Monitoring Analytics

REPORT TO THE OHIO PUBLIC UTILITY COMMISSION

Congestion in the State of Ohio:

January 1, 2008 through December 31, 2009

The Independent Market Monitor for PJM

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Overview of Congestion Calculations

This report provides details of congestion associated with the PJM related buses in the state of Ohio for the calendar years 2008 and 2009.[1] Congestion calculations throughout this report are for the PJM related buses wholly within the state of Ohio and not for any specific organization. The total congestion calculations are the sum of all the congestion calculations for the organizations with market activity in the area. The report also includes congestion event hours for the constraints which had the largest impact on congestion charges in PJM related buses in the state of Ohio, either positive or negative, and the congestion charges associated with each constraint.[2]

Total congestion costs equal net congestion costs plus explicit congestion costs. Net congestion costs equal load congestion payments minus generation congestion credits. Explicit congestion costs are the net congestion costs associated with point-to-point energy transactions. Each of these categories of congestion costs is comprised of day-ahead and balancing congestion costs. Day-ahead congestion costs are based on day-ahead MW while balancing congestion costs are based on deviations between day-ahead and real-time MW priced at the congestion price in the Real Time Energy Market.[3]

Table 1 shows a summary of the total congestion costs in Ohio for calendar years 2008 and 2009. Table 2 shows a monthly breakdown of congestion costs for calendar years 2008 and 2009.

Table 1 Total Ohio congestion costs (Dollars (Millions)): Calendar years 2008 and 2009

	Congestion Costs	Percent Change
2008	($104.2)	NA
2009	($9.4)	91%
Total	($113.7)	

1 Any discussion of Ohio congestion in the following report is referring to congestion associated with PJM related buses within the state of Ohio, rather than the entire state of Ohio.

2 Congestion event hours are hours in which a transmission constraint is binding. In day ahead, an interval equals one hour. In real time, an interval equals five minutes. In order to have a consistent metric for day-ahead and real-time congestion frequency, real-time congestion frequency is measured using the convention that an hour is constrained if any one of its component five-minute intervals is constrained.

3 See Table 11 , "Congestion Definitions," for a summary of relevant definitions.

Table 2 Monthly Ohio congestion costs (Dollars (Millions)): Calendar years 2008 and 2009

	Total Congestion Costs		
	2008	2009	Change
Jan	($13.0)	($5.4)	$7.6
Feb	($7.2)	($2.4)	$4.8
Mar	($5.2)	($1.7)	$3.5
Apr	($6.9)	($1.1)	$5.9
May	($6.7)	$0.1	$6.8
Jun	($14.8)	$0.6	$15.3
Jul	($16.2)	($0.0)	$16.2
Aug	($7.9)	$0.9	$8.8
Sept	($8.3)	$0.7	$9.0
Oct	($6.0)	$1.0	$7.0
Nov	($6.3)	$0.1	$6.4
Dec	($5.7)	($2.3)	$3.4
Total	($104.2)	($9.4)	$94.8

Congestion at any point on the system can be expressed as a component of LMP measured relative to the system marginal price (SMP). The price at the load weighted reference bus is called the system marginal price SMP. Thus, the SMP is equal to the load weighted system price for the entire footprint. At the load weighted system reference bus there is no congestion and there are no marginal losses. The congestion component of LMP (CLMP) at any point on the system is calculated with respect to the SMP. When a transmission constraint occurs, the resulting CLMP is positive on one side of the constraint and negative on the other side of the constraint and the corresponding congestion costs are positive or negative. For each transmission constraint, the CLMP reflects the cost of the constraint at a pricing node and is equal to the product of the constraint shadow price and the distribution factor at the pricing node.

The total CLMP at a pricing node is the sum of all constraint contributions to LMP at the node and is equal to the difference between the actual LMP that results from transmission constraints, excluding losses, and the SMP. This total can be either positive or negative.

Where the load weighted CLMP for an area is negative, the area is experiencing negative congestion relative to the system load weighted reference bus and the area's load weighted LMP is less than SMP. Where the load weighted LMP in an area is less than SMP, total congestion in the area will be negative. Where the load weighted CLMP for an area is positive, the area is experiencing positive congestion relative to the system load weighted reference bus and the area's load weighted LMP is less than SMP. Where

the load weighted LMP in an area is more than SMP, total congestion in the area will be positive.

In order to provide a more detailed explanation of the congestion calculations from which the total congestion charges are derived, each category of congestion is defined and a table of the congestion charges or credits associated with each category is provided.

Net Congestion

The net congestion bill is calculated by subtracting generating congestion credits from load congestion payments. The logic is that increased congestion payments by load are offset by increased congestion revenues to generation, for the area analyzed. Whether the net congestion bill is an appropriate measure of congestion for load depends on who pays the load congestion payments and who receives the generation congestion credits. The net congestion bill is an appropriate measure of congestion for a utility that charges load congestion payments to load and credits generation congestion credits to load. The net congestion bill is not an appropriate measure of congestion in situations where load pays the load congestion payments but does not receive the generation credits as an offset.

Load congestion payments are netted against generation congestion credits on an hourly basis, by participant, and then summed for the given period. The load congestion payments for a participant may be offset by credits from its owned generation portfolio or by credits from supply purchased from another entity via a bilateral transaction.

Load congestion payments and generation congestion credits are calculated for both the Day-Ahead and Balancing Energy Markets.

- **Day-ahead Load Congestion Payments.** Day-ahead load congestion payments are calculated for all cleared demand, decrement bids, and day-ahead energy sale transactions. (Decrement bids and energy sales can be thought of as scheduled load.) Day-ahead load congestion payments are calculated using load MW and the congestion component of LMP (CLMP) for the load bus, decrement bid location, or the source of the sale transaction, as applicable.

- **Day-ahead Generation Congestion Credits.** Day-ahead generation congestion credits are calculated for all cleared generation and increment offers and day-ahead energy purchase transactions. (Increment offers and energy purchases can be thought of as scheduled generation.) Day-ahead generation congestion credits are calculated using generation MW and the CLMP for the generator bus, increment offer location, or the sink of the purchase transaction, as applicable.

- **Balancing Load Congestion Payments.** Balancing load congestion payments are calculated for all deviations between a PJM Member's real-time load and energy sale transactions and their day-ahead cleared demand, decrement bids, and energy sale transactions. Balancing load congestion payments are calculated using MW deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled load exists.

- **Balancing Generation Congestion Credits.** Balancing generation congestion credits are calculated for all deviations between a PJM Member's real-time generation and energy purchase transactions and the day-ahead cleared generation, increment offers and energy purchase transactions. Balancing generation congestion credits are calculated using MW deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled generation exists.

Explicit Congestion Costs

Explicit congestion costs are the congestion costs associated with moving energy from one specific point to another across the transmission system. Point-to-point transactions may be either internal to PJM or be import or export transactions. Explicit congestion charges equal the difference between source and sink CLMPs for a point-to-point transaction.

- **Internal Purchases**. For internal purchases the explicit congestion costs are calculated based on the difference in CLMPs between the sink bus and source bus of the purchase.

- **Import & Export Transactions.** For point-to-point and network secondary transmission customers, the explicit congestion costs are calculated based on the difference in CLMPs between the sink bus and source bus of the purchase. Interface pricing points are the source bus for import transactions and the sink bus for export transactions.

The explicit congestion costs calculated for Ohio represent the costs associated with point to point transactions that sink in Ohio. For example, if a transaction is sourced in Pennsylvania and sinks in Ohio, the charges would be based on the MW of the transaction multiplied by the difference between the sink CLMP and the source CLMP. The resulting congestion costs are allocated to the zone and state of the sink location, in this case all of the zones contained in Ohio.

Table 3 shows the combined day-ahead and balancing load congestion payments, generation congestion credits, and explicit congestion costs for Ohio for calendar years 2008 and 2009. Table 4 shows the congestion cost categories separated by day-ahead and balancing to show the contributions from both the day-ahead and real-time markets.

Table 3 Total Ohio congestion costs by category: Calendar years 2008 and 2009

	Congestion Costs (Millions)				
	Load Payments	Generation Credits	Net Congestion Bill	Explicit	Grand Total
2008	($227.5)	($127.3)	($100.2)	($4.0)	($104.2)
2009	($54.1)	($45.8)	($8.2)	($1.2)	($9.4)

Table 4 Total day-ahead and balancing Ohio congestion costs by category: Calendar years 2008 and 2009

	Congestion Costs (Millions)								
	Day Ahead				Balancing				
	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
2008	($197.9)	($136.2)	($2.5)	($64.2)	($29.6)	$8.9	($1.5)	($40.0)	($104.2)
2009	($51.0)	($52.1)	($0.6)	$0.5	($3.1)	$6.3	($0.6)	($9.9)	($9.4)

Table 5 lists the top 15 constraints affecting Ohio congestion costs for calendar year 2009. Table 5 provides the type of constraint (Line, Transformer, or Interface), the location of the constraint and the congestion event hours for the period analyzed.

Table 5 Top 15 constraints affecting Ohio congestion costs: Calendar year 2009

				Event Hours	
No.	Constraint	Type	Location	Day Ahead	Real Time
1	AP South	Interface	500	3,501	604
2	Kammer - Ormet	Line	AEP	552	509
3	Sammis - Wylie Ridge	Line	AP	762	157
4	Wylie Ridge	Transformer	AP	354	335
5	West	Interface	500	504	87
6	Tiltonsville - Windsor	Line	AP	1,449	311
7	Mount Storm - Pruntytown	Line	AP	525	132
8	Kammer	Transformer	500	3,674	1,328
9	Belmont	Transformer	AP	1,029	76
10	5004/5005 Interface	Interface	500	776	294
11	Marquis - Waverly	Line	AEP	74	14
12	Poston - Postel Tap	Line	AEP	148	118
13	Dunes Acres - Michigan City	Flowgate	Midwest ISO	2,949	910
14	East Frankfort - Crete	Line	ComEd	2,134	0
15	Ruth - Turner	Line	AEP	704	313

Table 6 shows the congestion cost details of the top 15 constraints affecting Ohio congestion costs for calendar year 2009.

Table 6 Congestion cost details for the top 15 constraints affecting Ohio: Calendar year 2009

	Congestion Costs (Millions)								
	Day Ahead				Balancing				
Constraint	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
AP South	($17.0)	($11.8)	($0.9)	($6.0)	($1.0)	$0.9	$0.4	($1.4)	($7.4)
Kammer - Ormet	$8.1	($0.4)	$0.3	$8.7	($1.5)	$0.1	($0.0)	($1.6)	$7.1
Sammis - Wylie Ridge	($3.7)	($1.0)	($0.1)	($2.7)	($0.4)	$0.2	($0.0)	($0.6)	($3.3)
Wylie Ridge	($5.5)	($2.8)	($0.1)	($2.8)	$0.5	$0.2	($0.1)	$0.2	($2.6)
West	($6.4)	($4.4)	($0.0)	($2.1)	($0.0)	$0.1	$0.0	($0.1)	($2.2)
Tiltonsville - Windsor	($3.0)	($1.8)	($0.6)	($1.9)	$0.1	$0.4	$0.5	$0.3	($1.6)
Mount Storm - Pruntytown	($2.8)	($1.5)	($0.1)	($1.3)	$0.0	$0.3	$0.1	($0.1)	($1.5)
Kammer	($10.6)	($10.6)	($0.2)	($0.2)	($0.3)	$0.6	($0.2)	($1.1)	($1.3)
Belmont	$0.8	($0.3)	$0.3	$1.4	($0.0)	($0.1)	($0.2)	($0.1)	$1.2
5004/5005 Interface	($4.6)	($4.0)	($0.2)	($0.7)	($0.0)	$0.2	$0.0	($0.2)	($0.9)
Marquis - Waverly	$0.7	($0.1)	$0.1	$0.9	($0.0)	$0.0	($0.0)	($0.0)	$0.9
Poston - Postel Tap	$0.6	($0.1)	$0.2	$0.9	$0.2	$0.2	($0.1)	($0.0)	$0.9
Dunes Acres - Michigan City	$3.1	$2.1	($0.2)	$0.8	$0.2	$0.2	$0.0	$0.1	$0.9
East Frankfort - Crete	$1.7	$1.1	$0.2	$0.8	$0.0	$0.0	$0.0	$0.0	$0.8
Ruth - Turner	($0.7)	($1.5)	$0.1	$0.9	($0.0)	$0.1	$0.0	($0.2)	$0.7

Table 7 lists the top 15 constraints affecting Ohio congestion costs for calendar year 2008. Table 7 provides the type of constraint (Line, Transformer, or Interface), the location of the constraint and the congestion event hours for the period analyzed.

Table 7 Top 15 constraints affecting Ohio congestion costs: Calendar year 2008

				Event Hours	
No.	Constraint	Type	Location	Day Ahead	Real Time
1	AP South	Interface	500	3,572	1,016
2	Mount Storm - Pruntytown	Line	AP	2,559	812
3	Sammis - Wylie Ridge	Line	AP	1,915	1,257
4	Bedington - Black Oak	Interface	500	1,384	284
5	Kammer	Transformer	500	3,069	1,628
6	Mount Storm	Transformer	AP	935	469
7	Cloverdale - Lexington	Line	AEP	3,529	1,813
8	West	Interface	500	1,690	390
9	5004/5005 Interface	Interface	500	736	449
10	Krendale - Seneca	Line	AP	1,389	24
11	Bedington	Transformer	AP	1,192	303
12	Amos	Transformer	AEP	31	19
13	Axton	Transformer	AEP	425	0
14	Aqueduct - Doubs	Line	AP	307	7
15	Meadow Brook	Transformer	AP	774	173

Table 8 shows the congestion cost details of the top 15 constraints affecting Ohio congestion costs for calendar year 2008.

Table 8 Congestion cost details for the top 15 constraints affecting Ohio: Calendar year 2008

	Congestion Costs (Millions)								
	Day Ahead				Balancing				
Constraint	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
AP South	($48.1)	($31.0)	($0.5)	($17.6)	($5.9)	$3.2	$0.2	($8.9)	($26.6)
Mount Storm - Pruntytown	($24.3)	($13.4)	($0.4)	($11.2)	($3.8)	$0.3	($0.1)	($4.2)	($15.5)
Sammis - Wylie Ridge	($13.9)	($2.2)	($0.1)	($11.9)	($1.6)	$0.3	($1.0)	($2.9)	($14.8)
Bedington - Black Oak	($15.4)	($8.2)	($0.2)	($7.4)	($0.9)	$0.7	$0.0	($1.5)	($8.9)
Kammer	($16.6)	($13.4)	($0.0)	($3.3)	($2.6)	$1.9	$0.1	($4.3)	($7.6)
Mount Storm	($8.5)	($4.5)	($0.2)	($4.1)	($2.1)	($0.7)	($0.0)	($1.5)	($5.6)
Cloverdale - Lexington	($24.4)	($21.2)	($1.2)	($4.4)	($3.1)	($2.2)	$0.2	($0.6)	($5.0)
West	($10.5)	($8.1)	($0.2)	($2.5)	($0.9)	$1.4	$0.1	($2.2)	($4.7)
5004/5005 Interface	($4.7)	($3.3)	($0.1)	($1.5)	($0.9)	$0.4	$0.0	($1.3)	($2.7)
Krendale - Seneca	($3.6)	($1.7)	($0.1)	($2.0)	($0.0)	$0.0	$0.0	($0.1)	($2.1)
Bedington	($3.4)	($2.1)	($0.0)	($1.3)	($0.2)	$0.2	($0.0)	($0.5)	($1.8)
Amos	$0.1	($1.4)	$0.1	$1.5	$0.0	$0.0	$0.0	$0.1	$1.6
Axton	($2.0)	($3.1)	$0.2	$1.4	$0.0	$0.0	$0.0	$0.0	$1.4
Aqueduct - Doubs	($3.3)	($2.2)	($0.0)	($1.1)	($0.1)	$0.0	$0.0	($0.1)	($1.2)
Meadow Brook	($1.4)	($1.2)	$0.0	($0.2)	($0.6)	$0.2	($0.0)	($0.9)	($1.1)

Table 9 shows the constraints with the largest changes in total congestion costs between calendar years 2008 and 2009. Congestion costs for the AP South interface increased toward zero from 2008 to 2009 by $19.2 million. In addition, congestion costs for the Mount Storm – Pruntytown line increased by $14.0 million from 2008 to 2009. The location of these constraints relative to Ohio means that as these constraints occur more frequently, the result is lower prices in Ohio or negative congestion. An increase in congestion event hours on these constraints would, all else held equal, decrease congestion prices in Ohio. Conversely, a decrease in congestion event hours on these constraints would, all else held equal, cause congestion prices to increase toward zero. Both of these constraints saw decreases in congestion event hours from 2008 to 2009.

Table 9 Top 15 constraint congestion cost deltas for Ohio: Calendar years 2008 and 2009

	Congestion Cost Deltas (Millions)								
	Day Ahead				Balancing				
	Load	Generation			Load	Generation			Grand
Constraint	Payments	Credits	Explicit	Total	Payments	Credits	Explicit	Total	Total
AP South	$31.2	$19.2	($0.3)	$11.6	$5.0	($2.3)	$0.2	$7.5	$19.1
Mount Storm - Pruntytown	$21.5	$11.9	$0.3	$9.9	$3.8	($0.1)	$0.2	$4.1	$14.0
Sammis - Wylie Ridge	$10.3	$1.2	$0.1	$9.2	$1.2	($0.1)	$1.0	$2.3	$11.5
Bedington - Black Oak	$13.4	$6.6	$0.1	$6.9	$0.7	($0.5)	($0.0)	$1.3	$8.2
Kammer - Ormet	$7.2	($0.4)	$0.2	$7.8	($1.1)	$0.1	$0.0	($1.2)	$6.6
Kammer	$6.0	$2.8	($0.2)	$3.1	$2.3	($1.2)	($0.3)	$3.2	$6.3
Mount Storm	$7.8	$4.2	$0.1	$3.8	$2.1	$0.9	$0.1	$1.3	$5.1
Cloverdale - Lexington	$22.5	$19.3	$1.1	$4.4	$2.9	$2.4	($0.2)	$0.3	$4.7
West	$4.1	$3.8	$0.1	$0.4	$0.8	($1.3)	($0.1)	$2.1	$2.5
Wylie Ridge	($5.5)	($2.8)	($0.1)	($2.8)	$0.7	($0.1)	($0.1)	$0.7	($2.1)
5004/5005 Interface	$0.1	($0.7)	($0.1)	$0.7	$0.9	($0.2)	$0.0	$1.0	$1.8
Krendale - Seneca	$2.8	$1.1	$0.1	$1.7	$0.0	($0.0)	($0.0)	$0.1	$1.8
Amos	($0.1)	$1.4	($0.1)	($1.5)	($0.0)	($0.0)	($0.0)	($0.1)	($1.6)
Tiltonsville - Windsor	($3.0)	($1.8)	($0.6)	($1.9)	$0.1	$0.4	$0.5	$0.3	($1.6)
Bedington	$3.0	$1.8	($0.0)	$1.2	$0.3	$0.0	$0.0	$0.2	$1.5

Table 10 Congestion event hour deltas for the top 15 constraints with the largest congestion cost deltas for Ohio: Calendar years 2008 and 2009

				Event Hours	
No.	Constraint	Type	Location	Day Ahead	Real Time
1	AP South	Interface	500	(71)	(412)
2	Mount Storm - Pruntytown	Line	AP	(2,034)	(680)
3	Sammis - Wylie Ridge	Line	AP	(1,153)	(1,100)
4	Bedington - Black Oak	Interface	500	(739)	(211)
5	Kammer - Ormet	Line	AEP	356	358
6	Kammer	Transformer	500	605	(300)
7	Mount Storm	Transformer	AP	(784)	(389)
8	Cloverdale - Lexington	Line	AEP	(2,514)	(1,379)
9	West	Interface	500	(1,186)	(303)
10	Wylie Ridge	Transformer	AP	338	243
11	5004/5005 Interface	Interface	500	40	(155)
12	Krendale - Seneca	Line	AP	(1,065)	(24)
13	Amos	Transformer	AEP	(31)	(19)
14	Tiltonsville - Windsor	Line	AP	1,449	301
15	Bedington	Transformer	AP	(838)	(154)

Conclusion

Over the study period, congestion costs in Ohio were negative due to the west to east pattern of power flows, although west to east congestion costs decreased. Congestion costs in Ohio increased from negative $104.2 million in 2008 to negative $9.4 million in 2009, an increase of $94.8 million or 91 percent. The increase in congestion costs was largely due to a decrease in the frequency of occurrence on many of the predominant constraints in PJM, including the AP South interface, the Mount Storm – Pruntytown line, the Sammis – Wylie Ridge line, and the Bedington – Black Oak interface. (See Table 10) As these constraints cause congestion prices in Ohio to decrease, as these constraints occur less frequently, congestion prices increase, all else held constant.

Congestion Definitions

Table 11 Congestion Definitions

Congestion Category	Calculation
DA Load Congestion Payments	DA Demand MWh * DA CLMP
DA Generation Congestion Credits	DA Supply MWh * DA CLMP
DA Net Congestion Bill	DA Load Congestion Payments - DA Generation Congestion Credits
DA Explicit Congestion Costs	DA Transaction MW * (DA Sink CLMP - DA Source CLMP)
DA Total Congestion Costs	DA Load Congestion Payments - DA Generation Congestion Credits + DA Explicit Congestion Costs
BAL Load Congestion Payments	BAL Demand MWh * RT CLMP
BAL Generation Congestion Credits	BAL Supply MWh * RT CLMP
BAL Net Congestion Bill	BAL Load Congestion Payments - BAL Generation Congestion Credits
BAL Explicit Congestion Costs	BAL Transaction MW * (RT Sink CLMP - RT Source CLMP)
BAL Total Congestion Costs	BAL Load Congestion Payments - BAL Generation Congestion Credits + BAL Explicit Congestion Costs
Total Congestion Costs	DA Total Congestion Costs + BAL Total Congestion Costs

MWh Category	Definition
DA Demand MWh	Cleared Demand, Decrement Bids, Energy Sale Transactions
DA Supply MWh	Cleared Generation, Increment Bids, Energy Purchase Transactions
RT Demand MWh	Load and Energy Sale Transactions
RT Supply MWh	Generation and Energy Purchase Transactions
BAL Demand MWh	RT Demand MWh - DA Demand MWh
BAL Supply MWh	RT Supply MWh - DA Supply MWh