



**Michigan Public Service
Commission Staff**



Michigan Capacity Needs Forum



Central Station Work Group



March 23, 2005

Topics

- **Summary of Construction Costs**
 - **PC Coal**
 - **Combined Cycle GT**
 - **Simple Cycle GT**
- **Emission forecasts PC Coal**
- **Construction Cost Summaries multiple technologies**
 - **EIA**
 - **Wisconsin Public Service Corp**

PC Coal Plant Summary

PC Coal Plant Construction Estimates

Capital Cost	EIA 1 X 600MW	Wolverine 2 X 750	Wisconsin 1 X 515
2003 overnight costs	1,213	1,250	1,467
Inflation adj for 2010 dollar basis @ 3%	279	287	337
Transmission interconnection	142	75	
Mercury control	7		
subtotal	1,634	1,612	1,804
Michigan regional labor rate (assumes 6.5% for 5 years)	7		
Total Plant Capital \$/kW w/o IDC	1,641	1,612	1,804
Steel Cost inflation could raise costs 10-15%			
Emissions (Lb / MBTU)	DECo	Wolverine	Wisconsin
SOx	0.08	0.182	0.12
NOx	0.03	0.07	0.08
Hg	Coal Specific	Unk	3.20E-06
Particulate	0.015	0.035	0.018
CO	100 *	0.12	208.2
VOC		0.004	

* ppm

CCGT Plant Summary

Combined Cycle Plant Construction Estimates			
Capital Cost	EIA	Mirant	Wisconsin
2003 overnight costs	160	320	508
Inflation adj for 2010 dollar basis @ 3%	395	510	583
Transmission interconnection	91	117	134
Mercury control	7		
	subtotal	627	717
Michigan regional labor rate (assumes 6.5% for 5 years)	3		
Total Plant Capital \$/kW w/o IDC	631	627	717

GT Plant Summary

Simple Cycle Plant Construction Estimates		
Capital Cost	Mirant	Wisconsin
2003 overnight costs	140	150
Inflation adj for 2010 dollar basis @ 3%	390	426
Transmission interconnection	90	114
Mercury control		
	subtotal	540
Michigan regional labor rate (assumes 6.5% for 5 years)		
Total Plant Capital \$/kW w/o IDC	480	540

EIA 2005 Annual Energy Outlook Data

Table 38. Cost and Performance Characteristics of New Central Station Electricity Generating Technologies

Technology	Online Year ¹	Size (mW)	Lead time (years)	Base		Project Contingency Factor	Technological Optimism Factor ²	Total Overnight Cost in 2004 ³ (2003 \$/kW)	Variable O&M ⁴ (2003 mills)	Fixed O&M (2003 \$/kW)	Heatrate in 2004 (Btu/kW-hr)	nth-of-a-kind Heatrate (Btu/kW-hr)
				Overnight Cost in 2004 (2003 \$/kW)	Lead time (years)							
Scrubbed Coal New	2008	600	4	1134	1.07	1.00	1213	4.06	24.36	8844	8600	
Integrated Coal-Gasification Comb Cycle (IGCC with carbon sequestration)	2008	550	4	1310	1.07	1.00	1402	2.58	34.21	8309	7200	
Conv Gas/Oil Comb Cycle	2010	380	4	1820	1.07	1.03	2006	3.93	40.26	9713	7920	
Adv Gas/Oil Comb Cycle (CC)	2007	250	3	540	1.05	1.00	567	1.83	11.04	7196	6800	
Adv CC with carbon sequestration	2007	400	3	517	1.08	1.00	558	1.77	10.35	6752	6333	
Conv Comb Turbine ⁵	2010	400	3	992	1.08	1.04	1114	2.60	17.60	8613	7493	
Adv Comb Turbine	2006	160	2	376	1.05	1.00	395	3.16	10.72	10817	10450	
Fuel Cells	2006	230	2	356	1.05	1.00	374	2.80	9.31	9183	8550	
Adv Nuclear	2007	10	3	3679	1.05	1.10	4250	42.40	5.00	7930	6960	
Distributed Generation - Base	2013	1000	6	1694	1.10	1.05	1957	0.44	60.06	10400	10400	
Distributed Generation - Peak	2007	2	3	769	1.05	1.00	807	6.30	14.18	9950	8900	
Biomass	2006	1	2	924	1.05	1.00	970	6.30	14.18	11200	9880	
MSW - Landfill Gas	2008	80	4	1612	1.07	1.02	1757	2.96	47.18	8911	8911	
Geothermal ^{6,7}	2007	30	3	1402	1.07	1.00	1500	0.01	101.07	13648	13648	
Conventional Hydropower ⁶	2008	50	4	2960	1.05	1.00	3108	0.00	104.98	45335	36468	
Wind	2008	500	4	1319	1.10	1.00	1451	4.60	12.35	10338	10338	
Solar Thermal ⁷	2007	50	3	1060	1.07	1.00	1134	0.00	26.81	10280	10280	
Photovoltaic ⁷	2007	100	3	2515	1.07	1.10	2960	0.00	50.23	10280	10280	
	2006	5	2	3868	1.05	1.10	4467	0.00	10.34	10280	10280	

Data does not include Transmission Interconnection costs or IDC

Wisconsin Public Service Corp. Summary Data

Cost & Performance

	Rated Capacity 59 F (MW)	Reserve Capacity 90 F (MW)	Construction Costs (2003\$/kW)	Variable O & M (\$/MWh)	Fixed O & M (\$/kW-yr)	Fuel Cost (\$/MMBTU)	Average Heat Rate (BTU/kWh)	Forced Outage Rate (%)	Scheduled Maintenance Cycle (wks/yr)
Wind	100	20	\$996.50	-\$15.90	\$25.29			0.00%	0
Biomass	50	50	\$2,193.00	\$3.24	\$78.18	\$3.220	13,894	10.00%	3
Farm Digester	19.2	19.2	\$0.00	\$40.00	\$0.00	\$0.000	10,000	0.00%	0
75 MW Combustion Turbine	83.3	74.2	\$513.81	\$2.60	\$4.20	\$4.120	11,666	10.40%	2
150 MW Combustion Turbine	164.7	146.6	\$425.47	\$3.31	\$3.34	\$4.120	10,506	10.50%	2
249 MW Combined Cycle	249.3	234.3	\$796.88	\$3.03	\$9.21	\$4.450	6,955	6.12%	2-2-2-2-6
508 MW Combined Cycle	507.8	483.5	\$582.84	\$2.85	\$4.99	\$4.450	6,855	6.12%	2-2-2-2-6
250 MW Subcritical PC Weston	250	251.8	\$1,848.52	\$3.59	\$19.81	\$0.971	9,638	6.60%	3-3-3-3-6
250 MW Subcritical PC Generic	250	251.8	\$1,949.11	\$3.59	\$39.03	\$0.971	9,638	6.60%	3-3-3-3-6
515 MW Supercritical PC Weston	515	519	\$1,403.28	\$3.48	\$11.23	\$0.971	9,134	6.70%	3-3-3-3-6
515 MW Supercritical PC Generic	515	519	\$1,467.70	\$3.48	\$20.56	\$0.971	9,134	6.70%	3-3-3-3-6
50 MW Rental Capacity (June-July-Aug)	50	50	\$0.00	\$90.00	\$51.50	\$0.000	10,000	0.00%	0

NOTES:

- [1] Cost shown in Dec. 2002\$/s, capital and fixed O&M based upon rated capacity.
- [2] Construction Costs includes Precertification costs and Rail Car costs (where applicable).
- [3] Fixed O&M costs include estimated costs/start
- [4] Average Heat Rate is @ 100% Load and 59°F
- [5] Wind Variable O&M - 10 yr federal tax credit spread over 25 years.

Emission Rates (Units: lb/MMBTU)

	NO _x	SO ₂	Part.	Mercury	CO ₂
Wind	0	0	0	0	0
Biomass	0	0	0	0	0
Farm Digester	0	0	0	0	0
75 MW Combustion Turbine	0.033	0.0006	0.009	0	116.6
150 MW Combustion Turbine	0.033	0.0006	0.009	0	116.6
249 MW Combined Cycle	0.033	0.0006	0.009	0	116.6
508 MW Combined Cycle	0.033	0.0006	0.009	0	116.6
250 MW Subcritical PC Weston	0.08	0.12	0.018	0.0000032	208.2
250 MW Subcritical PC Generic	0.08	0.12	0.018	0.0000032	208.2
515 MW Supercritical PC Weston	0.08	0.12	0.018	0.0000032	208.2
515 MW Supercritical PC Generic	0.08	0.12	0.018	0.0000032	208.2

Data does not include IDC

Summary and Recommendation

- **EIA, Wolverine and Wisconsin data are in general agreement**
 - All parties confirm data is accurate but not precise
- **Better data would require specific analysis**
 - Site selection
 - Fuel selection (Coal source)
 - Environmental control assumptions
 - AE engineering analysis
- **PC Construction costs – 2005 decision 2010 operating date**
 - Low end \$1,600/kW
 - High end \$1,800/kW
 - High steel prices could raise costs by 10-15%
 - Group recommendation ???
- **GT Construction costs – 2005 decision 2010 operating date**
 - CCGT - \$625 – 725/kW
 - GT – \$500 - 550/kW