties on the map**
- **We used different colors for different ACPF areas**
- **Some generators did not belong to a major node. For those we identified an ACPF area and a county containing that generator and placed that county on a map with the ACPF color**

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Transmission Constraints Limiting the Ability to Use Generation in West PJM and East MISO and to Serve PJM Loads

ISO	Constraint Number	Constraint	Cons type	Class	Congestion	Symbol in Map
PJM	1	147 - Cloverdale-Lexington 5	Line	Source & Sink		—
PJM	2	178 - Crete-E. Frankfort 345	Line	Source		—
PJM	3	97 - Benton Harbor-Palisades	Line	Source		—
PJM	4	1-TRIPS,8MT STM -01PRNTY - 1	Line	Source & Sink	Top Constraint	—
PJM	5	78 - Black Oak-Bedington 500	Line	Source & Sink	Top Constraint	—
PJM	6	180 - Crete-St. John 345 B (	Line	Source		—
PJM	7	314 - Homer City-Shelocta 23	Line	Source & Sink		—
PJM	8	63601SOCIALBLAIRSVL	Line	Source & Sink		—
PJM	9	FG 1713 DICKERSN-PL VIEW 230	Line	Source & Sink		—
PJM	10	460 - Mt. Storm-Doubs 500 (f	Line	Source & Sink		—
PJM	11	650 - Seneca-Maple 138 (flo)	Line	Source & Sink		—
PJM	12	188 - Danville-East Danville	Line	Sink		—
PJM	13	1-TRIP EDISON-MDWRD PBRG-TRN	Line	Sink		—
PJM	14	299 - Halifax-Person 230 (fl	Line	Sink		—
PJM	15	70 - Branchburg-Flagtown 230	Line	Sink		—
PJM	16	751 - Warren-Falconer 115 (f	Line	Sink		—
PJM	17	Croyden-Burlington	Line	Sink		—
PJM	18	Mickleton-Delco Tap	Line	Sink		—
PJM	19	N PHILADELPH WANEETA ACTUAL	Line	Sink		—
PJM	20	130 - Cedar Grove-Clifton 23	Line	Sink	Top Constraint	—
PJM	21	Juniata-Lewiston	Line	Sink		—
PJM	22	NFG 23 - Roseland-Cedar Gro	Line	Sink	Top Constraint	—
PJM	23	50 - Axton 765/138 Xfm (flo)	Transformer	Source & Sink		⅄
PJM	24	1-TRIPS,08SGROVE-08SGROVE- 1	Transformer	Source		⅄
PJM	25	1130 - Wylie Ridge 345/500 X	Transformer	Source & Sink	Top Constraint	⅄
PJM	26	317 - Homer City 345/230 Xfm	Transformer	Sink		⅄
PJM	27	690 - St. Clair 345/230 Xfm	Transformer	Sink		⅄
PJM	28	750 - Waldwick-Hawthorne 230	Transformer	Sink		⅄
PJM	29	1228 - Clover 230/500 Xfm (f	Transformer	Sink		⅄
PJM	30	APS South Interface	Interface	Source & Sink	Top Constraint	━
PJM	31	INTERFACE= PJM - CENTRAL	Interface	Source & Sink	Top Constraint	━
PJM	32	INTERFACE= PJM - EASTERN	Interface	Source & Sink		━
PJM	33	INTERFACE= PJM - WESTERN	Interface	Source & Sink	Top Constraint	━
PJM \ NYISO	34	FARRGUT 1000MW WHEEL	Wheeling	Source & Sink		Ӿ
PJM \ NYISO	35	RAMAPO 1000MW WHEEL	Wheeling	Source & Sink	Top Constraint	Ӿ

CRA INTERNATIONAL

Locations of Under-utilized Generation in West PJM and East MISO and Transmission Constraints leading to PJM Loads

Legend: ISO Boundary

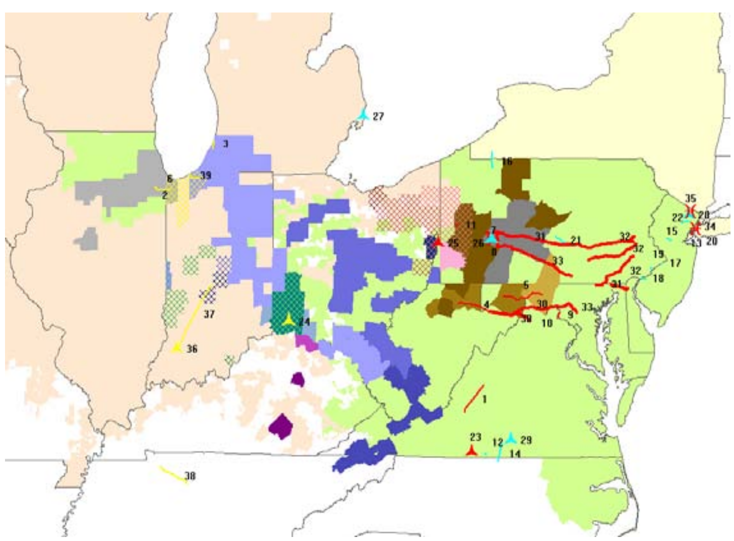
- MISO
- PJM
- NYISO

Legend – Constraint Symbol

- Source & Sink
- Sink
- Source

Legend: ACPF & Hub (MISO) Hash Pattern

- CIN
- CIN3
- CIN4
- FE
- FE4
- FE8
- IPL
- IPL8
- NIPS8



Legend: ACPF & Hub (PJM) Solid Pattern

- AEP
- AEP 2
- AEP 3
- AEP 8
- AP 1
- AP 2
- AP 7
- CIN 4
- DLCO
- EKPC
- EKPC 8
- NI 6
- PENELEC 2

CRA INTERNATIONAL

Locations of Under-utilized Generation in West PJM and Transmission Constraints leading to PJM Loads

Legend: ISO Boundary

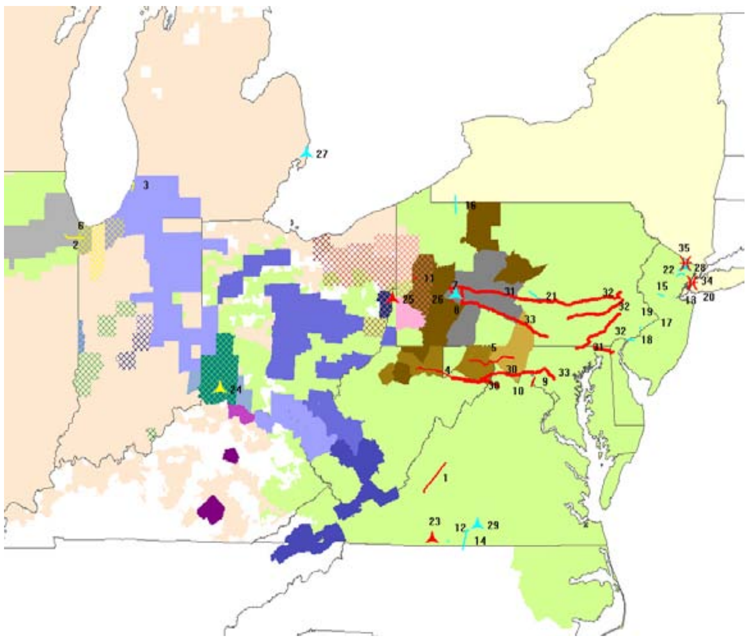
- MISO
- PJM
- NYISO

Legend – Constraint Symbol

- Source & Sink
- Sink
- Source

Legend: ACPF & Hub (MISO) Hash Pattern

- CIN
- CIN3
- CIN4
- FE
- FE4
- FE8
- IPL
- IPL8
- NIPS8



Legend: ACPF & Hub (PJM) Solid Pattern

- AEP
- AEP 2
- AEP 3
- AEP 8
- AP 1
- AP 2
- AP 7
- CIN 4
- DLCO
- EKPC
- EKPC 8
- NI 6
- PENELEC 2

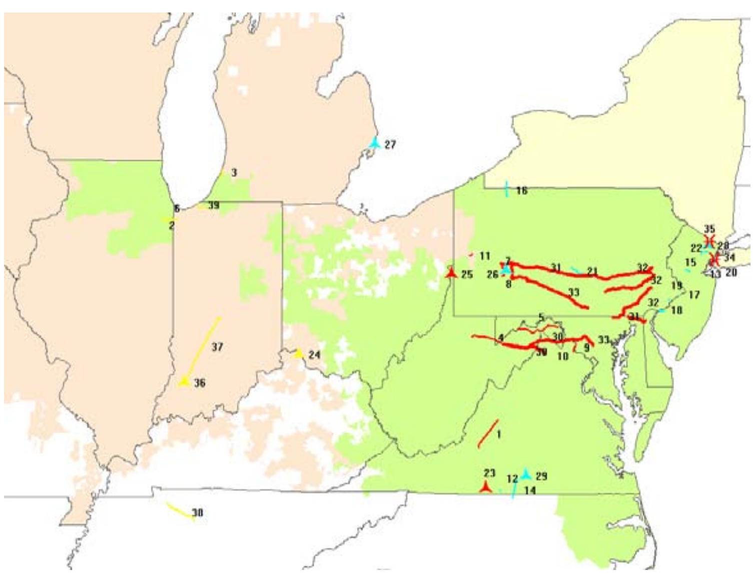
Transmission Constraints leading to PJM Loads

Legend: ISO Boundary

- MISO
- PJM
- NYISO

Legend – Constraint Symbol

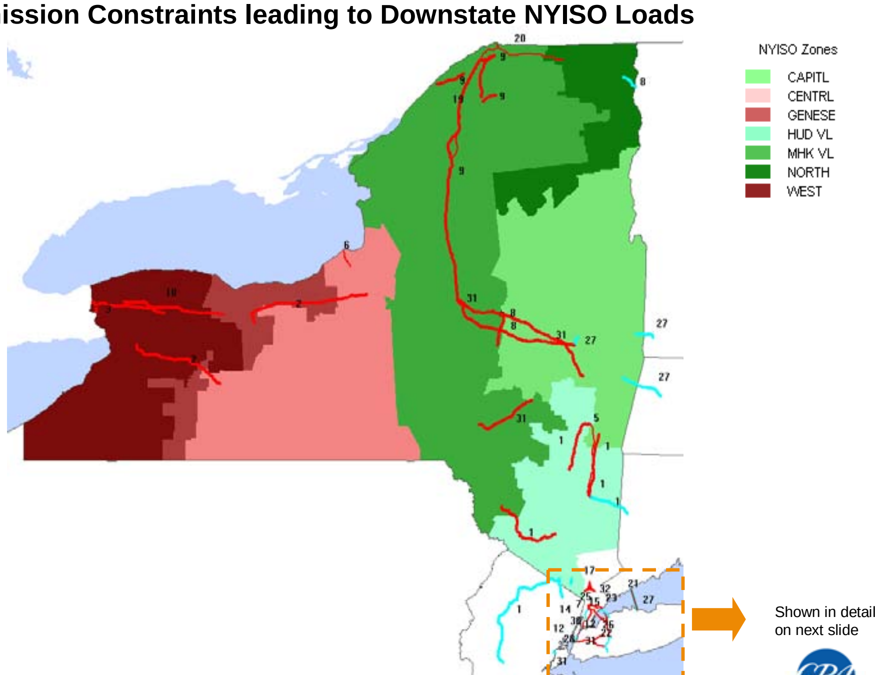
- Source & Sink
- Sink
- Source



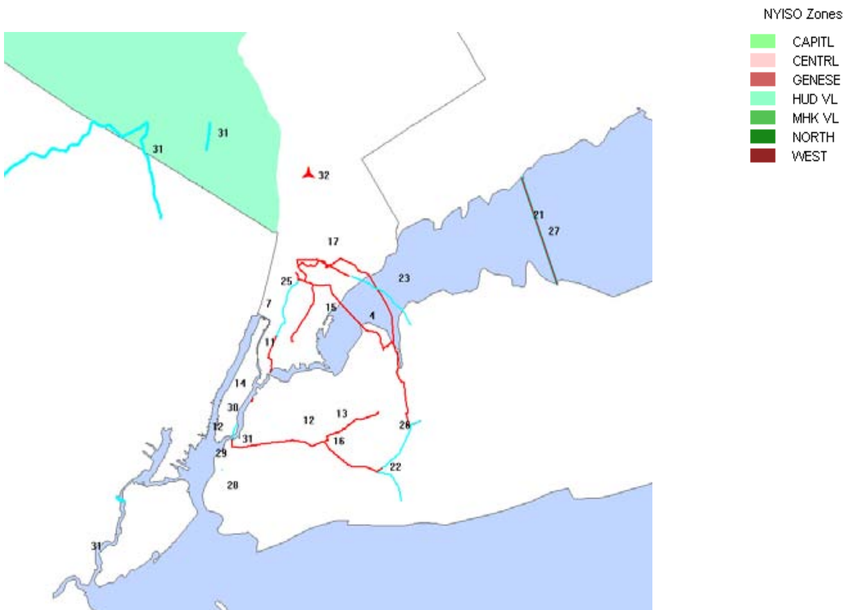
Transmission Constraints Limiting the Ability to Use Generation in Upstate NYISO and Ontario and to Serve NYISO Loads

ISO	Constaint Number on Map	Flowgate Name	Constraint Type	Class	Congestion	Symbol in Map
NYISO	1	11 I/F UPNY - SENY OPEN LO	Interface	Source & Sink	Top Constraint	—
NYISO	2	14 I/F WEST CENTRAL OP HI	Interface	Source & Sink	Top Constraint	—
NYISO \ IMO	3	1454 - IMO-NYIS	Interface	Source & Sink		—
NYISO	4	1TRIP Dun-ShoreRd SpBrk-EGC	Line	Source & Sink	Top Constraint	—
NYISO	5	1TRIP Leeds-Pleasant Val HI	Line	Source & Sink	Top Constraint	—
NYISO	6	1-TRIPS,SCRIBA -VOLNEY - 1	Line	Source & Sink		—
NYISO	7	1TSPBKTRMT:DUN SO1R-E179 ST	Line	Source & Sink		—
NYISO	8	7 I/F CENTRAL EAST LO	Interface	Source & Sink	Top Constraint	—
NYISO	9	7 I/F MOSES SOUTH OPEN HI	Interface	Source & Sink	Top Constraint	—
NYISO	10	8 I/F DYSINGER-EAST OPEN LO	Interface	Source & Sink		—
NYISO	11	Actual:E179 ST-HG 6	Line	Source & Sink	Top Constraint	—
NYISO	12	Actual:HUDAVE E-JAMAICA	Line	Source & Sink	Top Constraint	—
NYISO	13	Actual:L SUCSPH-JAMAICA	Line	Source & Sink		—
NYISO	14	Actual:RAINEY8W-VERNON-W	Line	Source & Sink		—
NYISO	15	Actual:SPRBROOK-TREMONT	Line	Source & Sink		—
NYISO	16	Actual:V STRM P-JAMAICA	Line	Source & Sink	Top Constraint	—
NYISO	17	CP10_12_1-tips, ReacBus-Dvnp	Line	Source & Sink	Top Constraint	—
NYISO	18	CP10_20_E179St_Hg4_E179St_Hg	Line	Source & Sink	Top Constraint	—
NYISO \ IMO	19	NFG7010 - IMO - ADIRONDACK	Line	Source & Sink	Top Constraint	—
NYISO \ IMO	20	NFG7105 - ADIRONDACK - IMO	Line	Source & Sink	Top Constraint	—
NYISO	21	NORHR138 138-NRTHPT P 138- 1	Line	Source & Sink		—
NYISO	22	BARRET VALLEY STREAM ACTUAL	Line	Sink		—
NYISO	23	1-TRIPS,HMP HRBR-DVNPT NK- 1	Line	Sink	Top Constraint	—
NYISO	24	1-TRIPS,SHORE RD-L SUCS - 1	Line	Sink		—
NYISO	25	Actual:DUN SO1R-E179 ST	Line	Sink	Top Constraint	—
NYISO	26	VALLEY STRM - E GARDEN CTY	Line	Sink		—
NYISO \ ISONE	27	NFG9155 - NYIS-ISONE	Interface	Sink		—
NYISO	28	1TGOWNGOTN:GOWANUSS-GOTHLS S	Line	Sink		—
NYISO	29	1TGOWSGOTS:GOWANUSN-GOTHLS N	Line	Sink		—
NYISO	30	1-TRIPS,E15ST 46-FARRAGUT- 1	Line	Sink		—
NYISO	31	16 I/F TOTAL EAST LO	Interface	Sink		—
NYISO	32	1-TRIPS,E VIEW1 -EASTVIEW- 1	Transformer	Source & Sink		⅄
NYISO \ PJM	33	FARRGUT 1000MW WHEEL	Wheeling	Source & Sink	Top Constraint	ж
NYISO \ PJM	34	RAMAPO 1000MW WHEEL	Wheeling	Source & Sink		ж

Locations of Under-utilized Generation in West and Upstate NYISO and Transmission Constraints leading to Downstate NYISO Loads



Transmission Constraints leading to Downstate NYISO Loads



A.6.

March 23, 2007

Memo To: Poonum Agrawal and David Meyer
From: Steve Henderson and Ira Shavel
Subject: SCIT Congestion

The SCIT

The SCIT nomogram is a well-known limit on imports into southern California. The SCIT limits the sums of flows:

- Into Lugo
- Into Adelanto
- Into Victorville
- Into Devers
- Into Imperial valley
- Into Mirage
- Into Vincent
- From Eldorado
- From Pishg
- From Market Place
- From Mead
- From Midway (in the North)
- From Kramer
- From Victor

plus on the Intermountain and pacific DC ties into SCE and LADWP

Basically, the SCIT limits everything that goes to the LA and San Diego areas from directions (except from the south).[4] The SCIT affects LADWP, SCE and, perhaps to a lesser extent, SDG&E. SDG&E is affected less due to up-stream limits on Imperial to Miguel that inside the SCIT.

CAISO's Quantification of SCIT Congestion

In the CAISO's 2005 market monitoring report (for 2004) stated that the SCIT was one of the major points of Intra Zonal congestion.[5] Table 6.2 shows that 91% of the minimum load compensation costs (MLCC) were in SP15, and the SCIT was the largest single component (34% and $65 million). The other SP15 constraints cited are all in the

[4] Please see page 30 of the following link for a good diagram of the SCIT: http://ksghome.harvard.edu/~whogan/vacc1196.pdf

[5] http://www.caiso.com/docs/2005/04/28/2005042815043320024.pdf

LA area: South of Lugo, Sylmar (southern terminus the Pacific DC intertie), Serrano, and Victorville-Lugo.[6]

In the 2006 market Monitoring Report (for 2005),[7] the CAISO reports that the SCIT congestion in terms of MLCC was lower in 2005 than 2004 due to an increase of 500 MW in SCIT capacity for 2005 compared with 2004. The SCIT resulted in 18% ($22.6 million) of the MLCC in 2005, and South of Lugo 34% ($42.8 million).

Transmission Upgrades and the SCIT

The CAISO estimated an increase of the SCIT limit by 1,300 MW due to DPV2.[8]

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6 Table 6.2 reports June – December 2004 only.

7 http://www.caiso.com/17d5/17d5a20c52940.pdf

8 See page 39 of: http://www1.caiso.com/docs/2004/10/01/200410010805266902.pdf

A.7.

Memorandum

To: David Meyer, Poonum Agrawal, DOE

From: Ira Shavel, CRA

Date: January 16, 2007

Subject: **SAN DIEGO CONGESTION**

Indirect Measure of Congestion in San Diego – Unit capacity Factors

Under the California market design, SP15 Zone has only one price in the CAISO markets. Thus, there are no historical prices to observe – all we can do is to observe the dispatch. To look at the dispatch, we have summarized the generation of non-peaking gas units in SP15 for 2002-2006 (through 9/30) by station. The attached spreadsheet shows these results.

The two steam gas stations in the San Diego load pocket are Encina and South Bay. These units run much more than the other steam stations in SP15 even though they have high heat rates compared with most of the other steam units.

CAISO Reported San Diego Load Pocket Re-Dispatch

In the Annual Report on Market Monitoring and Performance (April 2006), the CAISO reports Intra-zonal congestion, which they explain only occurs in real time, since "…the CAISO only manages zonal congestion in the Day Ahead and Hour Ahead Markets."

The CAISO uses three methods to manage intra-zonal congestion:

1. Minimum Load Cost Compensation ("MLCC"), which are payments to generators that are denied a waiver from the Must Offer Obligation and are instructed to be on line. The CAISO pays them for their minimum load cost.
2. RMR real time dispatches. There are three components of RMR costs: 1) a Fixed Option Payment made to the generator to make the unit available for RMR service; 2) pre-dispatch costs incurred before real time; and 3) real-time dispatch cost. The CAISO argues that Fixed Option Payments and pre-dispatch costs are not intra-zonal congestion costs. Note, however, that if units were not under contract for RMR service, there would be more OOS costs. Thus, it is difficult to separate RMR pre-dispatch and Fixed Option Payments from intra-zonal congestion costs.
3. Out-of Sequence calls ("OOS"). These are calls for units to run out-of-merit. In PJM and NYISO, this is the way congestion is managed.

The CAISO reports that in 2005, 40% of the total CAISO intra-zonal OOS re-dispatch was due to the Miguel substation. This results in increase generation from San Diego area units. In 2005, the cost was about $14.4 million.

From the CAISO OASIS website, we have calculated what we understand are the OOS costs associated with Miguel in 2006. The total cost for the CAISO is $18.6 million ($3.4 million for incs and $15.2 million for decs). Miguel's portion of this is $5.1 million.

The CAISO reports that from June 2004 to December 2005 there were $8.9 million in MLCC due to the outage of San Onofre Nuclear Generating Station. Presumably these costs were incurred San Diego, since the system is constraint into San Diego from the north is at constraint San Onofre.

Finally, in 2005 real time RMR dispatch energy costs were $19 million in San Diego, and that RMR pre-dispatch and Fixed Option Payments were another $155 million. Certainly, some, if not all, of the $155 million is due to congestion in the San Diego area. The total RMR costs in San Diego for 2005 was about $174 million. To this should be added the $14.4 million of OOS costs associated with Miguel in 2005, for a total amount of congestion-related cost of about $188 million.

SunRise Power Link Transmission Project Benefit Estimates

The SunRise Power Link transmission project is expected to significantly reduce congestion in the San Diego area. This is confirmed in the Application of SDG&E to the California PUC and also in the CAISO South Regional Transmission Plan for 2006. The SDG&E Amended Application to the CPUC, dated August 4, 2006, has a comparison of the SDG&E benefit estimate with that of the CAISO on page IV-49. The annual benefits of the Sunrise Project are summarized in Table 1.

Table 1
Comparison of Annual Benefits of SunRise Project by SDG&E and CAISO
($ Millions)

Study Year	2010	2015
CAISO	$37	$138
SDG&E	$41	$395

While the SDG&E benefit estimates are somewhat higher than those of the CAISO, it is nonetheless the case that the estimated benefits of the SunRise project substantially exceed the costs of the project regardless of which set of benefit estimates are used. These benefits consist mainly of the reduction in redispatch costs needed in the WECC, and in Southern California in particular, due to the reduction in congestion associated with the SunRise project. These benefit estimates, although they are forward looking, are consistent with the historical evidence of congestion in the San Diego area in 2005 and 2006.