

less gas turbine power as a result. Additionally, more steam is required for the AGR and a large quantity of IP steam (450,000 lb/hr) is required for the water-gas shift reaction resulting in substantially less steam turbine output.

The auxiliary load of the facility also increases substantially due to the CO₂ compression (approximately 37.1 MW) and the increased auxiliary loads of the AGR. The net result is approximately a 25% reduction in net plant output and a 39% increase in net plant heat rate.

The cooling load of the facility decreases since a large portion of the steam is extracted for the AGR and water-gas shift reaction. However due to the large amount of steam leaving the cycle, the plant makeup requirement has increased by approximately 23%.

Table 13-2 illustrates the impact of CO₂ capture on the IGCC facility.

Table 13-2
IGCC Performance Impacts from CO₂ Capture

	Base Case (100% PRB)	CO ₂ Capture (100% PRB)
Ambient Dry Bulb Temperature, °F	73	73
Ambient Wet Bulb Temperature, °F	69	69
Elevation, ft.	100	100
Evaporative Cooling, On/Off	Off	Off
Coal Heat Input, MMBtu/hr (LHV)	4,705	4,883
Coal Heat Input, MMBtu/hr (HHV)	5,099	5,291
Gas Turbine Gross Output, MW (each)	224.9	213.8
Gas Turbine Gross Output, MW (total)	449.7	427.5
Steam Turbine Gross Output, MW	260.1	202.6
Gross Plant Output, MW	709.9	630.1
Auxiliary Load		
Power Block, MW	22.0	22.0
Material Handling, MW	5.9	6.2
Air Separation Unit, MW	122.1	123.4
Gasifier, MW	2.1	2.2
CO ₂ Compression	0.0	37.1
Syngas Treatment, MW	4.7	26.0
Total Plant Auxiliary Load, MW	156.8	216.8
Net Plant Output, MW	553.0	413.3
Net Plant Heat Rate, Btu/kWh (LHV)	8,510	11,810
Net Plant Heat Rate, Btu/kWh (HHV)	9,220	12,800
Plant Cooling Requirements, MMBtu/hr (Total)	2,141	2,101
Steam Cycle Cooling Requirement, MMBtu/hr	1,480	1,120
BOP Auxiliary Cooling Requirement, MMBtu/hr	661	981
Total Makeup Water Requirement		
GPM	4,980	6,147
Acre-ft/year (@ 85% CF)	6,830	8,430

The O&M for the IGCC facility with and without CO₂ capture is provided in Table 13-4.

Table 13-4
IGCC O&M Impacts from CO₂ Capture

	Base Case (100% PRB)	CO ₂ Capture (100% PRB)
Fixed O&M		
Labor, \$/yr	\$ 11,835,700	\$ 12,209,200
Office and Admin, \$/yr	\$ 118,400	\$ 122,100
Major Inspections, \$/yr	\$ 400,000	\$ 400,000
Standby Power Energy Costs, \$/yr	\$ 98,600	\$ 98,600
Other Fixed O&M, \$/yr	\$ 1,479,500	\$ 1,526,200
Fixed O&M, \$/yr	\$ 13,932,200	\$ 14,356,100
Variable O&M (85% CF)		
Emissions Allowance Costs, \$/yr		
NO _x Emissions Allowance Cost	\$ 3,588,300	\$ 3,604,800
SO ₂ Emissions Allowance Cost	\$ 360,700	\$ 78,800
Hg Emissions Allowance Cost	\$ 590,000	\$ 612,000
Major Maintenance Costs, \$/yr		
Steam Turbine / Generator Overhaul	\$ 260,400	\$ 260,400
HRSG Major Replacements	\$ 200,000	\$ 200,000
Gasifier Replacements	\$ 885,800	\$ 885,800
Candle Filter Major Replacements	\$ 300,000	\$ 300,000
Gas Turbine Major Replacements	\$ 8,148,700	\$ 8,148,700
Syngas Treatment Major Replacements	\$ 375,000	\$ 587,500
Air Separation Unit Major Replacements	\$ 275,000	\$ 275,000
Mercury Carbon Bed Replacements	\$ 530,300	\$ 530,300
HCN/COS Hydrolysis Catalyst Replacements	\$ 640,000	\$ -
Shift Catalyst Replacements	\$ -	\$ 1,020,000
Demin System Replacements	\$ 3,600	\$ 20,100
Water Treatment, \$/yr	\$ 1,479,100	\$ 2,066,800
Fly Ash & Slag Disposal	\$ 1,560,200	\$ 1,560,200
Other Variable O&M, \$/yr	\$ 5,297,400	\$ 6,154,900
Variable O&M, \$/yr (85% CF)	\$ 24,494,500	\$ 26,305,300
Fixed O&M, \$/kW-yr	\$ 25.19	\$ 34.74
Variable O&M, \$/MWh	\$ 5.95	\$ 8.55
Total O&M Cost, \$/Year (85% CF)	\$ 38,426,700	\$ 40,661,400

Table 13-6
SCPC Performance Impacts from CO₂ Capture

	Base Case (100% PRB)	CO ₂ Capture (100% PRB)
Ambient Dry Bulb Temperature, °F	73	73
Ambient Wet Bulb Temperature, °F	69	69
Elevation, ft.	100	100
Coal Heat Input, MMBtu/hr (LHV)	4,644	4,644
Coal Heat Input, MMBtu/hr (HHV)	5,033	5,033
Gross Plant Output, MW	614.5	521.4
Total Plant Auxiliary Load, MW	64.5	131.6
Net Plant Output, MW	550.0	389.8
Net Plant Heat Rate, Btu/kWh (LHV)	8,440	11,910
Net Plant Heat Rate, Btu/kWh (HHV)	9,150	12,910
Plant Cooling Requirements, MMBtu/hr (Total)	2,490	3,330
Steam Cycle Cooling Requirement, MMBtu/hr	2,300	1,354
BOP Auxiliary Cooling Requirement, MMBtu/hr	190	1,976
Total Makeup Water Requirement		
GPM	5,800	7,757
Acre-ft/year (@ 85% CF)	7,950	10,640

SCPC Capital Cost – CO₂ Capture

The additional capital cost encountered once CO₂ capture equipment is installed is shown in Table 13-7. The capital cost is provided in overnight mid-2006 US dollars.

Table 13-8
SCPC O&M Impacts from CO₂ Capture

	Base Case (100% PRB)	CO₂ Capture (100% PRB)
Fixed O&M		
Labor, \$/yr	\$ 9,687,800	\$ 10,434,900
Office and Admin, \$/yr	\$ 96,900	\$ 104,300
Major Inspections, \$/yr	\$ 280,000	\$ 280,000
Standby Power Energy Costs, \$/yr	\$ 98,600	\$ 98,600
Other Fixed O&M, \$/yr	\$ 1,211,000	\$ 1,304,400
Fixed O&M, \$/yr	\$ 11,374,300	\$ 12,222,200
Variable O&M (85% CF)		
Emissions Allowance Costs, \$/yr		
NO _x Emissions Allowance Cost	\$ 2,810,100	\$ 2,529,400
SO ₂ Emissions Allowance Cost	\$ 1,127,900	\$ 4,800
Hg Emissions Allowance Cost	\$ 1,734,700	\$ 1,734,900
Major Maintenance Costs, \$/yr		
Steam Turbine / Generator Overhaul	\$ 339,200	\$ 339,200
Steam Generator Major Replacements	\$ 893,900	\$ 893,900
Baghouse Bag Replacement	\$ 253,400	\$ 253,400
SCR Catalyst Replacement	\$ 312,000	\$ 312,000
Demin System Replacements	\$ 4,300	\$ 4,300
Water Treatment, \$/yr	\$ 1,759,500	\$ 2,372,900
Consumables/Disposal, \$/yr		
Limestone Consumption	\$ 524,700	\$ 551,200
SCR Ammonia (Anhydrous)	\$ 1,041,800	\$ 1,042,000
Scrubber Sludge Disposal	\$ 634,700	\$ 666,800
Fly Ash Disposal	\$ 1,412,600	\$ 1,412,800
Bottom Ash (Sales) / Disposal	\$ 351,900	\$ 351,900
Other Chemical Costs	\$ -	\$ 2,236,500
Other Variable O&M, \$/yr	\$ 5,634,800	\$ 5,634,800
Variable O&M, \$/yr (85% CF)	\$ 18,835,500	\$ 20,340,800
Fixed O&M, \$/kW-yr	\$ 20.68	\$ 31.19
Variable O&M, \$/MWh	\$ 4.60	\$ 6.97
Total O&M Cost, \$/Year (85% CF)	\$ 30,209,800	\$ 32,563,000