

Transmission Expansion Advisory Committee Meeting

2011 Market Efficiency Analysis Preliminary Results

June 9, 2011

- Review 2010 Historical Congestion
- Review Preliminary Results
- Review Future Market Efficiency Runs and Next Steps

- Total market congestion for 2010 about \$1428 million
- Top 20 congestion causing events account for about 76% of total congestion
- Future RTEP upgrades will help reduce congestion associated with most 2010 historical constraints



2010 Historical Market Congestion Top 20 Congestion-Causing Constraints

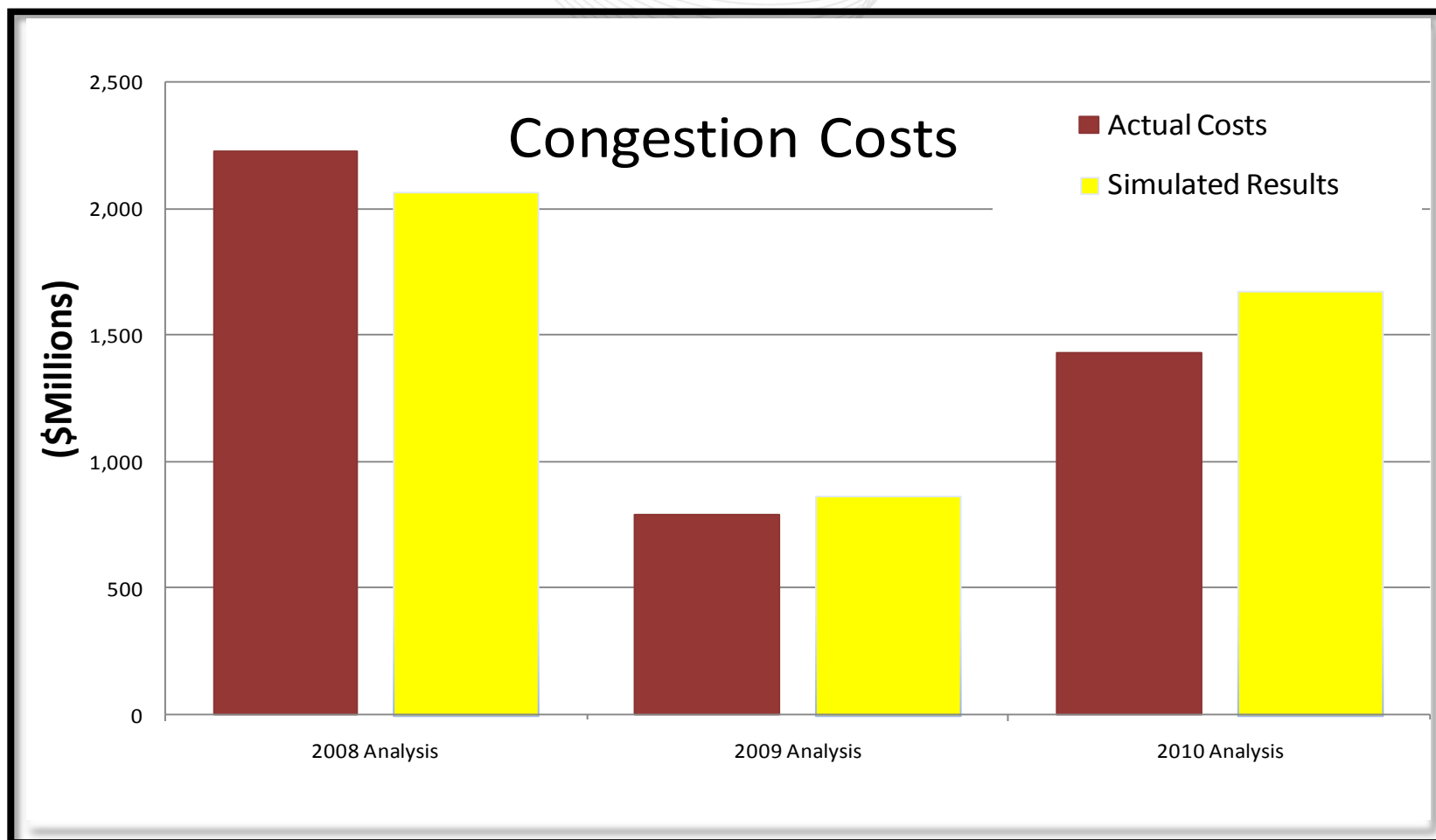
Rank	Constraint	Type	Location	# of Hours	Market Congestion (\$ Millions)	% of Total Congestion	Planned RTEP Upgrades expected to provide Congestion Relief
1	AP South	Interface	500	4645	\$421.6	30%	- TRAIL (6/2011) - Some congestion due to maintenance outages of the Meadowbrook-Morrisville 500 KV and Mount Storm-Pruntytown 500 KV lines.
2	Bedington - Black Oak	Interface	500	2291	\$105.3	7%	- TRAIL (6/2011) - Some congestion due to maintenance outages of the Meadowbrook-Morrisville 500 KV and Keystone-Juniata 500 KV lines.
3	5004/5005 Interface	Interface	500	1644	\$91.9	6%	- TRAIL (6/2011) - Some congestion due to maintenance outages of the Meadowbrook-Morrisville 500 KV and Keystone-Juniata 500 KV lines.
4	Doubs	XFMR	AP	909	\$64.7	5%	- Doubs XFMR replacement projects (6/2011) -Congestion mainly due to Doubs Transformer maintenance outages
5	AEP-DOM	Interface	500	691	\$62.3	4%	- TRAIL (6/2011) -Some congestion due to maintenance outages of the Meadowbrook-Morrisville 500 kV and Kammer-Harrison 500 KV lines.
6	East Frankfort - Crete	Line	ComEd	3084	\$39.9	3%	
7	Crete - St Johns Tap	Flowgate	MISO	2066	\$29.5	2%	
8	Cloverdale - Lexington	Line	AEP	1127	\$28.9	2%	- TRAIL (6/2011) -Some congestion due to maintenance outages of the Meadowbrook-Morrisville 500 KV and Mount Storm-Pruntytown 500 KV lines.
9	Belmont	XFMR	AP	1887	\$26.6	2%	
10	Brandon Shores - Riverside	Line	BGE	344	\$25.7	2%	Congestion mainly due to local outages



2010 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
11	Mount Storm - Pruntytown	Line	AP	571	\$24.9	2%	- TRAIL (6/2011) - Some congestion due to maintenance outage of the Meadowbrook-Morrisville 500 kV Line
12	West	Interface	500	179	\$22.2	2%	- TRAIL (6/2011) - Jacks Mountain Substation and 1000 MVAR Capacitors (6/2013)
13	Tiltonsville - Windsor	Line	AP	2723	\$19.4	1%	- Congestion mainly due to maintenance outages of the Kammer-Harrison 500 KV and Meadowbrook-Morrisville 500 KV lines
14	Pleasant Valley - Belvidere	Line	ComEd	2553	\$15.9	1%	-Some congestion due to maintenance outages of the Pleasant Valley to Woodstock 138 kV line
15	Graceton - Raphael Road	Line	BGE	565	\$15.1	1%	-Congestion mainly due to maintenance outages in Doub's Area
16	Brunner Island - Yorkana	Line	Met-Ed	237	\$14.1	1%	-Congestion due to Middletown Junction Circuit Breaker Replacement project
17	Crescent	XFMR	DLCO	740	\$13.5	1%	-Congestion due to Brunot Island XFMR and Beaver Valley Breaker maintenance outages
18	Clover	XFMR	Dominion	514	\$12.5	1%	-2nd Clover 500/230 KV transformer (6/2015)
19	Millville - Sleepy Hollow	Line	Dominion	401	\$12.3	1%	-Congestion mainly due to maintenance outage of the Meadowbrook-Morrisville 500 KV line.
20	Millville - Old Chapel	Line	Dominion	210	\$12.2	1%	-Congestion mainly due to maintenance outage of the Meadowbrook-Morrisville 500 KV line.
				Top 20	\$1,058.5		

- Simulation using 2011 as-is system topology was benchmarked to 2010 historical congestion.
 - Benchmark case shows comparable results to 2010 historical congestion
 - TrAIL included in as-is system topology for 2011 which accounts for a large portion of differences.
 - Total simulated congestion from 2010 analysis comparable to actual congestion



Results for Congestion > \$5 million

			2011 As-Is System Topology		2015 System Topology without MAPP, PATH, Susquehanna-Roseland, Mt. Storm-Doubs Reconductor	
Constraint Name	Area	Type	Frequency (Hours)	Market Congestion (\$millions)	Frequency (Hours)	Market Congestion (\$millions)
AP SOUTH	PJM	INTERFACE	3196	\$276.1	2753	\$223.4
5004/5005	PJM	INTERFACE	2426	\$124.9	515	\$21.6
Cloverdale 500kV to Lexington 500kV	AEP to DVP	500 kV	1064	\$123.5	1060	\$130.1
EASTERN	PJM	INTERFACE	666	\$53.4	1093	\$91.1
Black Oak - Bedington	PJM	INTERFACE	147	\$25.0	189	\$26.5
Lexington 500kV to Dooks 500kV	DVP	500 kV	152	\$23.0	242	\$42.7
Altoona 230kV to Bear Rock 230kV	PENELEC	LINE	714	\$19.7	1	\$0.1
Juniata 230kV to Dauphin 230kV	PPL	LINE	145	\$16.9	73	\$8.9
Altoona 230kV to Raystown 230kV	PENELEC	LINE	2392	\$16.8	0	\$0.0
Bedington 138kV to Harmony Junction Tap 138kV	AP	LINE	27	\$13.5	0	\$0.0
WESTERN	PJM	INTERFACE	62	\$6.5	403	\$21.0
				\$720.2		\$642.8

Indicates Congestion reduced by at least \$5 million in simulation made with 2015 topology



Preliminary Market Simulation Results – 2011 Generation and Load Scenario

Complete Results Data

			2011 As-Is System Topology		2015 System Topology without MAPP, PATH, Susquehanna-Roseland, Mt. Storm-Doubs Reconductor	
Constraint Name	Area	Type	Frequency (Hours)	Market Congestion (\$millions)	Frequency (Hours)	Market Congestion (\$millions)
AP SOUTH	PJM	INTERFACE	3196	\$276.1	2753	\$223.4
5004/5005	PJM	INTERFACE	2426	\$124.9	515	\$21.6
Cloverdale 500kV to Lexington 500kV	AEP to DVP	500 kV	1064	\$123.5	1060	\$130.1
EASTERN	PJM	INTERFACE	666	\$53.4	1093	\$91.1
Black Oak - Bedington	PJM	INTERFACE	147	\$25.0	189	\$26.5
Lexington 500kV to Dooms 500kV	DVP	500 kV	152	\$23.0	242	\$42.7
Altoona 230kV to Bear Rock 230kV	PENELEC	LINE	714	\$19.7	1	\$0.1
Juniata 230kV to Dauphin 230kV	PPL	LINE	145	\$16.9	73	\$8.9
Altoona 230kV to Raystown 230kV	PENELEC	LINE	2392	\$16.8	0	\$0.0
Bedington 138kV to Harmony Junction Tap 138kV	AP	LINE	27	\$13.5	0	\$0.0
WESTERN	PJM	INTERFACE	62	\$6.5	403	\$21.0
W H Sammis 345kV to Wylie Ridge 345kV	FE to AP	LINE	574	\$3.2	111	\$0.6
Clover 230kV to Clover 500kV	DVP	Transformer	152	\$3.2	305	\$7.5
Fredericksburg 230kV to Cranes Corner 230kV	DVP	LINE	16	\$2.6	10	\$1.6
Homer City Station 345kV to Homer City Station 230kV	PENELEC	Transformer	584	\$2.2	1490	\$6.8
CENTRAL	PJM	INTERFACE	136	\$1.7	145	\$3.6
Mitchell 138kV to Elrama 138kV	AP to DLCO	LINE	309	\$1.6	99	\$0.5
Lewistown 230kV to Juniata 230kV	PENELEC to PPL	LINE	234	\$0.9	9	\$0.0
Krendale 138kV to Seneca 138kV	AP to FE	LINE	134	\$0.8	2633	\$20.6
Dune Acres - Michigan City	PJM	INTERFACE	187	\$0.8	494	\$5.6
Wylie Ridge 500kV to Wylie Ridge 345kV	AP	Transformer	108	\$0.6	0	\$0.0
Keystone (PA) 500kV to Conemaugh 500kV	PJM	500 kV	35	\$0.6	0	\$0.0
Dover Energy (NRG) 69kV to Kent 69kV	DP&L	LINE	216	\$0.6	217	\$0.6
Keystone (PA) 230kV to Shelocta 230kV	PENELEC	LINE	262	\$0.6	0	\$0.0
Athenia 230kV to Saddle Brook 230kV	PSEG	LINE	914	\$0.3	0	\$0.0
N Meshoppen 230kV to N Meshoppen 115kV	PENELEC	Transformer	99	\$0.2	1892	\$4.0
Bremo Bluff 230kV to Powhatan 230kV	DVP	LINE	6	\$0.2	0	\$0.0
Athenia 230kV to Clifton 230kV	PSEG	LINE	256	\$0.2	526	\$0.1
Elrama 138kV to Mitchell 138kV	DLCO to AP	LINE	21	\$0.2	35	\$0.3
Bayonne 138kV to Passaic Valley Sewerage Commission 138kV	PSEG	LINE	526	\$0.1	1717	\$0.8
Graceton 230kV to Cooper 230kV	BG&E to PECO	LINE	14	\$0.1	225	\$2.0
Juniata 230kV to Cumberland 230kV	PPL	LINE	3	\$0.1	3	\$0.0
Dickerson Station "D" 230kV to 230kV	PEPCO to DVP	LINE	1	\$0.0	3	\$1.1
State Line Energy 138kV to Wolf Lake 138kV	CE to NIPS	LINE	8	\$0.0	3997	\$20.1
Croydon 230kV to Burlington 230kV	PECO to PSEG	LINE	13	\$0.0	683	\$0.1
Streator Cayuga Ridge Wind Farm 345kV to Wilton CTR 345 345kV	CE	LINE	1	\$0.0	21	\$0.7
Pleasant Prairie 345kV to Zion 345kV	WEC to CE	LINE	0	\$0.0	70	\$0.1
T157_TAP 500kV to Doubs 500kV	AP	500 kV	0	\$0.0	1	\$0.2
Erie South 230kV to Erie East 230kV	PENELEC	LINE	0	\$0.0	12	\$0.1
Peach Bottom 500kV to U2-74 500kV	PJM	500 kV	0	\$0.0	7	\$0.3
Tiltonville 138kV to Windsor 138kV	AEP to AP	LINE	0	\$0.0	11	\$0.1
Erie West 345kV to Erie South 345kV	PENELEC	LINE	0	\$0.0	1	\$0.0
				\$720.2		\$642.8



Preliminary Market Simulation Results – 2014 Generation and Load Scenario

Results for Congestion >\$5 million

			2011 As-Is System Topology		2015 System Topology without MAPP, PATH, Susquehanna-Roseland, Mt. Storm-Doubs Reconductor	
Constraint Name	Area	Type	Frequency (Hours)	Market Congestion (\$millions)	Frequency (Hours)	Market Congestion (\$millions)
AP SOUTH	PJM	INTERFACE	3605	\$434.9	3117	\$353.0
5004/5005	PJM	INTERFACE	2555	\$187.7	605	\$38.2
Cloverdale 500kV to Lexington 500kV	AEP to DVP	500 kV	1139	\$168.4	1134	\$178.5
EASTERN	PJM	INTERFACE	1134	\$110.8	1643	\$194.8
Bedington 138kV to Harmony Junction Tap 138kV	AP	LINE	130	\$99.5	0	\$0.0
Black Oak - Bedington	PJM	INTERFACE	498	\$84.1	697	\$131.3
Altoona 230kV to Bear Rock 230kV	PENELEC	LINE	1144	\$42.5	0	\$0.0
Lexington 500kV to Dooms 500kV	DVP	500 kV	110	\$21.1	204	\$50.7
Juniata 230kV to Dauphin 230kV	PPL	LINE	109	\$16.8	32	\$3.0
CENTRAL	PJM	INTERFACE	270	\$6.6	98	\$3.3
Keystone (PA) 500kV to Conemaugh 500kV	PJM	500 kV	90	\$5.4	0	\$0.0
				\$1,218.1		\$1,089.8

Indicates Congestion reduced by at least \$5 million in simulation made with 2015 topology



Preliminary Market Simulation Results – 2014 Generation and Load Scenario

Complete Results Data

Complete Results Data			2011 As-Is System Topology		2015 System Topology without MAPP, PATH, Susquehanna-Roseland, Mt. Storm-Doubs Reconductor	
			Frequency (Hours)	Market Congestion (\$millions)	Frequency (Hours)	Market Congestion (\$millions)
Constraint Name	Area	Type	Frequency (Hours)	Market Congestion (\$millions)	Frequency (Hours)	Market Congestion (\$millions)
AP SOUTH	PJM	INTERFACE	3605	\$434.9	3117	\$353.0
5004/5005	PJM	INTERFACE	2555	\$187.7	605	\$38.2
Cloverdale 500kV to Lexington 500kV	AEP to DVP	500 kV	1139	\$168.4	1134	\$178.5
EASTERN	PJM	INTERFACE	1134	\$110.8	1643	\$194.8
Bedington 138kV to Harmony Junction Tap 138kV	AP	LINE	130	\$99.5	0	\$0.0
Black Oak - Bedington	PJM	INTERFACE	498	\$84.1	697	\$131.3
Altoona 230kV to Bear Rock 230kV	PENELEC	LINE	1144	\$42.5	0	\$0.0
Lexington 500kV to Dooms 500kV	DVP	500 kV	110	\$21.1	204	\$50.7
Juniata 230kV to Dauphin 230kV	PPL	LINE	109	\$16.8	32	\$3.0
CENTRAL	PJM	INTERFACE	270	\$6.6	98	\$3.3
Keystone (PA) 500kV to Conemaugh 500kV	PJM	500 kV	90	\$5.4	0	\$0.0
Fredericksburg 230kV to Cranes Corner 230kV	DVP	LINE	24	\$4.3	40	\$5.6
W H Sammis 345kV to Wylie Ridge 345kV	FE to AP	LINE	888	\$4.1	122	\$0.6
Mt Storm 500kV to Doubs 500kV	DVP to AP	500 kV	3	\$3.9	0	\$0.0
WESTERN	PJM	INTERFACE	34	\$3.0	147	\$13.0
Mitchell 138kV to Eirama 138kV	AP to DLCO	LINE	306	\$3.0	24	\$0.1
Homer City Station 345kV to Homer City Station 230kV	PENELEC	Transformer	1310	\$2.9	1473	\$5.3
Clover 230kV to Clover 500kV	DVP	Transformer	70	\$2.7	215	\$7.9
Altoona 230kV to Raystown 230kV	PENELEC	LINE	341	\$2.3	0	\$0.0
Graceton 230kV to Cooper 230kV	BG&E to PECO	LINE	237	\$2.1	991	\$14.9
Krendale 138kV to Seneca 138kV	AP to FE	LINE	445	\$1.9	2452	\$32.0
Brunner Island 230kV to Yorkana 230kV	PPL to METED	LINE	6	\$1.3	0	\$0.0
Dune Acres - Michigan City	PJM	INTERFACE	162	\$1.3	579	\$7.8
Dover Energy (NRG) 69kV to Kent 69kV	DP&L	LINE	289	\$1.1	280	\$1.1
Dickerson Station "D" 230kV to 230kV	PEPCO to DVP	LINE	4	\$1.1	6	\$0.6
Lewistown 230kV to Juniata 230kV	PENELEC to PPL	LINE	173	\$1.0	1	\$0.0
N Meshoppen 230kV to N Meshoppen 115kV	PENELEC	Transformer	493	\$0.9	1865	\$5.6
Bayonne 138kV to Passaic Valley Sewerage Commission 138kV	PSEG	LINE	607	\$0.7	1421	\$3.2
Juniata 230kV to Cumberland 230kV	PPL	LINE	40	\$0.6	9	\$0.2
Streator Cayuga Ridge Wind Farm 345kV to Wilton CTR 345 345kV	CE	LINE	20	\$0.5	274	\$15.5
Wylie Ridge 500kV to Wylie Ridge 345kV	AP	Transformer	50	\$0.3	0	\$0.0
Red Lion 230kV to Cedar Creek 230kV	DP&L	LINE	15	\$0.3	2	\$0.0
Bremo Bluff 230kV to Powhatan 230kV	DVP	LINE	9	\$0.3	4	\$0.1
Athenia 230kV to Saddle Brook 230kV	PSEG	LINE	324	\$0.2	0	\$0.0
Graceton 230kV to Raphael Road 230kV	BG&E	LINE	1	\$0.1	0	\$0.0
Reybold 138kV to Lums Pond 138kV	DP&L	LINE	1	\$0.1	0	\$0.0
Athenia 230kV to Clifton 230kV	PSEG	LINE	55	\$0.1	189	\$0.1
State Line Energy 138kV to Wolf Lake 138kV	CE to NIPS	LINE	40	\$0.1	3522	\$16.7
Croydon 230kV to Burlington 230kV	PECO to PSEG	LINE	4	\$0.0	1281	\$0.2
Pleasant Prairie 345kV to Zion 345kV	WEC to CE	LINE	1	\$0.0	242	\$1.1
Streator Cayuga Ridge Wind Farm 345kV to Pontiac Midpoint 345kV	CE	LINE	0	\$0.0	50	\$4.7
Daleville 230kV to Bradford 230kV	PECO	LINE	0	\$0.0	32	\$0.7
Eirama 138kV to Mitchell 138kV	DLCO to AP	LINE	0	\$0.0	40	\$0.1
				\$1,218.1		\$1,089.8

RTEP Upgrades responsible for Congestion Reduction 2011 and 2014 Simulations

Constraints with at least \$5 million Congestion Reduction and RTEP Upgrade(s) responsible for reduction

Constraint Name	RTEP Upgrade Most Responsible for Reduction
AP SOUTH	Various RTEP upgrades and Loop Flow
5004/5005	Jacks Mountain Upgrade (6/2013)
Altoona 230kV to Bear Rock 230kV	Upgrade Conemaugh 500/230 KV transformer and new line from Conemaugh-Seward 230 KV (6/2014)
Juniata 230kV to Dauphin 230kV	Upgrade Conemaugh 500/230 KV transformer and new line from Conemaugh-Seward 230 KV (6/2014)
Altoona 230kV to Raystown 230kV	Upgrade Conemaugh 500/230 KV transformer and new line from Conemaugh-Seward 230 KV (6/2014)
Bedington 138kV to Harmony Junction Tap 138kV	Bedington - Harmony Jct. - Reconductor (TBD)
Keystone (PA) 500kV to Conemaugh 500kV	Upgrade Conemaugh 500/230 KV transformer and new line from Conemaugh-Seward 230 KV (6/2014)

- Final results for 2011, 2014, 2017, 2020
- 2025 High Level Simulation
- Consider upgrades to relieve congestion causing constraints
- Consider acceleration candidates
- Review 2010 Projects from Appendix A
- Independent review currently being conducted to confirm costs for several 2010 Market Efficiency Proposed Projects
 - Three Scopes of Work for different project areas
 - COMED Area
 - PPL, METED, and PENELEC Areas
 - Dominion and AEP Areas

COMED Area Proposed Projects

COMED Area Proposed Projects	Company Proposing Project	Expected ISD*	Expected Costs (\$ millions)
Byron-Cherry Valley-Pleasant Valley 345 KV	LS Power	6/1/2015	112.5
Byron-Pleasant Valley 345 KV	LS Power	6/1/2015	105
Cherry Valley - Pleasant Valley 345 KV	LS Power	6/1/2015	67.5
Byron - Charter Grove- Wayne 345 KV, Charter Grove 345/138 KV TX.	COMED	6/1/2015	275
Byron - Wayne 345 KV	LS Power	6/1/2015	175
Reconductor Woodstock-Marengo 138 kV	COMED	1/16/2012	8.85

*Expected ISA and Estimated Costs developed by company proposing project.

METED, PPL, PENELEC Area Proposed Projects

	Company Proposing Project	Expected ISD*	Expected Costs (\$ millions)
METED, PPL, and PENELEC Area Proposed Projects			
Liberty East Project Single - Hunterstown 500 kV TX, New Single Hunterstown-Conewago 230 kV line, New Conewago 230 kV substation connecting the Jackson – Three Mile Island 230 kV and West Shore - Brunner Island 230 kV transmission lines near their intersection in York County	LS Power	6/1/2015	125
Liberty East Project Double - Hunterstown 500 kV TX, New Double Hunterstown-Conewago 230 kV line, New Conewago 230 kV substation connecting the Jackson – Three Mile Island 230 kV and West Shore - Brunner Island 230 kV transmission lines near their intersection in York County	LS Power	6/1/2015	147.5

Dominion and AEP Area Proposed Upgrades

	Company Proposing Project	Expected ISD*	Expected Costs (\$ millions)
Dominion and AEP Area Proposed Projects			
New Single Kanawa River-Bath County 345 KV line, Bath County 500/345 kV TX	LS Power	6/1/2015	215
New Double Kanawa River-Bath County 345 KV line, Bath County 500/345 kV TX	LS Power	6/1/2015	290

*Expected ISA and Estimated Costs developed by company proposing project.