



# **Transmission Expansion Advisory Committee Meeting**

## **2009 Market Efficiency Analysis Preliminary Results**

July 15, 2009

- Review 2008 Historical Market Congestion
- Review Preliminary Simulation Results
- Next Steps



## 2008 Historical Market Congestion

- Total market congestion for 2008 about \$2.1 billion
- Top 20 congestion-causing constraints account for 88% of total 2008 congestion
- Future RTEP upgrades needed for reliability expected to relieve or eliminate most congestion associated with 2008 historical constraints



## 2008 Historical Market Congestion Top 20 Congestion-Causing Constraints

Rank	Constraint	Type	Location	# of Hours	Market Congestion (\$Millions)	% of Total Congestion	Planned RTEP Upgrades expected to provide Congestion Relief
1	AP South	Interface	500	3572	\$ 558.0	26.4%	- install 200 MVAR capacitor at Meadow Brook 500 kV (11/2009) - TrAIL (6/2011) - PATH (6/2014)
2	Cloverdale - Lexington	Line	AEP	3529	\$ 229.3	10.8%	- Bath County SPS (in-service / spring 2009) - TrAIL (6/2011) - PATH (6/2014)
3	Mt Storm-Pruntytown	Line	AP	2559	\$ 224.1	10.6%	- TrAIL (6/2011) - PATH (6/2014)
4	Bedington - Black Oak	Interface	500	1384	\$ 164.6	7.8%	- TrAIL (6/2011) - PATH (6/2014)
5	West	Interface	500	1690	\$ 105.9	5.0%	- Build Jack Mtn 500 kV substation and 1000 MVAR capacitors (6/2012) - TrAIL (6/2011) - PATH (6/2014)
6	Kammer	Transformer	500	3069	\$ 76.1	3.6%	- Replace Kammer 765/500 kV transformer (11/2009) - PATH (6/2014)
7	Sammis - Wylie Ridge	Line	AP	1915	\$ 59.5	2.8%	- PATH (6/2014)
8	Bedington	Transformer	AP	1192	\$ 55.4	2.6%	- 4th Bedington 500/138 kV Trf (in-service / spring 2009)
9	5004/5005 Interface	Interface	500	736	\$ 42.7	2.0%	- TrAIL (6/2011) - PATH (6/2014) - MAPP (6/2014)
10	Mt Storm	Circuit Breaker	AP	935	\$ 42.7	2.0%	- circuit breaker replaced (in-service / spring 2009)



## 2008 Historical Market Congestion Top 20 Congestion-Causing Constraints (cont)

Rank	Constraint	Type	Location	# of Hours	Market Congestion (\$Millions)	% of Total Congestion	Planned RTEP Upgrades expected to provide Congestion Relief
11	East	Interface	500	757	\$ 40.4	1.9%	- install 600 MVar capacitors at Elroy 500 kV (in-service / spring 2009) - install 400 MVar capacitors at Branchburg 500 kV (6/2012) - Susquehanna-Roseland 500 kV (6/2012) - MAPP (6/2014)
12	Atlantic - Larrabee	Line	JCPL	1556	\$ 39.2	1.9%	- replace line traps (in-service / spring 2009) and reconductor circuit (6/2011)
13	Meadowbrook	Transformer	AP	709	\$ 36.5	1.7%	- 4th Meadowbrook 500/138 KV Trf (in-service / spring 2008)
14	Branchburg - Readington	Line	PSEG	1121	\$ 30.9	1.5%	- Replace wave trap on Branchburg-Readington (in-service / spring 2008) - Reconductor Branchburg-Readington (6/2011) - Susquehanna-Roseland 500 kV (6/2012)
15	East Frankfort - Crete	Line	ComEd	1002	\$ 28.2	1.3%	- Congestion mainly from outage of Collins-Wilton Center 765 KV line.
16	Aqueduct-Doubs	Line	AP	307	\$ 28.1	1.3%	- Doubs-Aqueduct-Dickerson (6/2009) - PATH (6/2014)
17	Central	Interface	500	671	\$ 26.6	1.3%	- Build Jack Mtn 500 kV substation and 1000 MVAR capacitors (6/2012) - MAPP (6/2014)
18	Axton	Transformer	AEP	411	\$ 26.2	1.2%	
19	Harwood - Susquehanna	Line	PPL	117	\$ 23.2	1.1%	- Congestion mainly from outage of parallel facility
20	Krendale - Seneca	Line	AP	1389	\$ 22.3	1.1%	- Congestion mainly from outage of Cabot-Keystone 500 KV line
				Top 20	\$ 1,860	87.87%	



# Transmission Topology and Constraints

- Power flow Cases
  - 2009 power flow case to represent today's "as-is" system
  - 2013 RTEP power flow case to represent future system
- Thermal Constraints
  - monitor/contingency pairs
  - NERC Book of Flowgates
  - Historical PJM congestion events
- Voltage Constraints
  - PJM reactive interface limits
  - MW limits based on historical values for "as-is" case adjusted for future upgrade impacts in 2013 case



## Reactive Interface Limit Values

- Values used for as-is 2009 system model based on historical averages
- Historical averages increased by anticipated effect of RTEP reactive reinforcements to develop future 2013 system values

	WESTERN	CENTRAL	EASTERN	BO-BED (POST)	APS (PRE)	APS (POST)	50045005 (POST)
As-Is 2009 System	5750	4000	6200	2650	3800	4450	4000
Future 2013 System	6050	4250	6450	2650	3850	4500	4250



## Preliminary Market Simulation Results

- Annual simulations using as-is 2009 system topology will be benchmarked to 2008 historical constraints
- Annual simulations using 2013 RTEP system topology will estimate economic impact of future upgrades
  - Identify acceleration candidates
  - Identify future bottlenecks



# Market Simulation Results 2009 Generation and Load Scenario

## Impact of 2013 RTEP Upgrades on Congestion by Constraint

Constraint	2009 As-Is System Topology		2013 System Topology	
	Frequency (hours)	Congestion (\$Millions)	Frequency (hours)	Congestion (\$Millions)
AP-South Interface	4929	354.2	1824	51
01BLACKO - 01BEDNGT	1731	105.5	12	0.8
01DOUBS - 01DOUBS	68	70.2	0	0
05KAMMER - 01KAMMER	3305	64.9	0	0
05CLOVRD - 8LEXNGTN	1085	58.9	344	4.1
8LEXNGTN - 8DOOMS	373	47.6	10	0.5
Western Interface	1068	44.1	0	0
01PRNTY - 8MT STM	1207	25.2	0	0
15ELRM 5 - 01MITCHL	2109	15.5	2211	14
8MT STM - 01DOUBS	75	13.5	0	0
Eastern Interface	420	13.3	16	0.5
50045005 Interface	219	6.3	12	0.7
Central Interface	308	3.8	1464	9.9
8CLOVER - 6CLOVER	332	3	738	5.2
01MITCHL - 01SHEPLR	644	2.5	0	0
01BEDNGT - 01HARMNY	10	1.4	0	0
SOLPT 44 - HWKPT 44	48	1.2	38	0.7
HOMER CT - SHELOCTA	292	0.8	799	0.6
ALTOONA - RAYSTOWN	77	0.6	0	0
CROYDON - BRLGTN11	1750	0.5	1385	0.1
GRACETON - RAPHAEL	14	0.5	0	0
ALTOONA - BEAR RCK	39	0.4	350	4.6
CRETE;BP - 17STJOHN	66	0.4	0	0
KEYSTONE - CONEM-GH	62	0.4	0	0
LEWISTWN - JUNIATA	131	0.4	77	0.4
NRGDOVER - KENT	63	0.2	7	0
01MITCHL - 01UNIONJ	11	0.1	11	0.2
01CHARLR - 01MITCHL	0	0	283	1.2
01DOUBS - STATIONH	0	0	1	0.1
BURT2334 - SANDY34T	0	0	5	0.2
CONOWG01 - COLOR PE	0	0	241	1.4
CRETE;BP - E FRA; B	0	0	250	0.1
ERIE SE - ERIE E	0	0	946	0.1
GRACETON - PCHBTMTP	0	0	71	0.2
HOMER CY - WATRC345	0	0	277	0.4
LINWOOD - CHICHST2	0	0	57	0.5
WANETA3 - RICHMOND	60	0	900	0.1
		835.4		97.6

Top 20 Constraint for 2008

Note: 2013 System Topology includes TRAIL, PATH, Susquehanna-Roseland 500 KV, MAPP, Branchburg-Roseland 500 KV, and Roseland-Hudson 500 KV upgrades.



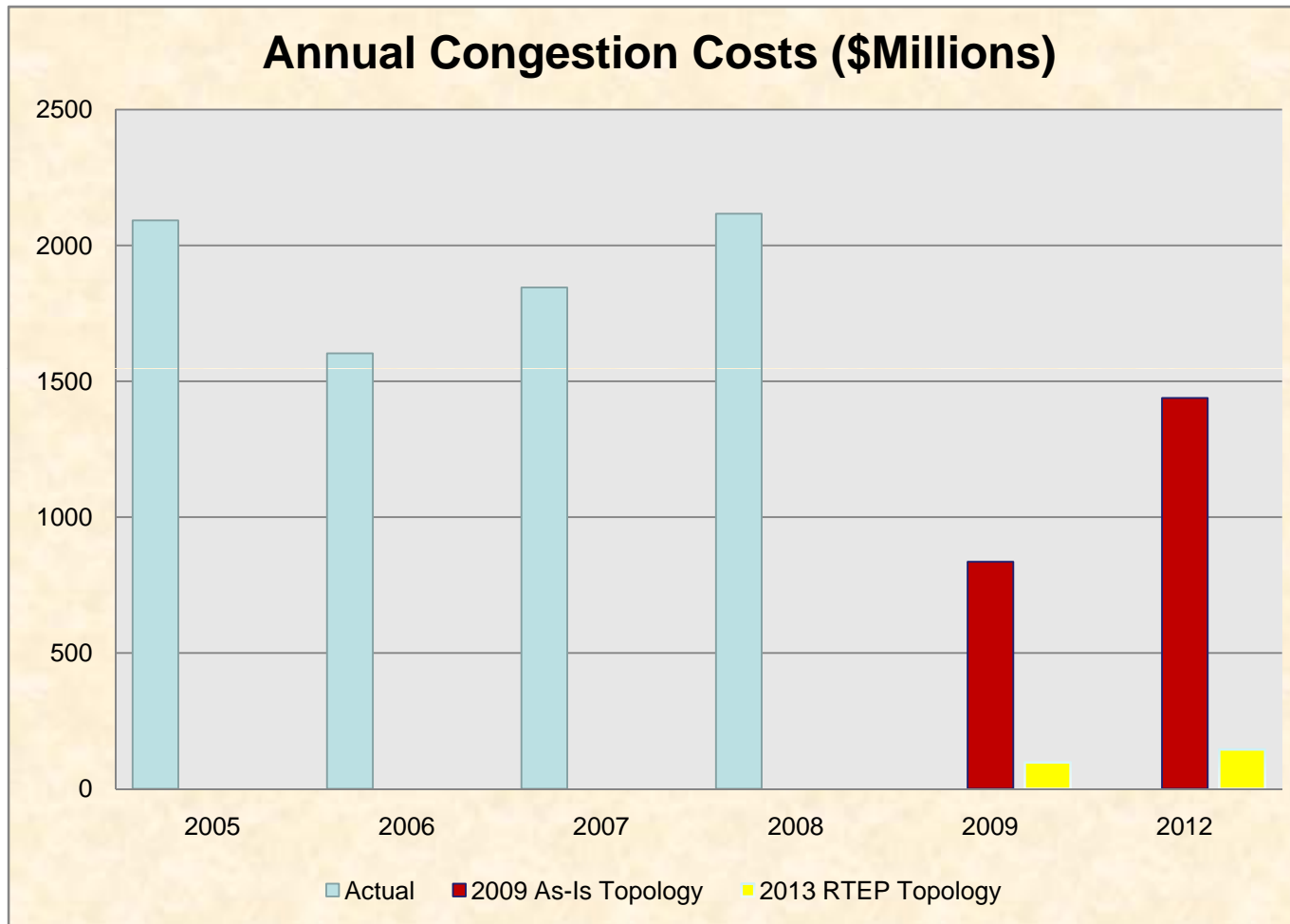
# Market Simulation Results 2012 Generation and Load Scenario

## Impact of 2013 RTEP Upgrades on Congestion by Constraint

Constraint	2009 As-Is System Topology		2013 System Topology	
	Frequency (hours)	Congestion (\$Millions)	Frequency (hours)	Congestion (\$Millions)
AP-South Interface	4900	569.9	1342	55.7
01BLACKO - 01BEDNGT	1940	200.7	43	6.3
01DOUBS - 01DOUBS	165	171.7	0	0
Eastern Interface	1043	117.7	59	6.6
ATHENIA - SADDLBRK	5456	75.5	0	0
Western Interface	757	45.7	0	0
05CLOVRD - 8LEXNGTN	891	43.1	363	3.3
PORTLAND - GRYSTN Q	92	37.9	0	0
Central Interface	757	24.8	1354	17
8LEXNGTN - 8DOOMS	140	24	3	0.1
6BREMO - 6POWHATN	565	19.9	3	0
8CLOVER - 6CLOVER	575	15.8	763	14.5
05KAMMER - 01KAMMER	708	15.4	0	0
SOLPT 44 - HWKPT 44	135	11.5	66	3
8MT STM - 01DOUBS	60	9.1	0	0
01PRNTY - 8MT STM	321	8.6	0	0
1SELRM 5 - 01MITCHL	1000	8	646	2.6
EDDYSTN3 - ISLANDR6	25	6	0	0
ALTOONA - BEAR RCK	193	5.7	619	18.4
GRACETON - RAPHAEL	71	4	0	0
01MITCHL - 01SHEPLR	624	3.9	0	0
INDRV2&3 - OMAR	5	3.4	0	0
01BEDNGT - 01HARMNY	23	3	0	0
50045005 Interface	87	2.4	30	1.9
CDR NKTP - CEDAR NK	21	2.3	0	0
KEYSTONE - CONEM-GH	97	2.1	0	0
N WALES7 - HARTMAN	8	1.8	0	0
NRGDOVER - KENT	212	1.4	40	0.1
CROYDON - BRLGTN11	2645	1	1784	0.1
N PHILA - WANEETA2	288	0.7	0	0
01MAHNSL - 05TIDD	263	0.5	0	0
01MITCHL - 01UNIONJ	24	0.2	26	0.6
CRETE;BP - 17STJOHN	29	0.2	0	0
LINWOOD - CHICHST2	3	0.2	88	1.7
MTN CRK - PORTLAND	2	0.2	0	0
BRUNNER - YORKANA	2	0.1	0	0
CORDO; B - NELSO; B	17	0.1	3	0
HOMER CT - SHELOCTA	24	0.1	612	1.6
WANEETA3 - RICHMOND	195	0.1	797	0.1
01CHARLR - 01MITCHL	0	0	231	2.2
BURT2334 - SANDY34T	0	0	82	4.9
CONOWG01 - COLOR_PE	0	0	94	0.8
COXSCRNR - LUMBRTN	0	0	544	0.2
ERIE SE - ERIE E	0	0	671	0.3
GRACETON - PCHBTMTP	0	0	151	0.2
HOMER CY - WATRC345	0	0	174	0.5
LUMBRTN - COOKSTOW	0	0	220	0.1
YORKANA - STARYORK	0	0	37	2.4
		1438.7		145.2
<b>Top 20 Constraint for 2008</b>				

Note: 2013 System Topology includes TRAIL, PATH, Susquehanna-Roseland 500 KV, MAPP, Branchburg-Roseland 500 KV, and Roseland-Hudson 500 KV upgrades.

## Impact of 2013 RTEP Upgrades on Total PJM Congestion



- Finalize monitor/contingency files based on:
  - Stakeholder Review
  - RTEP reliability analysis results
- Conduct annual simulations of 2015 and 2018 generation and load scenarios
  - Identify potential acceleration candidates
  - Identify future transmission bottlenecks and enhance existing upgrades or develop new upgrades to relieve
- Conduct cost-benefit analysis of any acceleration candidate or any economic upgrade