



GAMS

Multimodal Coal Transportation Model

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Agenda

› Greenmont Energy Consulting Models ‹

- Greenmont Energy Model (GEM™)
- Greenmont Transportation Model (GTM™)

Case Study

- Modeling the Impact of Monongahela River Lock Closures on Utility Steam Coal Transportation and Sourcing in the Ohio River Basin

Areas of GEM™ Application

Modeling Future Market Interplay & Predicting the Balanced Market Settling Points (Volume & Price)

Coal, Electricity, Allowances

Proposed Environmental
Legislation/Regulations Analysis

Impact of New Emis. Limits

Supply/Demand Balances & Prices

Optimized Future New Capacity
by Type & Location

Elec. Generation

Coal Mining

Licensing the Greenmont Energy
Model (GEM)

Infrastructure Disruptions Analysis

Caused by Nature (e.g. Hurricanes)

Caused by Man (National Security)

Caused by Time & Decay (USACE)

Mergers & Acquisitions Support

Market Power Analyses

Valuations

Advising & Assisting Industrials in Coal Procurement Implementation

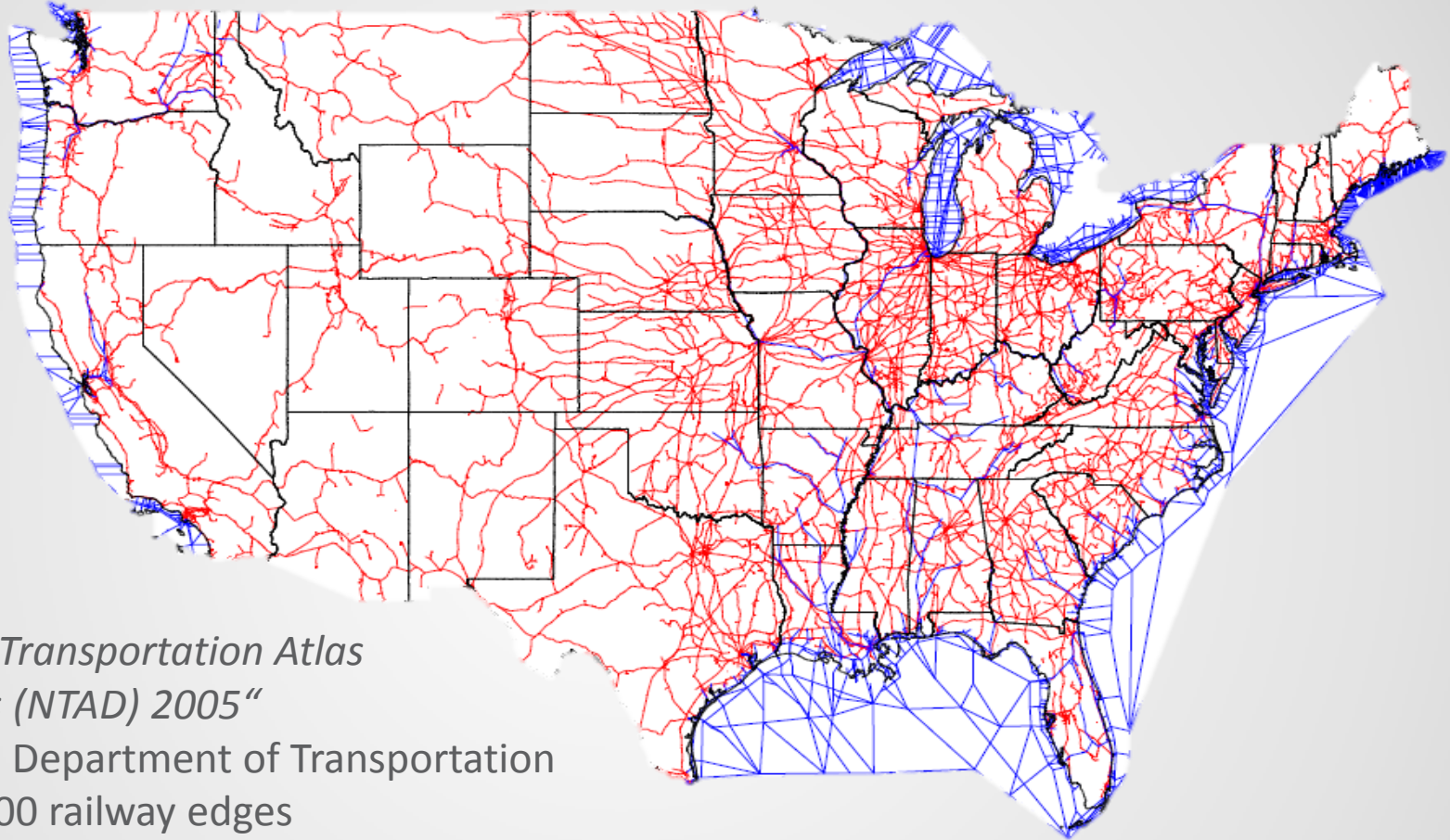
Expert Witness Testimony in
Lawsuits & Arbitrations



GEM™ at a Glance

- Fully integrated (all pieces interacting simultaneously; market forces balance to equilibrium in one calculation pass-not solving separate modules to feed others)
- Solves at the coal unit level (dispatch, coal choice & cleanup choice optimized)
- Includes all EGU (US & Canada), 124 generation areas & 104 coal types
- Written in the GAMS language, uses CPLEX solver
- Dynamic transportation network (**GTM** sub-model)
- Flexible assumption input
- Over 200 output report in GDX format for seamless interaction with Excel & Access etc.
- All types of clean-up equipment optimized by unit
- All environmental regulations & RPS
- Various types of new generation capacity (optimized by type, size & location)
- Emission allowance banking & trading both national & regional (prices optimized)
- New generation & cleanup equipment learning curves
- New mine capacity building (optimized)
- Load curves
- Transmission network (optimized wheeling)

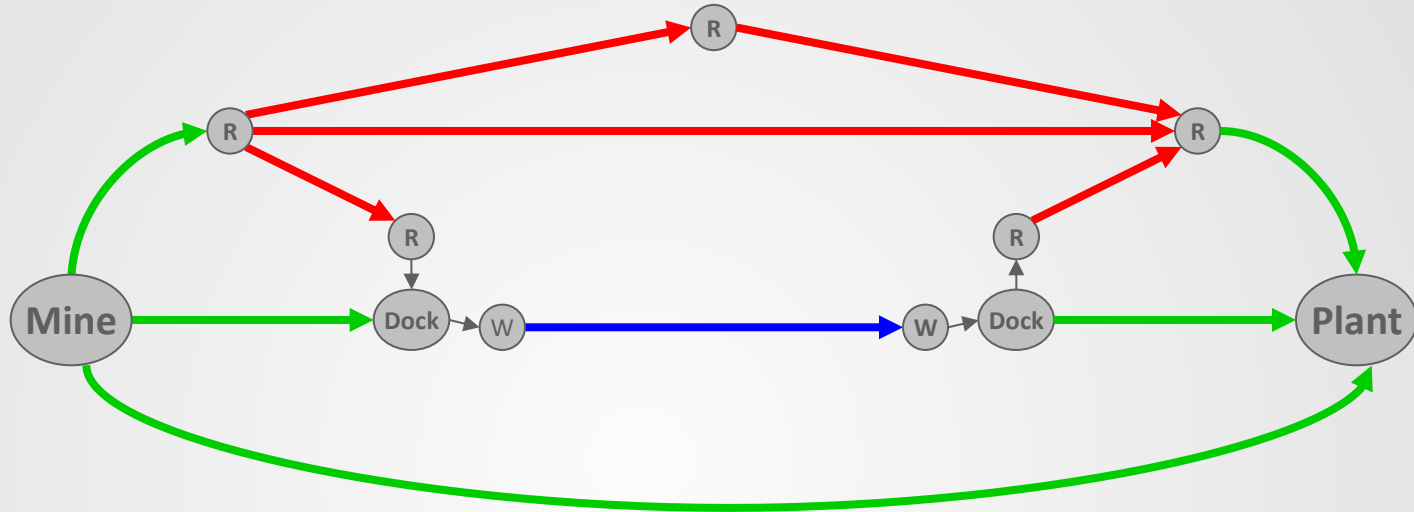
The GTM™ Transportation **Network**



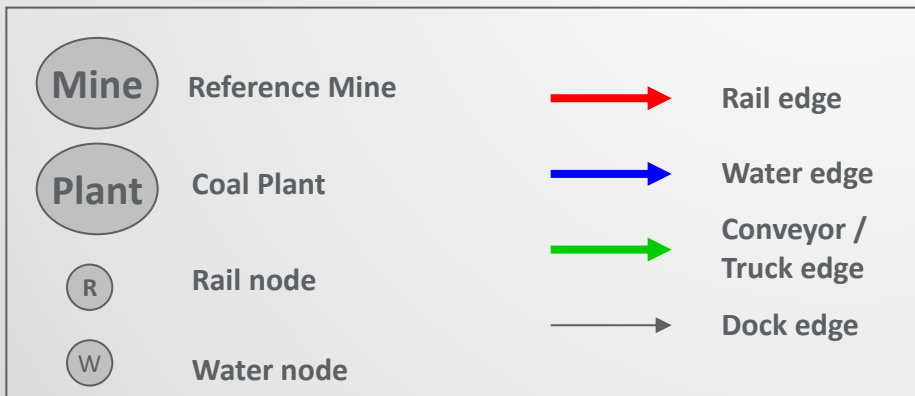
„National Transportation Atlas
Databases (NTAD) 2005“
of the U.S. Department of Transportation

- ~160.000 railway edges
- ~130.000 railway nodes
- ~7.000 waterway edges
- ~6.000 waterway nodes
- + ~45.000 conveyor or truck edges

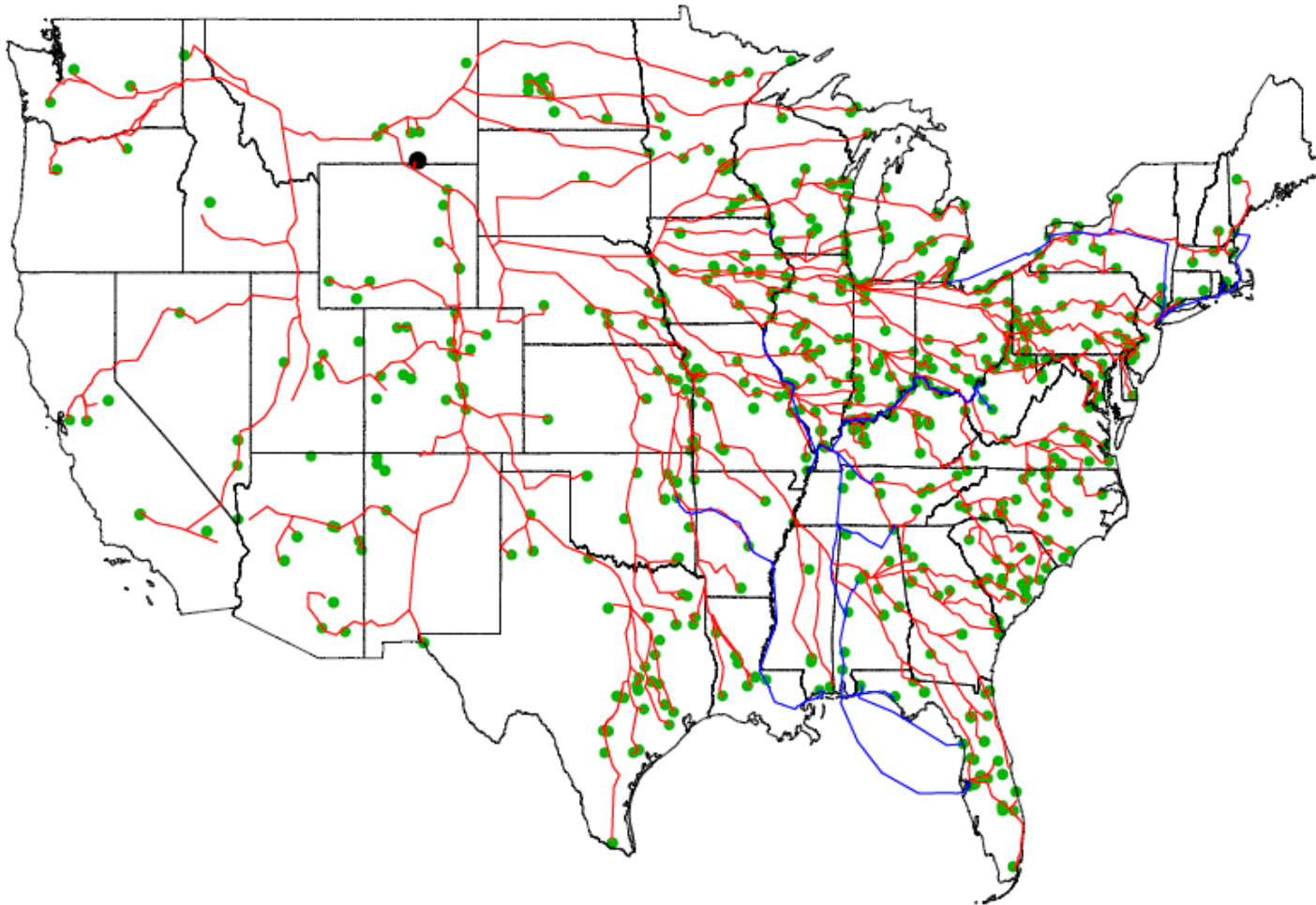
Possible Modes of Transportation



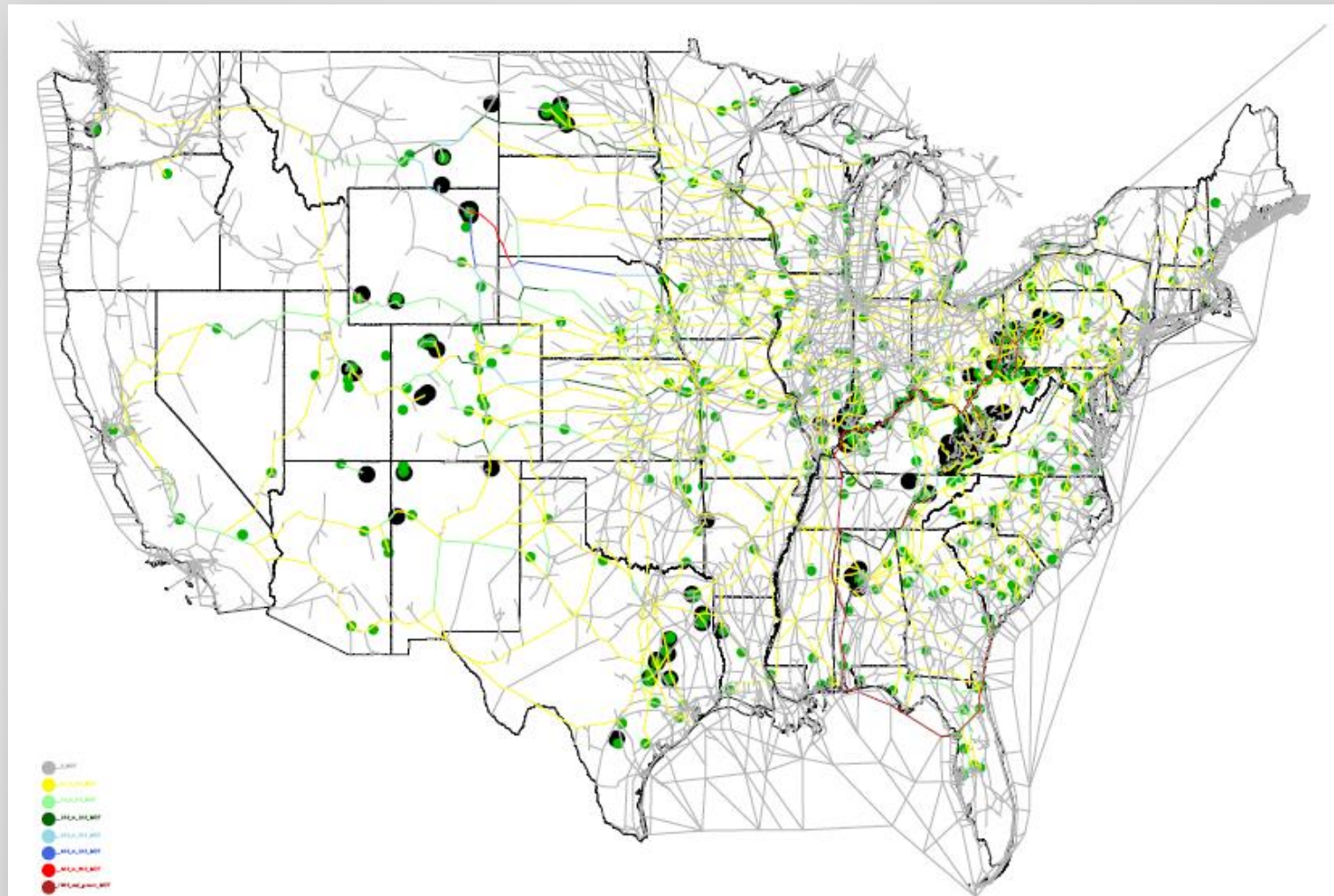
Explanation



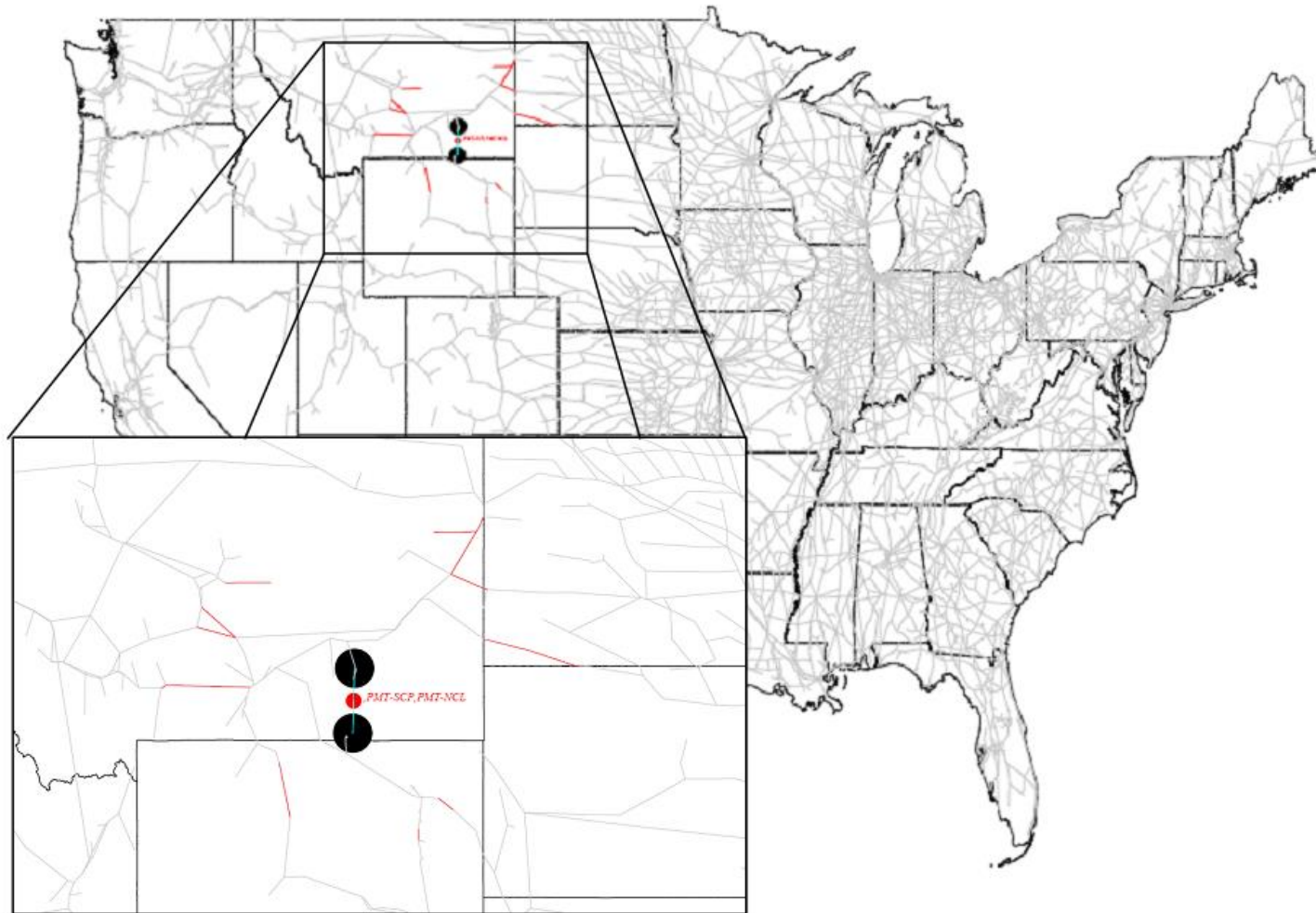
Shortest Paths for Powder River Basin Coal



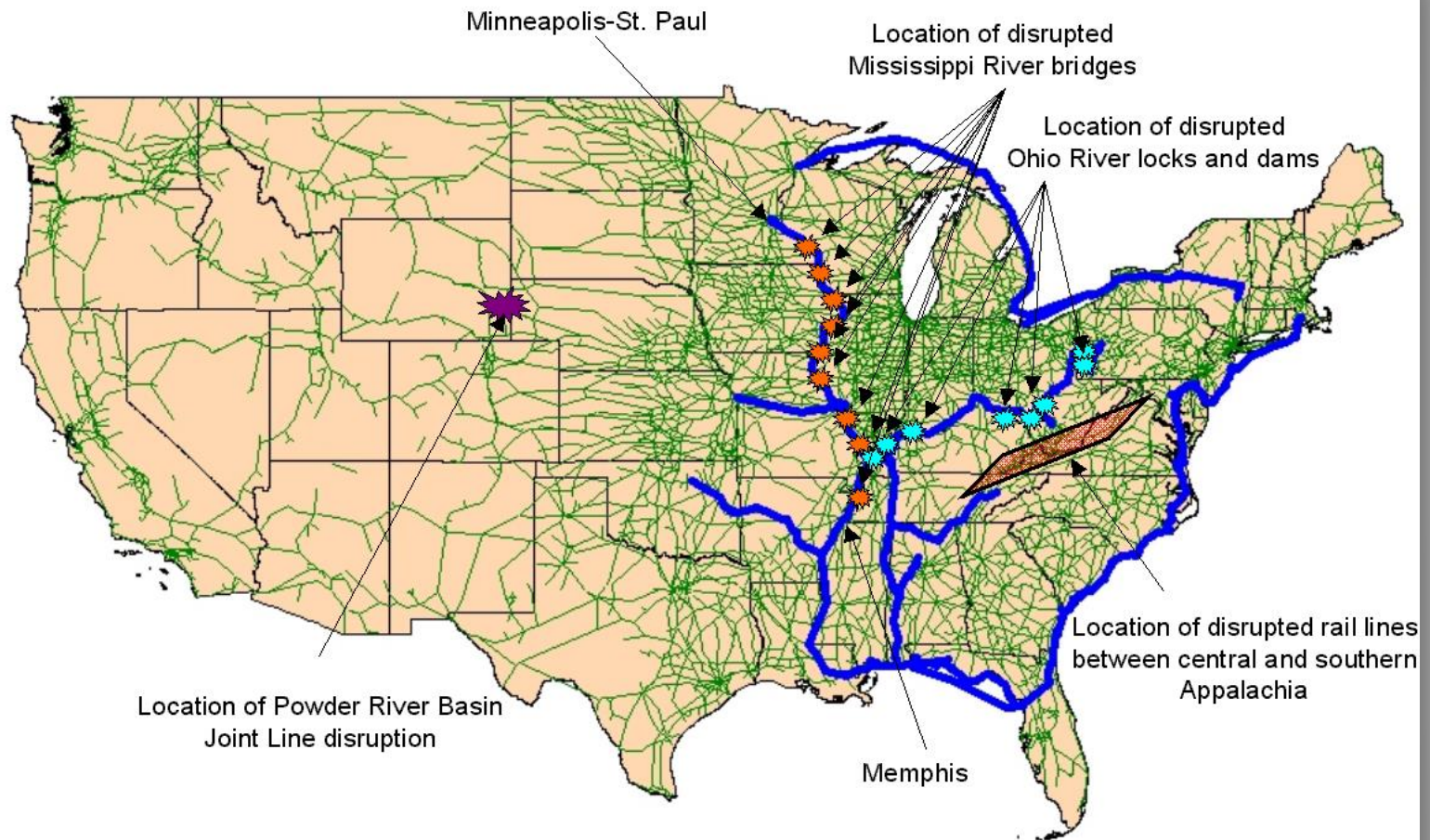
Multi Commodity Flow – Density Classes



Min-Cut for Powder River Basin Coal



Example of GTM “Special” Use





Agenda

Greenmont Energy Consulting Models

- Greenmont Energy Model (GEM™)
- Greenmont Transportation Model (GTM™)

> Case Study<

- Modeling the Impact of Monongahela River Lock Closures on Utility Steam Coal Transportation and Sourcing in the Ohio River Basin

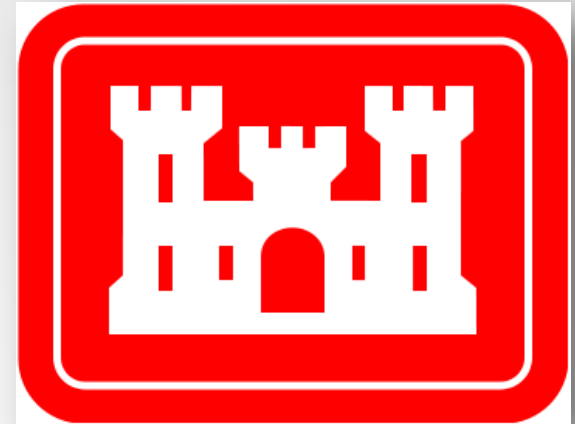
Typical Modeling **Project Progression**

- Explain pros and cons of GEM/GTM and if, why and how it can add value
- Manage expectations and educate client when necessary while leveraging client's proprietary knowledge and data
- Work with client on defining scenarios, setting assumptions and collecting/sanitizing data if necessary
- Seek GAMS's help to address any model logic modifications or additions
- Start runs, calibrate, rerun, calibrate, rerun, calibrate, rerun..... until runs are credible (including back-casting)
- Share results with client and get on the same page with regards to credibility and conclusions which might involve more reruns. Investigate whether counterintuitive results are revelations or just unacceptable
- Author analysis report discussing scope, assumptions, findings and conclusions
- Participate in high level presentation of project findings

Corporate Project



Greenmont Energy Consulting, LLC



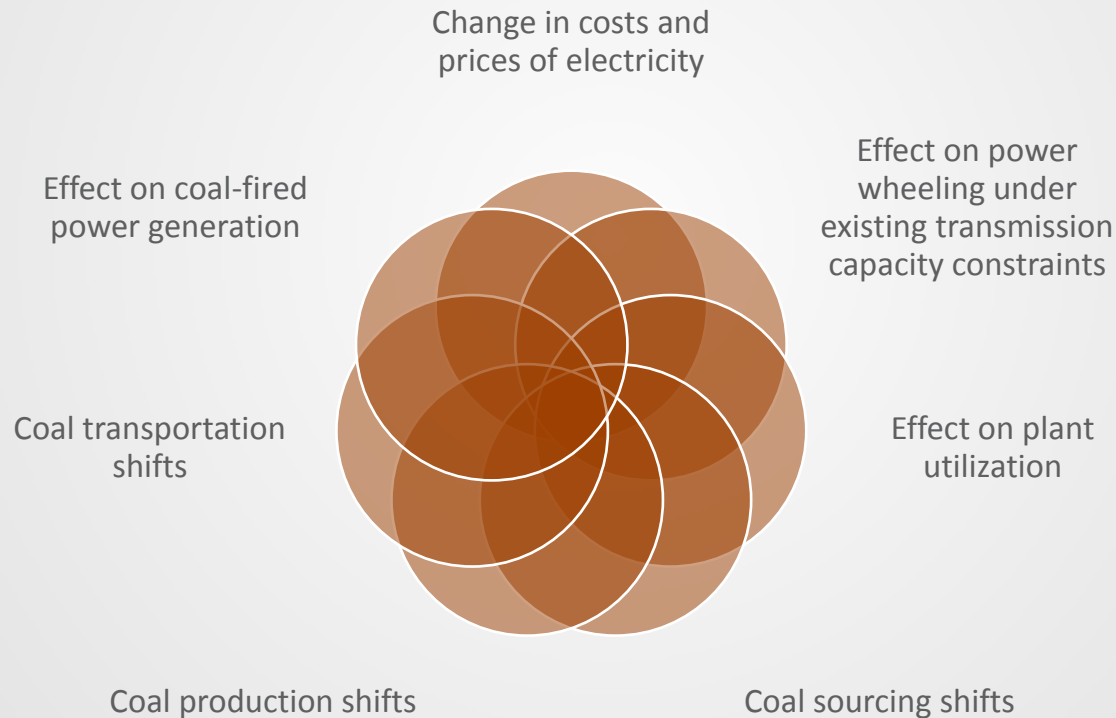
US Army Corps of Engineers



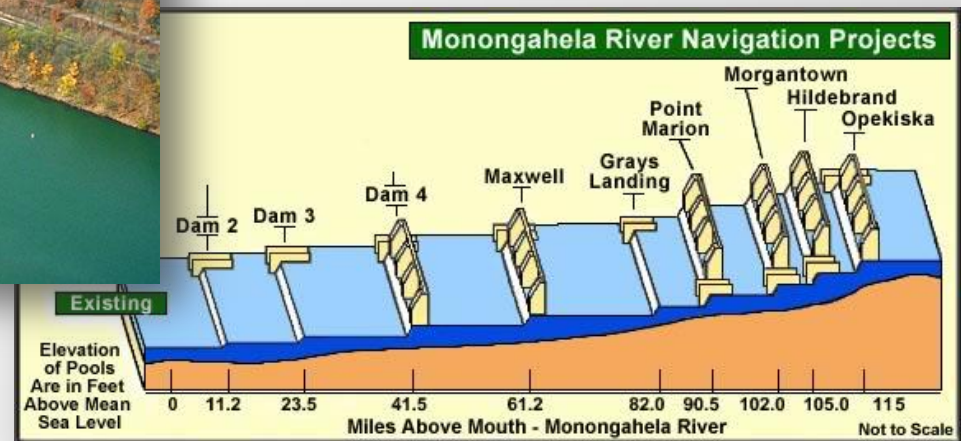
Leonardo Technologies, Inc.

Study for US Army Corps of Engineers

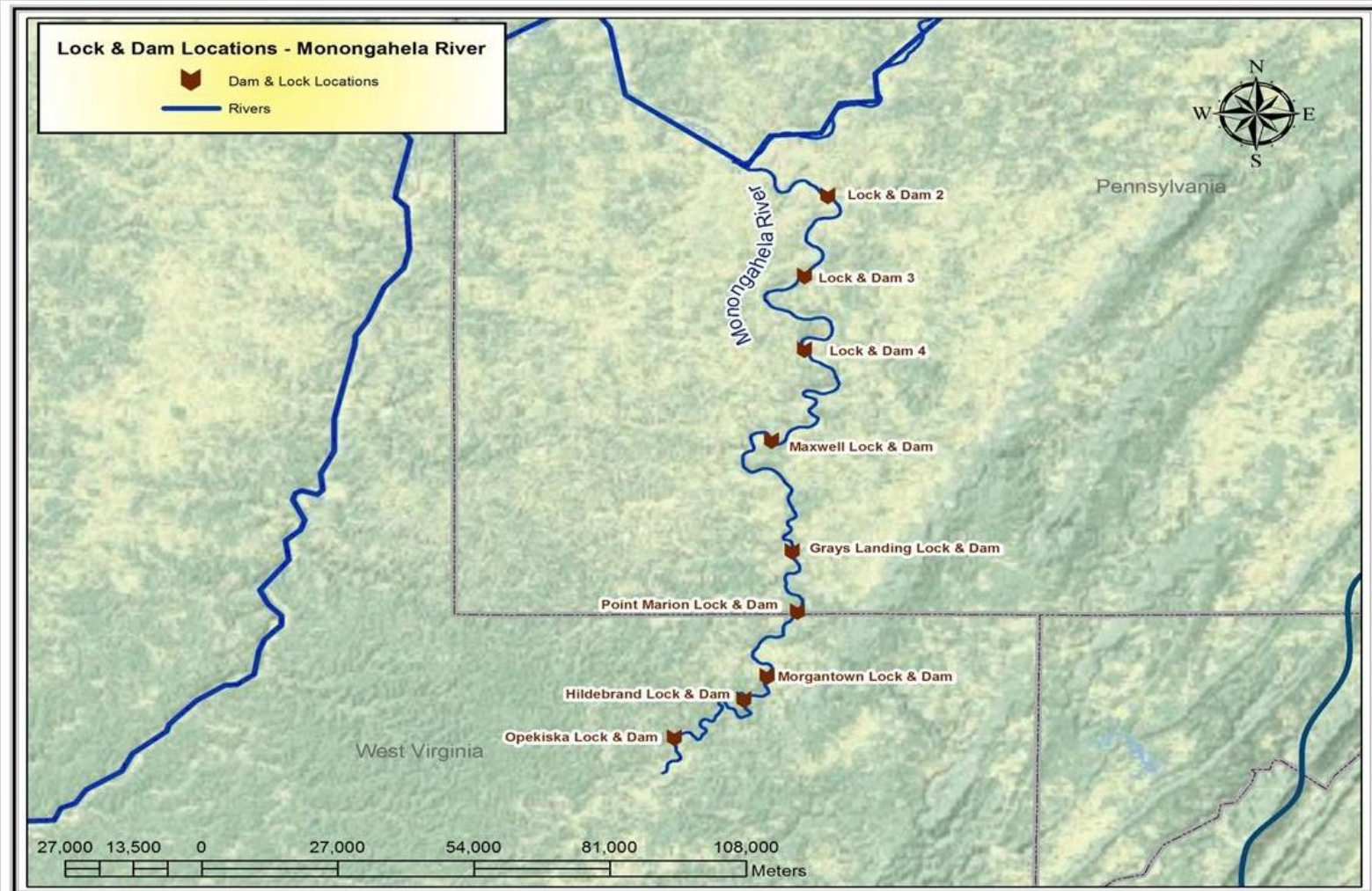
Measuring the Impact of Monongahela Lock Closures on Forecasts of Utility Steam Coal Consumption, Sourcing and Transportation in the Ohio River Basin



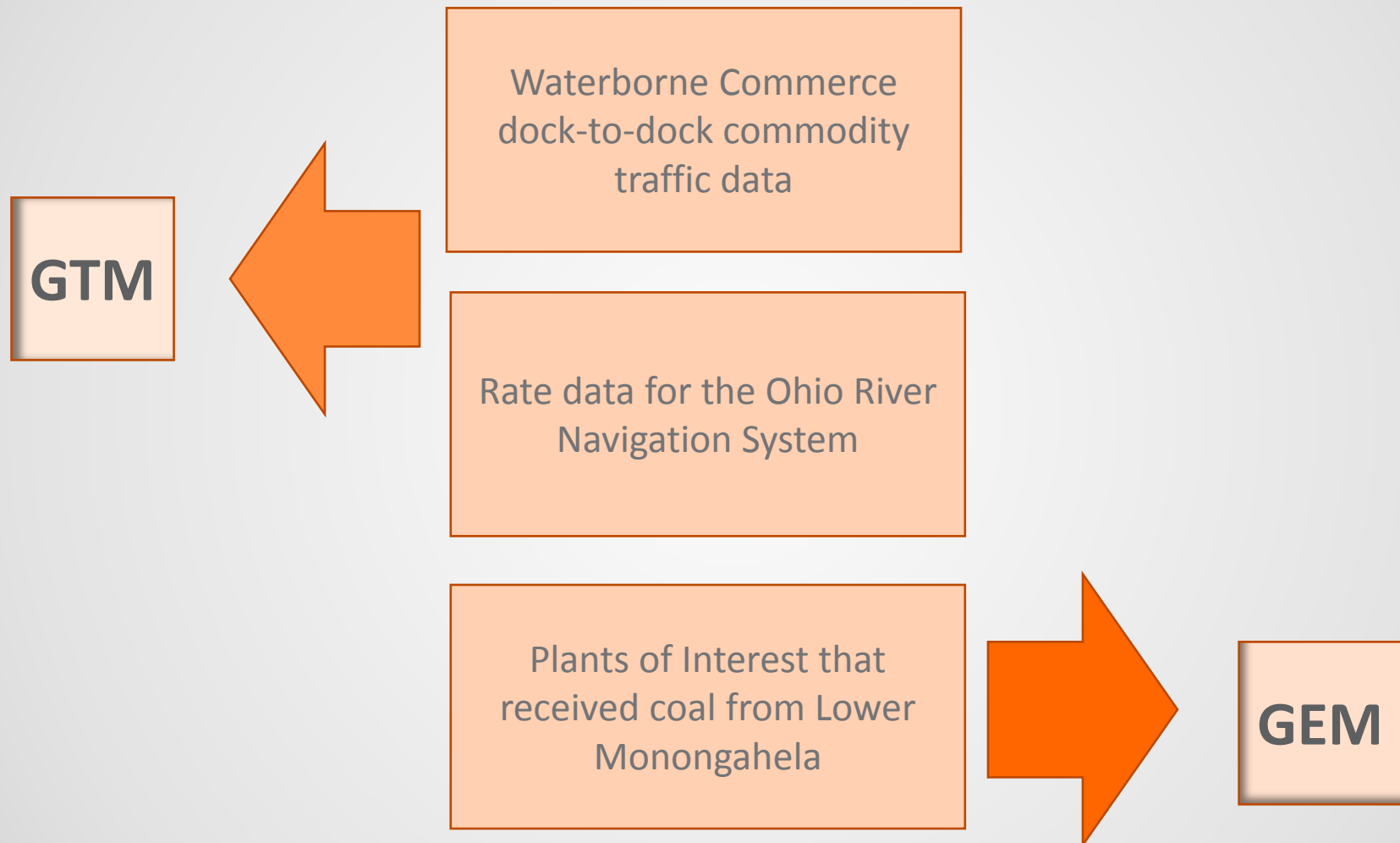
Monongahela River Lock & Dam Examples



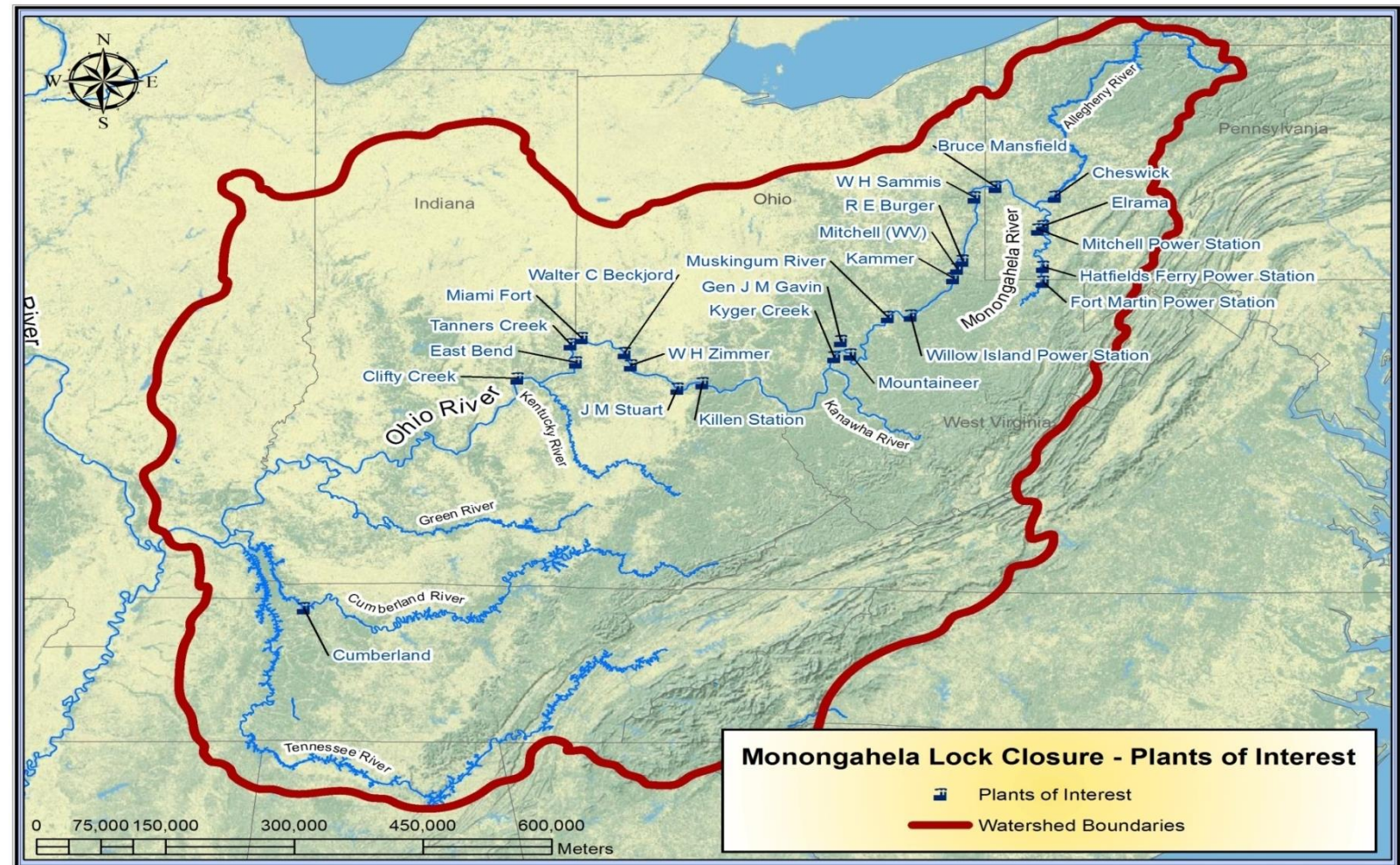
Monongahela River Lock & Dam Locations



Leveraging Client Proprietary Data



Monongahela River Lock Closure – Plants of Interest



Back-Casting & Base Year

MON-OPEN																	
	2008 Code	ALA	CGH	ILL	IND	KMC	LTM	NWV	OHO	PMT	PNW	PSW	QMC	VIR	WKY	WPA	mnt
Big Bend	645			0.02			0.02			0.03					0.17		0.25
Clifty Creek	983					0.20		0.20			4.25					0.57	5.22
Tanners Creek	988		0.02									1.39		0.20	0.54	0.18	2.33
Beckjord	2830					0.69							0.74				1.43
Miami Fort	2832			0.58		1.38			0.90						0.24	0.51	3.61
Stuart	2850			0.84		4.38											5.23
Burger	2864					0.07						0.52				0.28	0.88
Sammis	2866	0.31						0.81				3.80	0.40			1.72	7.05
Muskingum River	2872					0.18							3.33			0.35	3.85
Kyger Creek	2876					0.02						1.92	0.05			0.80	2.79
Elrama	3098							0.12								0.46	0.58
Hatfield	3179					0.05		1.29				1.29				2.67	5.30
Mitchell (PA)	3181					0.20									0.51		0.71
Cumberland	3399			5.30		1.36		0.49								0.23	7.38
Fort Martin	3943							1.87				1.03				0.80	3.70
Willow Island	3946					0.32				0.03							0.36
Kammer	3947											0.48			0.30	1.04	1.83
Mitchell (WV)	3948							4.80									4.80
Genoa	4143										1.49						1.49
East Bend	6018			0.41					0.57						1.03		2.01
Zimmer	6019			0.13	0.27	1.01			1.31				0.13		0.23	1.00	4.09
Killen	6031														1.41		1.41
Mansfield	6094							5.61	0.64						0.17	1.50	7.92
Mountaineer	6264					0.50			1.66			0.93	1.42				4.51
Gen JM Gavin	8102								4.52			1.23	3.02		0.48	0.17	9.43
Cheswick	8226							0.21		0.14						0.72	1.07
	2009	ILL	KMC	NWV	OHO	PMT	PNW	QMC	WKY	WPA							mnt
Big Bend	645					0.07			0.19								0.26
Clifty Creek	983							5.81									5.81
Tanners Creek	988		1.14			0.49											1.63
Beckjord	2830					0.24		1.40	1.19								2.83
Miami Fort	2832			2.79				0.53									3.32
Stuart	2850		7.74														7.74
Burger	2864							0.05									0.05
Sammis	2866					0.27		1.57		1.65							3.48
Muskingum River	2872				2.76	0.16											2.91
Kyger Creek	2876		2.46														2.46
Elrama	3098			0.03						0.17							0.19
Hatfield	3179			4.35													4.35
Mitchell (PA)	3181									0.38							0.38
Cumberland	3399									5.73							5.73
Fort Martin	3943			0.13						1.80							1.93
Willow Island	3946							0.04									0.04
Kammer	3947							0.79									0.79
Mitchell (WV)	3948				4.02												4.02
Genoa	4143						1.49										1.49
East Bend	6018			1.79													1.79
Zimmer	6019			3.75													3.75
Killen	6031								2.26								2.26
Mansfield	6094									7.17							7.17
Mountaineer	6264	4.70															4.70
Gen JM Gavin	8102	7.26							2.33								9.59
Cheswick	8226							0.33		0.97							1.30

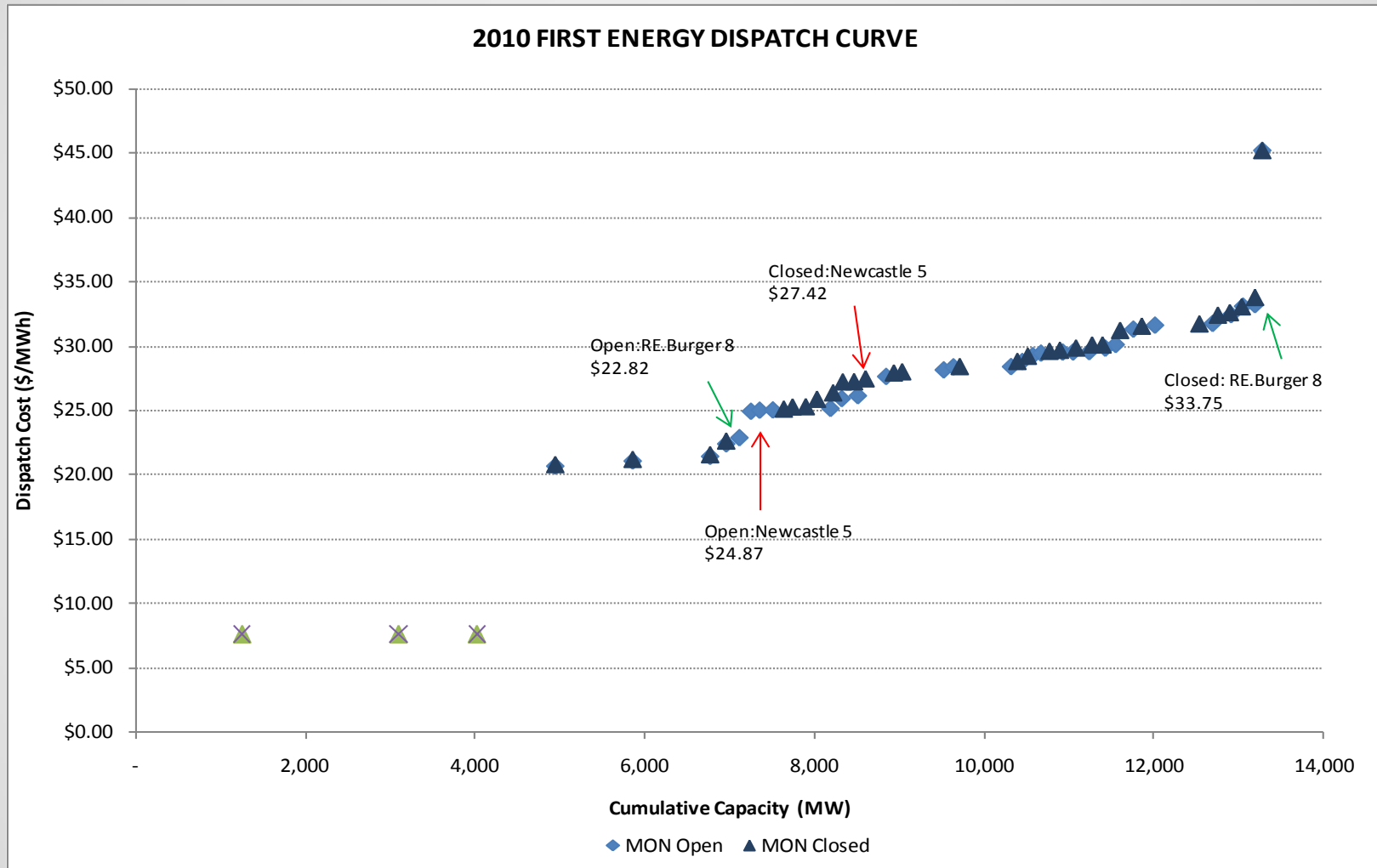
GTM Run Results Feeding into GEM

Transportation	2010	ALA	CGH	CPA	ILL	IND	KMC	LTM	NWV	NWV	NWV	OHO	OHO	OHO	PMT	PNW	PSW	QMC	VIR	WKY	WPA	WPA
Cost \$/ton	OPEN	CMP	SCP	HIS	HIS	HIS	NCP	SCP	HIS	MIS	NCP	HIS	MIS	NCP	SCP	SCP	UCP	NCP	NCP	HIS	MIS	NCP
Big Bend	645	\$ 7.20	\$ 37.33	\$ 9.78	\$ 15.57	\$ 10.77	\$ 20.70	\$ 15.48	\$ 9.53	\$ 11.70	\$ 10.00	\$ 11.80	\$ 17.54	\$ 9.96	\$ 34.36	\$ 33.90	\$ 33.54	\$ 8.95	\$ 19.20	\$ 11.37	\$ 9.55	\$ 10.12
Clifty Creek	983	\$ 7.17	\$ 35.65	\$ 6.27	\$ 12.13	\$ 7.66	\$ 18.63	\$ 7.40	\$ 6.02	\$ 8.20	\$ 6.49	\$ 9.80	\$ 15.54	\$ 6.46	\$ 32.79	\$ 32.32	\$ 31.95	\$ 5.45	\$ 17.62	\$ 8.28	\$ 6.05	\$ 6.62
Tanners Creek	988	\$ 7.26	\$ 35.74	\$ 6.13	\$ 10.47	\$ 6.17	\$ 16.79	\$ 7.49	\$ 5.88	\$ 8.05	\$ 6.35	\$ 8.16	\$ 13.86	\$ 6.31	\$ 33.10	\$ 32.62	\$ 32.25	\$ 5.31	\$ 17.28	\$ 6.72	\$ 5.90	\$ 6.48
Beckjord	2830	\$ 7.34	\$ 35.82	\$ 6.01	\$ 10.28	\$ 5.23	\$ 21.87	\$ 7.57	\$ 5.76	\$ 7.93	\$ 6.23	\$ 9.54	\$ 15.15	\$ 6.19	\$ 32.46	\$ 31.99	\$ 31.63	\$ 5.18	\$ 20.62	\$ 5.66	\$ 5.78	\$ 6.36
Miami Fort	2832	\$ 7.22	\$ 35.70	\$ 6.09	\$ 11.93	\$ 7.63	\$ 22.40	\$ 7.45	\$ 5.84	\$ 8.01	\$ 6.31	\$ 9.61	\$ 15.38	\$ 6.27	\$ 32.34	\$ 31.87	\$ 31.51	\$ 5.26	\$ 21.14	\$ 8.17	\$ 5.86	\$ 6.44
Stuart	2850	\$ 7.67	\$ 36.14	\$ 6.04	\$ 12.35	\$ 8.12	\$ 16.89	\$ 7.90	\$ 5.78	\$ 7.96	\$ 6.26	\$ 9.56	\$ 14.80	\$ 6.22	\$ 32.79	\$ 32.32	\$ 31.96	\$ 5.10	\$ 15.88	\$ 8.63	\$ 5.81	\$ 6.38
Burger	2864	\$ 8.10	\$ 36.58	\$ 5.14	\$ 11.05	\$ 6.00	\$ 22.51	\$ 21.18	\$ 4.96	\$ 10.06	\$ 5.43	\$ 4.41	\$ 10.35	\$ 4.26	\$ 33.94	\$ 33.46	\$ 33.09	\$ 4.98	\$ 21.26	\$ 6.43	\$ 4.97	\$ 5.31
Sammis	2866	\$ 8.27	\$ 36.75	\$ 4.47	\$ 11.21	\$ 6.16	\$ 18.78	\$ 22.12	\$ 4.47	\$ 6.09	\$ 4.94	\$ 8.93	\$ 11.33	\$ 1.34	\$ 34.10	\$ 33.62	\$ 33.26	\$ 5.23	\$ 17.77	\$ 6.59	\$ 4.45	\$ 4.37
Muskingum River	2872	\$ 14.74	\$ 43.22	\$ 12.13	\$ 16.18	\$ 12.64	\$ 26.75	\$ 25.26	\$ 11.90	\$ 14.02	\$ 12.37	\$ 12.68	\$ 13.78	\$ 11.89	\$ 39.86	\$ 39.40	\$ 39.04	\$ 11.20	\$ 27.07	\$ 13.07	\$ 11.92	\$ 12.42
Kyger Creek	2876	\$ 7.80	\$ 36.28	\$ 5.59	\$ 10.75	\$ 5.70	\$ 15.95	\$ 24.52	\$ 5.34	\$ 7.52	\$ 5.81	\$ 8.68	\$ 10.56	\$ 5.69	\$ 33.64	\$ 33.16	\$ 32.79	\$ 3.50	\$ 14.88	\$ 6.13	\$ 5.37	\$ 5.94
Elrama	3098	\$ 8.53	\$ 37.01	\$ 7.10	\$ 11.47	\$ 6.43	\$ 19.07	\$ 17.59	\$ 3.30	\$ 4.18	\$ 7.19	\$ 7.89	\$ 16.58	\$ 7.77	\$ 33.65	\$ 33.18	\$ 32.82	\$ 5.49	\$ 18.05	\$ 6.85	\$ 3.02	\$ 2.77
Hatfield	3179	\$ 8.66	\$ 37.14	\$ 4.71	\$ 11.60	\$ 6.56	\$ 19.20	\$ 17.86	\$ 3.73	\$ 3.53	\$ 4.11	\$ 9.35	\$ 16.36	\$ 5.16	\$ 37.45	\$ 36.92	\$ 36.52	\$ 5.63	\$ 18.19	\$ 6.99	\$ 3.13	\$ 4.59
Mitchell (PA)	3181	\$ 8.46	\$ 36.94	\$ 3.95	\$ 11.40	\$ 6.36	\$ 19.00	\$ 17.48	\$ 3.24	\$ 3.85	\$ 7.04	\$ 7.75	\$ 16.45	\$ 7.71	\$ 33.58	\$ 33.11	\$ 32.75	\$ 5.43	\$ 17.98	\$ 6.79	\$ 2.95	\$ 2.43
Cumberland	3399	\$ 6.26	\$ 35.04	\$ 7.10	\$ 12.31	\$ 7.94	\$ 19.52	\$ 6.49	\$ 6.84	\$ 9.02	\$ 7.31	\$ 10.62	\$ 16.36	\$ 7.28	\$ 31.68	\$ 31.21	\$ 30.85	\$ 6.27	\$ 17.15	\$ 8.66	\$ 6.87	\$ 7.44
Fort Martin	3943	\$ 8.53	\$ 37.01	\$ 4.67	\$ 11.47	\$ 6.42	\$ 19.06	\$ 17.47	\$ 2.37	\$ 4.60	\$ 1.79	\$ 9.74	\$ 15.76	\$ 5.12	\$ 37.31	\$ 36.79	\$ 36.39	\$ 5.49	\$ 18.05	\$ 6.85	\$ 1.39	\$ 5.66
Willow Island	3946	\$ 8.01	\$ 36.49	\$ 5.38	\$ 9.45	\$ 5.91	\$ 20.64	\$ 18.62	\$ 5.16	\$ 7.27	\$ 5.64	\$ 5.61	\$ 11.18	\$ 5.03	\$ 33.13	\$ 32.67	\$ 32.31	\$ 4.64	\$ 20.88	\$ 6.34	\$ 5.18	\$ 5.68
Kammer	3947	\$ 8.10	\$ 36.58	\$ 5.14	\$ 11.04	\$ 6.00	\$ 22.51	\$ 20.73	\$ 4.96	\$ 10.05	\$ 5.43	\$ 4.41	\$ 10.35	\$ 4.26	\$ 33.94	\$ 33.46	\$ 33.09	\$ 4.97	\$ 21.25	\$ 6.42	\$ 4.97	\$ 5.31
Mitchell (WV)	3948	\$ 8.06	\$ 36.54	\$ 5.10	\$ 9.51	\$ 5.96	\$ 16.89	\$ 17.69	\$ 4.92	\$ 8.75	\$ 5.39	\$ 2.87	\$ 10.31	\$ 4.22	\$ 33.19	\$ 32.72	\$ 32.36	\$ 4.94	\$ 17.38	\$ 6.39	\$ 4.93	\$ 5.27
Genoa	4143	\$ 8.29	\$ 30.18	\$ 8.82	\$ 11.65	\$ 6.73	\$ 29.37	\$ 8.52	\$ 8.57	\$ 10.75	\$ 9.04	\$ 12.35	\$ 18.09	\$ 9.00	\$ 24.69	\$ 24.22	\$ 23.86	\$ 8.00	\$ 26.44	\$ 7.16	\$ 8.59	\$ 9.17
East Bend	6018	\$ 12.53	\$ 41.01	\$ 11.78	\$ 17.25	\$ 13.21	\$ 23.83	\$ 12.76	\$ 11.53	\$ 13.71	\$ 12.00	\$ 15.31	\$ 20.97	\$ 11.96	\$ 37.66	\$ 37.19	\$ 36.83	\$ 10.96	\$ 22.81	\$ 13.75	\$ 11.55	\$ 12.13
Zimmer	6019	\$ 7.49	\$ 35.97	\$ 6.09	\$ 12.17	\$ 7.94	\$ 21.85	\$ 7.72	\$ 5.84	\$ 8.02	\$ 6.31	\$ 9.62	\$ 15.16	\$ 6.27	\$ 32.61	\$ 32.14	\$ 31.78	\$ 5.24	\$ 20.59	\$ 8.45	\$ 5.86	\$ 6.44
Killen	6031	\$ 7.53	\$ 36.01	\$ 5.90	\$ 10.47	\$ 5.42	\$ 20.67	\$ 7.76	\$ 5.65	\$ 7.82	\$ 6.12	\$ 9.42	\$ 14.66	\$ 6.08	\$ 32.65	\$ 32.18	\$ 31.82	\$ 5.26	\$ 19.40	\$ 5.85	\$ 5.67	\$ 6.25
Mansfield	6094	\$ 8.31	\$ 36.79	\$ 4.12	\$ 11.25	\$ 6.20	\$ 22.94	\$ 18.77	\$ 4.22	\$ 5.74	\$ 4.69	\$ 8.33	\$ 11.50	\$ 2.65	\$ 33.43	\$ 32.96	\$ 32.60	\$ 5.27	\$ 20.18	\$ 6.63	\$ 4.12	\$ 3.91
Mountaineer	6264	\$ 7.90	\$ 36.38	\$ 5.61	\$ 9.34	\$ 5.79	\$ 19.57	\$ 21.30	\$ 5.35	\$ 7.53	\$ 5.82	\$ 6.98	\$ 9.29	\$ 5.64	\$ 33.74	\$ 33.26	\$ 32.89	\$ 3.82	\$ 19.79	\$ 6.22	\$ 5.38	\$ 5.95
Gen JM Gavin	8102	\$ 7.79	\$ 36.27	\$ 5.59	\$ 9.24	\$ 5.69	\$ 20.69	\$ 21.51	\$ 5.33	\$ 7.51	\$ 5.80	\$ 7.17	\$ 10.57	\$ 5.68	\$ 33.63	\$ 33.15	\$ 32.78	\$ 3.49	\$ 20.65	\$ 6.12	\$ 5.36	\$ 5.93
Cheswick	8226	\$ 8.44	\$ 36.92	\$ 2.87	\$ 11.38	\$ 6.33	\$ 18.97	\$ 19.65	\$ 3.93	\$ 7.21	\$ 4.40	\$ 9.30	\$ 11.81	\$ 4.28	\$ 34.27	\$ 33.80	\$ 33.43	\$ 5.40	\$ 17.96	\$ 6.76	\$ 3.83	\$ 3.26

Transportation	2010	ALA	CGH	CPA	ILL	IND	KMC	LTM	NWV	NWV	NWV	OHO	OHO	OHO	PMT	PNW	PSW	QMC	VIR	WKY	WPA	WPA
Cost \$/ton	CLOSED	CMP	SCP	HIS	HIS	HIS	NCP	SCP	HIS	MIS	NCP	HIS	MIS	NCP	SCP	SCP	UCP	NCP	NCP	HIS	MIS	NCP
Big Bend	645	\$ 7.20	\$ 37.33	\$ 9.78	\$ 15.57	\$ 10.77	\$ 20.70	\$ 15.48	\$ 16.32	\$ 16.64	\$ 16.69	\$ 11.80	\$ 17.54	\$ 9.96	\$ 34.36	\$ 33.90	\$ 33.54	\$ 8.95	\$ 19.20	\$ 11.37	\$ 18.21	\$ 16.91
Clifty Creek	983	\$ 7.17	\$ 35.65	\$ 6.27	\$ 12.13	\$ 7.66	\$ 18.63	\$ 7.40	\$ 15.86	\$ 16.23	\$ 14.69	\$ 10.80	\$ 15.54	\$ 8.74	\$ 32.79	\$ 32.32	\$ 31.95	\$ 5.45	\$ 17.62	\$ 8.28	\$ 16.30	\$ 14.85
Tanners Creek	988	\$ 7.26	\$ 35.74	\$ 8.38	\$ 10.47	\$ 6.17	\$ 16.79	\$ 7.49	\$ 14.22	\$ 14.59	\$ 13.04	\$ 9.16	\$ 13.86	\$ 7.09	\$ 33.10	\$ 32.62	\$ 32.25	\$ 5.31	\$ 17.28	\$ 6.72	\$ 16.16	\$ 14.71
Beckjord	2830	\$ 7.34	\$ 35.82	\$ 6.01	\$ 10.28	\$ 5.23	\$ 21.87	\$ 7.57	\$ 14.05	\$ 14.37	\$ 14.42	\$ 9.54	\$ 15.15	\$ 6.19	\$ 32.46	\$ 31.99	\$ 31.63	\$ 5.18	\$ 20.62	\$ 5.66	\$ 14.44	\$ 13.15
Miami Fort	2832	\$ 7.22	\$ 35.70	\$ 8.34	\$ 11.93	\$ 7.63	\$ 22.40	\$ 7.45	\$ 15.68	\$ 16.04	\$ 14.50	\$ 10.61	\$ 15.38	\$ 8.54	\$ 32.34	\$ 31.87	\$ 31.51	\$ 5.26	\$ 21.14	\$ 8.17	\$ 16.12	\$ 14.67
Stuart	2850	\$ 7.67	\$ 36.14	\$ 6.04	\$ 12.35	\$ 8.12	\$ 16.89	\$ 7.90	\$ 14.06	\$ 14.40	\$ 14.44	\$ 9.56	\$ 14.80	\$ 6.22	\$ 32.79	\$ 32.32	\$ 31.96	\$ 5.10	\$ 15.88	\$ 8.63	\$ 14.45	\$ 13.17
Burger	2864	\$ 8.10	\$ 36.58	\$ 5.14	\$ 11.05	\$ 6.00	\$ 22.51	\$ 21.18	\$ 9.95	\$ 10.06	\$ 10.32	\$ 4.41	\$ 10.35	\$ 4.26	\$ 33.94	\$ 33.46	\$ 33.09	\$ 4.98	\$ 21.26	\$ 6.43	\$ 10.34	\$ 9.20
Sammis	2866	\$ 8.27	\$ 36.75	\$ 4.47	\$ 11.21	\$ 6.16	\$ 18.78	\$ 21.40	\$ 10.93	\$ 9.79	\$ 11.30	\$ 8.93	\$ 11.33	\$ 1.34	\$ 34.10	\$ 33.62	\$ 33.26	\$ 5.23	\$ 17.77	\$ 6.59	\$ 10.78	\$ 8.74
Muskingum River	2872	\$ 14.74	\$ 43.22	\$ 14.47	\$ 16.18	\$ 12.64	\$ 26.75	\$ 25.26	\$ 17.32	\$ 19.39	\$ 16.57	\$ 13.56	\$ 13.78	\$ 12.71	\$ 39.86	\$ 39.40	\$ 39.04	\$ 11.20	\$ 27.07	\$ 13.07	\$ 19.24	\$ 19.58
Kyger Creek	2876	\$ 7.80	\$ 36.28	\$ 7.72	\$ 10.75	\$ 5.70	\$ 15.95	\$ 24.52	\$ 14.43	\$ 15.09	\$ 13.50	\$ 9.48	\$ 10.56	\$ 7.83	\$ 33.64	\$ 33.16	\$ 32.79	\$ 3.50	\$ 14.88	\$ 6.13	\$ 14.86	\$ 13.73
Elrama	3098	\$ 16.87	\$ 43.64	\$ 7.10	\$ 18.31	\$ 14.76	\$ 21.99	\$ 17.59	\$ 6.82	\$ 4.18	\$ 7.19	\$ 7.89	\$ 16.58	\$ 7.77	\$ 40.28	\$ 39.81	\$ 39.45	\$ 15.26	\$ 19.93	\$ 15.19	\$ 6.40	\$ 2.77
Hatfield	3179	\$ 19.18	\$ 45.88	\$ 8.67	\$ 20.62	\$ 17.08	\$ 21.81	\$ 17.86	\$ 3.73	\$ 3.53	\$ 4.11	\$ 9.35	\$ 16.36	\$ 9.25	\$ 45.64	\$ 45.13	\$ 44.75	\$ 15.08	\$ 19.83	\$ 17.51	\$ 3.13	\$ 4.59
Mitchell (PA)	3181	\$ 16.69	\$ 43.47	\$ 7.34	\$ 18.13	\$ 14.59	\$ 21.88	\$ 17.48	\$ 6.66	\$ 3.85	\$ 7.04	\$ 7.75	\$ 16.45	\$ 7.71	\$ 40.11	\$ 39.65	\$ 39.29	\$ 15.14	\$ 19.86	\$ 15.01	\$ 6.06	\$ 2.43
Cumberland	3399	\$ 6.26	\$ 35.04	\$ 7.10	\$ 12.31	\$ 7.94	\$ 19.52	\$ 6.49	\$ 15.13	\$ 15.46	\$ 15.51	\$ 10.62	\$ 16.36	\$ 7.28	\$ 31.68	\$ 31.21	\$ 30.85	\$ 6.27	\$ 17.15	\$ 8.66	\$ 15.52	\$ 14.23
Fort Martin	3943	\$ 18.57	\$ 45.28	\$ 9.22	\$ 20.01	\$ 16.46	\$ 21.29	\$ 17.47	\$ 2.37	\$ 4.60	\$ 1.79	\$ 9.74	\$ 15.76	\$ 7.97	\$ 44.84	\$ 44.33	\$ 43.95	\$ 14.56	\$ 19.43	\$ 16.89	\$ 1.39	\$ 5.66
Willow Island	3946	\$ 8.01	\$ 36.49	\$ 5.38	\$ 9.45	\$ 5.91	\$ 20.64	\$ 18.62	\$ 9.03	\$ 11.27	\$ 9.40	\$ 5.61	\$ 11.18	\$ 5.03	\$ 33.13	\$ 32.67	\$ 32.31	\$ 4.64	\$ 20.88	\$ 6.34	\$ 10.92	\$ 11.54
Kammer	3947	\$ 8.10	\$ 36.58	\$ 5.14	\$ 11.04	\$ 6.00	\$ 22.51	\$ 20.73	\$ 9.41	\$ 10.05	\$ 9.79	\$ 4.41	\$ 10.35	\$ 4.26	\$ 33.94	\$ 33.46	\$ 33.09	\$ 4.97	\$ 21.25	\$ 6.42	\$ 9.80	\$ 9.20
Mitchell (WV)	3948	\$ 8.06	\$ 36.54	\$ 5.10	\$ 9.51	\$ 5.96	\$ 16.89	\$ 17.69	\$ 7.88	\$ 8.75	\$ 8.25	\$ 2.87	\$ 10.31	\$ 4.22	\$ 33.19	\$ 32.72	\$ 32.36	\$ 4.94	\$ 17.38	\$ 6.39	\$ 9.77	\$ 9.40
Genoa	4143	\$ 8.29	\$ 30.18	\$ 8.82	\$ 11.65	\$ 6.73	\$ 29.37	\$ 8.52	\$ 16.86	\$ 17.19	\$ 17.24	\$ 12.35	\$ 18.09	\$ 9.00	\$ 24.69	\$ 24.22	\$ 23.86	\$ 8.00	\$ 26.44	\$ 7.16	\$ 17.25	\$ 15.96
East Bend	6018	\$ 12.53	\$ 41.01	\$ 14.25	\$ 17.25	\$ 13.21	\$ 23.83	\$ 12.76	\$ 21.33	\$ 21.68	\$ 20.20	\$ 16.45	\$ 20.97	\$ 14.45	\$ 37.66	\$ 37.19	\$ 36.83	\$ 10.96	\$ 22.81	\$ 13.75	\$ 21.76	\$ 20.86
Zimmer	6019	\$ 7.49	\$ 35.97	\$ 8.34	\$ 12.17	\$ 7.94	\$ 21.85	\$ 7.72	\$ 15.68	\$ 16.05	\$ 14.51	\$ 10.62	\$ 15.16	\$ 8.55	\$ 32.61	\$ 32.14	\$ 31.78	\$ 5.24	\$ 20.59	\$ 8.45	\$ 16.12	\$ 14.67
Killen	6031	\$ 7.53	\$ 36.01	\$ 5.90	\$ 10.47	\$ 5.42	\$ 20.67	\$ 7.76	\$ 13.93	\$ 14.26	\$ 14.30	\$ 9.42	\$ 14.66	\$ 6.08	\$ 32.65							

Energy Dispatch Curve

With & without Mon Closure



Total **Cost Picture** For Electricity Generation

- with Mon Open

Mining	26,918.92
Mine expansion	48.07
Coal transportation	17,008.53
Gas including differential	16,886.29
Penalties	23.58
Unit expansion	2,394.85
O&M	6,154.78
Dispatch non-coal and -gas	6,433.53
Transmission	717.95
Operating clean-up equipment	<u>3,049.98</u>
Total	79,636.48

- with Mon Closed

Mining	26,808.13
Mine expansion	48.09
Coal transportation	17,261.14
Gas including differential	16,844.78
Penalties	29.73
Unit expansion	2,485.44
O&M	6,156.34
Dispatch non-coal and -gas	6,433.91
Transmission	710.47
Operating clean-up equipment	<u>3,057.23</u>
Total	79,835.27

Difference in TOTAL Cost of Satisfying Electricity Demand = \$198.789 million More Cost with Mon Closure (for year 2010 alone)

Some Conclusions

- Loss of Monongahela River navigability does not result in Brown-outs or Black-outs of electricity
- There are traffic pattern shifts with loss of the Mon
 - Movement of low-sulfur coal upstream decreases, as does movement of high-sulfur coal going downstream
 - These losses are made up by coals from within the demanding areas, albeit at a higher cost
- Overall coal production changes little, but there are economic impacts on the electricity side
- Cost of producing U.S. electricity goes up by \$200 million in the one year tested without Mon traffic availability
- Price paid for electricity goes up by about \$1.0 billion for that same one-year period (significantly higher cost units on the margin)
- About 21 million people are directly affected in the “Plants of Interest” areas
- However, by “ripple effect” to other service areas, many more people are affected by the increase in electricity prices



GAMS

Thank You

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