Section 8

CAPITAL AND PRODUCTION COST ESTIMATES

INTRODUCTION

Estimates of plant investment and other capital requirements, as well as estimates of the costs of production of the coal liquid products, have been developed for the three coal conversion plants presented in Sections 5, 6, and 7. For reference, the basic parameters of these plants are summarized in Table 8-1. Data developed include:

1. Capital cost estimates

2. Required product selling prices to achieve acceptable returns on equity

3. Analysis of the sensitivity of product selling price to several factors including:

   --Capital cost

   --Technical and economic parameters

   --Alternative financing schemes

Production cost estimates are developed on two bases: first, for nonregulated producers, and second, for regulated utility producers.

Table 8-1

COAL CONVERSION PLANT PARAMETERS

Case		HE	HW	CM
Process		H-Coal	H-Coal	Lurgi Methanol
Type of Coal		Illinois No. 6	Wyodak	Illinois No. 6
Plant Performance				
Coal Feed (As Received)	st/sd	21,891	30,960	25,418
Products				
Propane	bbl/sd	7,175		
Butane	bbl/sd	4,658		
Gasoline	bbl/sd	16,010	21,772	
Turbine Fuel	bbl/sd	27,393	25,880	
Fuel Oil	bbl/sd	6,880	3,743	
Methanol	st/sd			15,919
Ammonia	st/sd	222	162	
Sulfur	st/sd	664	194	768
Phenol	st/sd	50	24	
Power Export	kW	0	18,572	0
Thermal Efficiency,[a]	%	69.7	59.6	53.9
Operating Requirements				
Raw Water	gpm	9,196	8,633	16,624
Ash Disposal (Dry)	st/sd	2,253	1,716	2,646
Operating Jobs/Shift		82	82	60
Land Requirement - Acres		1,000	1,000	1,000

[a] Thermal efficiency is shown for primary fuel products. By-products and power are excluded.

PROJECT CAPITAL AND OPERATING COST ESTIMATING BASES

Table 8-2 presents the parameters used in developing the investment and production cost estimates. This table is divided into several sections as follows:

A. General project parameters as applied to nonregulated producers

B. Modifications to those general project parameters relevant to regulated producers

C. Capital estimating bases

D. Operating cost estimating bases

Tables 8-3, 8-4, and 8-5 present process contingency and maintenance cost rates for the three plants under consideration.

In an effort to quantify the uncertainty in the design and cost of a commercial-scale plant, process contingencies are added to those sections of the plant not considered to be commercially proven at this time. In addition, project contingency is applied at the rate of 15 percent of plant cost including process contingency to allow for additional equipment or other costs that would result from complete design of a specific project at an actual site.

Assumptions and considerations involved in developing the cost estimates are listed below:

- Location - Springfield, Illinois area for Cases HE and CM
  - Gillette, Wyoming area for Case HW

- All field labor data are based on a Stone & Webster labor survey for the plant locations mentioned above.

- Labor productivity is 1.31 for Springfield, Illinois area and 1.25 for Gillette, Wyoming area, based on ample labor being available at the job site. No construction camp cost is included.

- All material, subcontracts, labor, and construction costs are mid-1982.

- A clear and level site is assumed.

- A soil pressure of 3000 lb/sq ft and a frost line of 4 ft are assumed.

- It is assumed that no underground obstructions exist and that site drainage is not required.

- Electrical power is generated at the site with an emergency tie-in to the local power grid.

- Water supply is provided from a river water source including all associated water treating.

- All equipment costs are derived from Stone & Webster in-house estimating data, except for special proprietary items.

- Bulk materials and labor costs are estimated for foundations, electrical services, painting, fireproofing, and structural steel.

- Erection man-hours for equipment are based on Stone & Webster standard estimating labor units. Factored piping, instrumentation, and insulation man-hours are based on man-hour per dollar of material cost.

- All other indirect construction costs are factored based on in-house historical data.

- The following items are excluded: office equipment, office supplies, medical equipment, and expendable laboratory supplies.

Table 8-2

PROJECT CAPITAL AND OPERATING COST ESTIMATING BASES

A. GENERAL PROJECT PARAMETERS - NONREGULATED PRODUCERS

No.	Item	Basis
1.	Cost Estimates	Mid-1982 $
2.	Type of Industry	Non-regulated
3.	Common Equity Capital	100%
4.	Rate of Inflation (Escalation)	8.5% per year
5.	Return on Equity (DCF Rate)	18.3% per year (9.0% excluding inflation)
6.	Plant Schedule	Design & Construction - Commence at the beginning of 1985 Commercial Operation - Start at the beginning of 1990
7.	Schedule of Expenditures	See below
8.	Plant Book Life	20 years
9.	Book Depreciation	Straight Line
10.	Plant Tax Life	5 years
11.	Method of Depreciation	Accelerated Cost Recovery System as follows:

Schedule of Expenditures (item 7):

	Yr	%
(1985)	1	10
	2	20
	3	30
	4	20
	5	20

Method of Depreciation (item 11):

Yr	Depreciable Fraction
1	0.15
2	0.22
3	0.21
4	0.21
5	0.21

Table 8-2 (cont'd)

No.	Item	Basis
12.	Income Tax	Federal Rate - 46% State Rate - 7.4%
13.	Rate of Increase in Coal Purchase Price	

Type Coal	%/Yr Over Inflation Rate
Illinois	0.74
Wyodak	1.5

No.	Item	Basis
14.	Rate of Increase of Competitive Fuel Price	0.74% per year over the Inflation Rate
15.	Competitive Fuel	North African Crude with an average delivered price of $\$6.50/10^6$ Btu mid-1982 basis.

B. MODIFICATIONS TO GENERAL PROJECT PARAMETERS FOR UTILITY-TYPE FINANCING - REGULATED PRODUCER

No.	Item	Basis
1.	Type of Utility	Investor-Owned Utility
2.	Common Equity	35%
3.	Preferred Stock	15%
4.	Debt	50%
5.	Return on Common Equity	15.3% per year
6.	Preferred Stock Dividend	11.5% per year
7.	Interest on Debt	11.0% per year
8.	Plant Book Life	30 years

C. CAPITAL COST ESTIMATING BASES (BOTH TYPES OF PRODUCERS)

No.	Item	Basis
1.	Project Contingency	15%
2.	Process Contingency	(Refer to Tables 8-3, 8-4, 8-5)
3.	Prepaid Royalty	0.5% of Unescalated PFI

Table 8-2 (cont'd)

No.	Item	Basis
4.	Land	\$6200/acre
5.	Organization & Start-up Expenses	Sum of a) One month of fixed operating and maintenance costs b) One month of variable operating costs (calculated at full capacity) c) One week of full capacity fuel or raw materials cost d) 2% of Total Plant Facilities Investment
6.	Investment Tax Credit	8% of Non-expensable, Escalated PFI in the year of expenditure
7.	Working Capital	Sum of a) Two months cost of coal at full capacity b) Three months cost of total labor c) Two months cost of all other operating costs at full capacity d) A contingency of 25% of the total of above three costs
8.	Allowance for Funds During Construction (AFDC)	Cost of money for regulated facility and return on common equity for nonregulated facility.

D. ESTIMATING OPERATING COST BASES (BOTH TYPES OF PRODUCERS)

No.	Item	Basis
1.	Annual Operating Capacity Factor	90%
2.	Coal Price	Illinois Coal-\$1.89/10^6 Btu, HHV Wyodak Coal-\$0.75/10^6 Btu, HHV
3.	Operating Labor	\$17.25/man-hour, including 35% payroll burden

Table 8-2 (cont'd)

No.	Item	Basis
4.	Administrative & Support Labor	30% of the total Operating & Maintenance Labor
5.	Maintenance Cost	(Refer to Table 8-3, 8-4, 8-5)
6.	Maintenance Labor Cost	40% of Maintenance Cost
7.	Maintenance Materials Cost	60% of Maintenance Cost
8.	General & Administrative Expense (Only for nonregulated producer)	0.7% of Unescalated PFI
9.	By-product Credits	Electric Power - 50 mils/kWh Sulfur - \$62.50 per short ton Ammonia - \$70.00 per short ton
10.	Property Tax and Insurance	2% of Escalated PFI
11.	Raw Water Cost	60¢ per 1000 gallons
12.	Ash Disposal Cost	\$5.65 per short ton (dry)

Table 8-3

PROCESS CONTINGENCY AND MAINTENANCE COST RATES
CASE HE

Unit	Section	Process Contingency Percent of Mid-1982 Estimated Base Cost	Maintenance Costs Percent of Mid-1982 Estimated Base Cost
100	Coal Preparation	0	3
200	H-Coal Liquefaction		
201-202-203	Coal Slurrying, H-Coal Reaction, Effluent Separation, Fractionation	30	6
204	Amine Plant	0	2
205	Cryogenic Plant	0	2
206-207-208	Product Upgrading	20	3
300	Light Ends Processing		
301	DGA Amine Plant	0	2
302	Gas Plant (LPG Recovery)	0	2
400	Hydrogen Plant		
401	Gasification (Texaco)	15	4
402	CO Shift	0	3
403	Acid Gas Removal	0	2
500	Oxygen Plant	0	2
600	Emission Control System		
601	Sulfur Recovery (CLAUS)	0	2
602	Tail Gas Treating (SCOT)	15	3
603	Sulfur Flaking	0	2
700	Effluent Control System		
701	Phenol Recovery	0	3
702	Sour Water Stripping	0	3
703	Ammonia Recovery (PHOSAM)	0	3

Table 8-3 (cont'd)

PROCESS CONTINGENCY AND MAINTENANCE COST RATES
CASE HE

Unit	Section	Process Contingency Percent of Mid-1982 Estimated Base Cost	Maintenance Costs Percent of Mid-1982 Estimated Base Cost
800	Tank Storage	0	1.5
900	Refrigeration	0	2
1000	Power Generation	0	1.5
1100	Cooling Water System	0	1.5
1300	Water & Waste Treatment	20	1.5
1400	Flare System	0	1.5
1500	Building	0	1.5
1600	Common Facilities	0	1.5

Table 8-4

PROCESS CONTINGENCY AND MAINTENANCE COST RATES
CASE HW

Unit	Section	Process Contingency Percent of Mid-1982 Estimated Base Cost	Maintenance Costs Percent of Mid-1982 Estimated Base Cost
100	Coal Preparation	20	3
200	H-Coal Liquefaction		
201-202-203	Coal Slurrying, H-Coal Reaction, Effluent Separation, Fractionation	30	6
204	Amine Plant	0	2
205	Cryogenic Plant	0	2
206-207-208	Product Upgrading	20	3
300	Light Ends Processing		
301	DGA Amine Plant	0	2
400	Hydrogen Plant		
401	Gasification (Texaco)	15	4
402	CO Shift	0	3
403	Acid Gas Removal	0	2
405	Gas Reform & Shift	0	4
406	CO_2 Removal	0	3
500	Oxygen Plant	0	2
600	Emission Control System		
601	Sulfur Recovery (CLAUS)	0	2
602	Sulfur Recovery (Beavon and Stretford)	15	3
603	Sulfur Flaking	0	2
700	Effluent Control System		
701	Phenol Recovery	0	3

Table 8-4 (cont'd)

PROCESS CONTINGENCY AND MAINTENANCE COST RATES
CASE HW

Unit	Section	Process Contingency Percent of Mid-1982 Estimated Base Cost	Maintenance Costs Percent of Mid-1982 Estimated Base Cost
702	Sour Water Stripping	0	3
703	Ammonia Recovery (PHOSAM)	0	3
800	Tank Storage	0	1.5
900	Refrigeration	0	2
1000	Power Generation	0	1.5
1100	Cooling Water System	0	1.5
1300	Water & Waste Treatment	20	1.5
1400	Flare System	0	1.5
1500	Buildings	0	1.5
1600	Common Facilities	0	1.5

Table 8-5

PROCESS CONTINGENCY AND MAINTENANCE COST RATES
CASE CM

Unit	Section	Process Contingency Percent of Mid-1980 Estimated Base Cost	Maintenance Costs Percent of Mid-1980 Estimated Base Cost
100	Coal Preparation & Grinding	0	3
200	Slurry Preparation	30	3
300	Air Separation Plant	0	2
400	Gasification, Quench and Scrubbing	15	4
500	Shift Conversion and Heat Recovery	0	3
600	Acid Gas Removal	0	2
700	Sulfur Recovery (CLAUS)	0	2
800	Tail Gas Treating (SCOT)	15	3
900	Methanol Synthesis	0	2.5
1000	Power Generation	0	1.5
1100	Cooling Water System	0	1.5
1200	Tankage-Storage	0	1.5
1300	Water Management	10	1.5
1400	Flare System	0	1.5
1500	Buildings	0	1.5
1600	Common Facilities	0	1.5

CAPITAL COST ESTIMATES

Table 8-6 summarizes capital requirements for the three cases under study. The data presented are based on data developed in subsequent tables and sections as follows:

- Tables 8-7, 8-8, and 8-9 present data on the catalyst and chemical requirements - both for initial fill and for makeup.
- Tables 8-10, 8-11, and 8-12 present the capital cost estimates for the plants by sections, with definition of the elements of these estimates: equipment and material, subcontract, labor, etc.
- The total capital requirements for a facility to start up in 1990 are based on data presented in Appendix A. These data were developed through use of an EPRI computer program designed to develop project costs on a real time basis as well as to develop manufacturing costs.

Table 8-6

CAPITAL REQUIREMENTS SUMMARY

Case	HE	HW	CM
Process	H-Coal	H-Coal	Lurgi Methanol
Coal	Illinois No. 6	Wyodak	Illinois No. 6
Plant Facilities Investment - Mid-1982 $\$10^6$			
Base Estimate	2,032	2,536	2,416
Process Contingencies	224	351	98
Project Contingencies	338	433	377
Total Plant Investment	2,594	3,320	2,891
Initial Fill of Cat. & Chem.	20	21	24
Total Plant Facilities Investment	2,614	3,341	2,915
Total Capital Requirement - Jan 1990 startup @ 8.5% general inflation rate - $\$10^6$			
Nonregulated producer	5,733	7,198	6,367
Regulated, investor-owned utility	5,300	6,640	5,882

Table 8-7

SUMMARY OF CATALYSTS AND CHEMICALS COST
CASE HE

Unit	Catalyst or Chemical	Initial Charge Quantity[a]	Initial Charge Cost $[b]	Annual Makeup[c] Quantity[a]	Annual Makeup[c] Cost $[b]
200	American Cyanamid HDS-1442A Catalyst	998,500 lb	5,419,900	7,063,500 lb	38,340,600
	Startup Oil	13,400 bbl	441,300	-	-
300	DGA (diglycolamine)	100,000 lb	88,500	22,200 lb	20,200
400	Sour Shift Catalyst	1,144,000 lb	10,367,400	251,100 lb	2,275,700
	Selexol Solvent	2,128,000 lb	2,813,100	200,000 lb	264,900
600	Activated Alumina	164,000 lb	108,600	61,100 lb	40,700
	Cobalt Moly Catalyst	343,000 lb	728,100	76,200 lb	162,500
700	Solvent (for Tar Acids)		17,700		103,500
	Sour Water Stripper Chemicals		14,200		64,600
1000/1300	Lime	55 tons	2,000	2,900 tons	102,800
	Soda Ash	47 tons	5,600	2,600 tons	296,300
	Sulfuric Acid (93 percent)	89 tons	7,400	2,200 tons	178,300
	Caustic Soda (100 percent)	12 tons	99,100	160 tons	1,220,700
	Cooling Water Chemicals		14,200		198,000
	Boiler Feedwater Chemicals		7,100		29,300
	TOTAL		20,134,200		43,298,100

[a] Ref: EPRI AF-1297

[b] Mid-1982 dollars

[c] At 100% Annual Capacity Factor

Table 8-8

SUMMARY OF CATALYSTS AND CHEMICALS COST
CASE HW

Unit	Catalyst or Chemical	Initial Charge Quantity[a]	Initial Charge Cost $[b]	Annual Makeup[c] Quantity[a]	Annual Makeup[c] Cost $[b]
200	American Cyanamid HDS-1442A Catalyst	897,600 lb	4,872,200	7,946,700 lb	43,135,600
	Startup Oil	18,000 bbl	594,700	-	-
300	DGA (diglycolamine)	249,000 lb	226,600	43,300 lb	39,300
400	Sour Shift Catalyst	1,192,500 lb	10,807,600	266,700 lb	2,425,600
	Selexol Solvent	2,250,000 lb	2,973,600	210,000 lb	277,800
	HDS Catalyst	1,875 cf	308,000	700 cf	110,100
	Zinc Oxide Adsorbent	2,925 cf	311,500	3,300 cf	346,100
	Reforming Catalyst	1,988 cf	479,100	700 cf	177,000
	High Temp. Shift Catalyst	2,160 cf	181,700	600 cf	53,800
	Low Temp. Shift Catalyst	2,220 cf	398,800	1,200 cf	221,600
	Potassium Carbonate	232,500 lb	55,500	46,700 lb	11,000
	Gas Treatment Chemicals		42,500		5,900
600	Activated Alumina	78,000 lb	51,900	16,700 lb	11,000
	Stretford Process Chemicals		60,200		29,300
700	Solvent (for Tar Acids)		7,900		30,800
	Sour Water Stripper Chemicals		8,400		26,500
1000/1300	Lime	45 tons	1,700	2,300 tons	85,200
	Soda Ash	38 tons	4,500	2,000 tons	236,000
	Sulfuric Acid (93 percent)	120 tons	9,900	2,900 tons	241,200
	Caustic Soda (100 percent)	17 tons	140,400	200 tons	1,652,000
	Cooling Water Chemicals		10,500		150,800
	Boiler Feedwater Chemicals		4,800		19,800
	TOTAL		21,552,000		49,286,400

[a] Ref: EPRI AF-1297

[b] Mid-1982 dollars

[c] At 100% Annual Capacity Factor

Table 8-9

SUMMARY OF CATALYSTS AND CHEMICALS COST
CASE CM

Unit	Catalyst or Chemical	Initial Charge Quantity	Initial Charge Cost $[a]	Annual Makeup[b] Quantity	Annual Makeup[b] Cost $[a]
500	Shift Catalyst	704,700 lb	6,386,200	156,600 lb	1,419,100
600	Methanol	2,000 gal	1,800	1,420,800 gal	1,257,300
700	CLAUS Sulfur Recovery Catalyst	----	2,336,400	----	519,200
800	SCOT Catalyst	----	1,274,400	----	283,200
	Di-Isopropanol Amine	8,000 gal	45,300	21,300 gal	120,600
900	LURGI Methanol Synthesis Catalyst	----	13,957,000	----	3,101,600
1000/ 1300	Lime	525 tons	19,400	13,900 tons	510,800
	Sodium Hydroxide (50%)	200 tons	44,800	2,800 tons	1,244,200
	Miscellaneous	----	30,300	----	512,000
	TOTAL		24,095,600		8,968,000

[a] Mid-1982 dollars

[b] At 100% Annual Capacity Factor

Table 8-10

ESTIMATED PLANT FACILITIES INVESTMENT - CASE HE
BASIS: MID-1982 $1000

		Cost Without Contingencies							Contingencies		
Unit	Plant Section	Equipment & Material	Sub-contract	Labor	In Place Estimate[a]	Overhead & Support[b]	Sales Tax[c]	Total Estimated Base Cost	Process	Project	Total Plant Investment
100	Coal Preparation	57,330	18,095	13,347	---	25,948	1,292	116,012	---	17,402	133,414
200	Coal Liquefaction	238,162	94,324	77,774	53,546	164,347	6,753	634,906	152,606	118,127	905,639
300	Light Ends Processing	7,610	725	2,104	---	4,404	152	14,995	---	2,249	17,244
400	Hydrogen Plant	82,324	147,360	23,287	---	57,754	3,267	313,992	20,277	50,140	384,409
500	Oxygen Plant	---	---	---	116,301	5,015	814	122,130	---	18,320	140,450
600	Emission Control System	25,286	4,228	11,509	---	19,700	536	61,259	2,952	9,632	73,843
700	Effluent Control System	7,738	638	2,369	44,934	10,876	473	67,028	---	10,054	77,082
800	Tank Storage	8,174	23,635	6,391	---	10,405	447	49,052	---	7,358	56,410
900	Refrigeration	6,445	240	2,544	---	4,273	129	13,631	---	2,045	15,676
1000	Power Generation	5,849	136,328	2,613	---	13,471	1,752	160,013	---	24,002	184,015
1100	Cooling Water System	---	---	---	22,420	7,670	291	30,381	---	4,557	34,938
1300	Water & Waste Treatment	---	---	---	204,678	35,267	2,047	241,992	48,399	43,559	333,950
1400	Flare System	---	---	---	5,459	2,323	71	7,853	---	1,178	9,031
1500	Buildings	---	9,989	---	---	3,269	70	13,328	---	1,999	15,327
1600	Common Facilities	65,084	25,303	34,909	---	58,478	1,503	185,277	---	27,791	213,068
TOTAL		504,002	460,865	176,847	447,338	423,200	19,597	2,031,849	224,234	338,413	2,594,496

Initial Fill of Catalysts & Chemicals	20,134
Total Plant Facilities Investment	2,614,630

---

[a] Includes Material, Labor, and a portion of Overhead & Support

[b] Includes Payroll Burden, Field Indirect Cost, Home Office Cost and Fee

[c] 2% Sales Tax on Material and Equipment Cost

Table 8-11

ESTIMATED PLANT FACILITIES INVESTMENT - CASE HW
BASIS: MID-1982 $1000

		Cost		Without		Contingencies			Contingencies		
Unit	Plant Section	Equipment & Material	Sub-contract	Labor	In Place Estimate[a]	Overhead & Support[b]	Sales Tax[c]	Total Estimated Base Cost	Process	Project	Total Plant Investment
100	Coal Preparation	116,735	23,180	18,290	---	41,931	2,544	202,680	40,536	36,482	279,698
200	Coal Liquefaction	363,093	135,346	127,287	65,684	258,025	10,018	959,453	244,867	180,648	1,384,968
300	Light Ends Processing	5,921	552	1,722	---	3,577	118	11,890	---	1,784	13,674
400	Hydrogen Plant	127,698	164,374	32,875	---	80,318	4,361	409,626	15,489	63,767	488,882
500	Oxygen Plant	---	---	---	127,931	5,266	896	134,093	---	20,114	154,207
600	Emission Control System	---	---	---	25,278	4,967	177	30,422	3,107	5,029	38,558
700	Effluent Control System	---	---	---	45,727	8,437	412	54,576	---	8,186	62,762
800	Tank Storage	6,148	19,989	4,884	---	8,163	362	39,546	---	5,932	45,478
900	Refrigeration	---	---	---	9,516	3,074	114	12,704	---	1,906	14,610
1000	Power Generation	10,323	180,266	3,573	---	18,146	2,369	214,677	---	32,201	246,878
1100	Cooling Water System	---	---	---	18,880	6,492	245	25,617	---	3,843	29,460
1300	Water & Waste Treatment	---	---	---	197,696	34,085	1,977	233,758	46,751	42,076	322,585
1400	Flare System	---	---	---	5,459	2,323	71	7,853	---	1,178	9,031
1500	Buildings	---	9,989	---	---	3,269	70	13,328	---	1,999	15,327
1600	Common Facilities	65,084	25,303	34,909	---	58,478	1,505	185,279	---	27,792	213,071
TOTAL		695,002	558,999	223,540	496,171	536,551	25,239	2,53[illegible],502	350,750	432,937	3,319,189

Initial Fill of Catalysts & Chemicals	21,552
Total Plant Facilities Investment	3,340,741

[a] Includes Material, Labor, and a portion of Overhead & Support

[b] Includes Payroll Burden, Field Indirect Cost, Home Office Cost and Fee

[c] 2% Sales Tax on Material and Equipment Cost

Table 8-12

ESTIMATED PLANT FACILITIES INVESTMENT - CASE CM
BASIS: MID-1982 $1000

Unit	Plant Section	Cost Without Contingencies: Equipment & Material	Sub-contract	Labor	In Place Estimate[a]	Overhead & Support[b]	Sales Tax[c]	Total Estimated Base Cost	Contingencies: Process	Project	Total Plant Investment
100	Coal Preparation	34,019	15,488	13,145	---	23,224	805	86,681	---	13,002	99,683
200	Slurry Preparation	3,359	624	1,211	---	2,417	67	7,678	2,303	1,497	11,478
300	Air Separation Plant	---	---	---	523,826	17,698	3,666	545,190	---	81,779	626,969
400	Gasification	283,233	68,032	62,051	---	127,198	6,413	546,927	82,040	94,345	723,312
500	Shift & Heat Recovery	96,371	7,269	22,223	---	42,851	2,000	170,714	---	25,607	196,321
600	Acid Gas Removal	---	---	---	177,000	5,105	1,770	183,875	---	27,581	211,456
700	Claus/Sulfur Flaking	15,441	2,549	7,380	2,707	12,867	346	41,290	---	6,194	47,484
800	SCOT	8,514	1,048	3,663	---	6,291	170	19,686	2,952	3,396	26,034
900	Methanol Synthesis	116,716	3,293	20,914	---	40,053	2,351	183,327	---	27,499	210,826
'000	Power Generation	122,784	9,933	17,049	---	39,366	2,575	191,707	---	28,756	220,463
100	Cooling	24,595	28,620	11,185	---	23,779	864	89,043	---	13,356	102,399
200	Tankage	5,646	16,935	5,317	---	9,982	316	38,196	---	5,729	43,925
1300	Water & Waste Treatment	17,019	51,325	7,624	5,286	23,619	906	105,779	10,578	17,454	133,811
1400	Flare	3,232	58	1,720	---	2,682	65	7,757	---	1,164	8,921
1500	Buildings	1,306	5,601	1,882	---	3,881	65	12,736	---	1,910	14,646
1600	Common Facilities	65,084	25,303	34,909	---	58,478	1,505	185,279	---	27,792	213,071
TOTAL		797,319	236,078	210,274	708,819	439,491	23,884	2,415,865	97,873	377,061	2,890,799

Initial Fill of Catalysts & Chemicals	24,096
Total Plant Facilities Investment	2,914,895

---

[a] Includes Material, Labor, Sub-contract, and a portion of Overhead & Support

[b] Includes Payroll Burden, Field Indirect Cost, Home Office Cost and Fee

[c] 2% Sales Tax on Material and Equipment Cost

PLANT OPERATING COSTS

Estimates of the fixed and variable operating costs for the three cases under study are presented in Tables 8-13, 8-14, and 8-15. These data are based on:

- The plant parameters presented in Table 8-1
- The operating cost bases presented in Table 8-2

and other elements of this study as stated in the tables.

Table 8-13

ESTIMATED PLANT OPERATING COSTS - CASE HE
100% ANNUAL CAPACITY FACTOR
PLANT OUTPUT: 14.175 x 10^9 BTU/HR

Fixed Costs	Basis	Unit Cost	Cost 1982 $\$10^3$/Yr	$\$/10^6$ Btu Output[c]
Operating Labor	82 jobs/shift	\$17.25/man-hr	12,391	
Maintenance Labor	40% of total maintenance cost[a]		24,942	
Maintenance Material	60% of total maintenance cost		37,414	
Administrative and Support Labor	@ 30% of Operating & Maintenance Labor		11,200	
General & Administrative Costs[b]	@ 0.7% of Plant Facilities Investment (see Table 8-10)		18,302	
Taxes & Insurance	@ 2% of Escalated Plant Facilities Investment (see Table A-1)		43,571	
Total Fixed Costs			147,820	1.32
Variable Costs				
Raw Water	9,196 gpm	60¢/10^3 gal	2,900	
Catalyst & Chemicals	See Table 8-7		43,298	
Ash Disposal (Dry)	2253 st/sd	\$5.65/st	4,646	
Total Variable Costs			50,844	0.41
Total Operating Costs (Nonregulated Producer)				1.73

[a] Total maintenance costs based on applying the factors presented in Table 8-3 to the section capital costs presented in Table 8-10.

[b] Nonregulated producer only - not included in the regulated, investor-owned utility case.

[c] Unit costs calculated for 90% Annual Capacity Factor.

Table 8-14

ESTIMATED PLANT OPERATING COSTS - CASE HW
100% ANNUAL CAPACITY FACTOR
PLANT OUTPUT: 12.284×10^9 BTU/HR

Fixed Costs	Basis	Unit Cost	Cost 1982 $\$10^3$/Yr	$\$/10^6$ Btu Output[c]
Operating Labor	82 jobs/shift	\$17.25/person-hr	12,391	
Maintenance Labor	40% of total maintenance cost[a]		34,536	
Maintenance Material	60% of total maintenance cost		51,803	
Administrative and Support Labor	@ 30% of Operating & Maintenance Labor		14,078	
General & Administrative Costs[b]	@ 0.7% of Plant Facilities Investment (see Table A-6)		23,385	
Taxes & Insurance	@ 2% of Escalated Plant Facilities Investment (see Table A-6)		55,672	
Total Fixed Costs			191,865	1.98
Variable Costs				
Raw Water	8,633 gpm	60¢/10^3 gal	2,724	
Catalyst & Chemicals	See Table 8-8		49,287	
Ash Disposal (Dry)	1,716 st/sd	\$5.65/st	3,539	
Total Variable Costs			55,550	0.52
Total Operating Costs (Nonregulated Producer)				2.50

[a] Total maintenance costs based on applying the factors presented in Table 8-4 to the section capital costs presented in Table 8-11.

[b] Nonregulated producer only - not included in the regulated, investor-owned utility case.

[c] Unit costs calculated for 90% Annual Capacity Factor

Table 8-15

ESTIMATED PLANT OPERATING COSTS - CASE CM
100% ANNUAL CAPACITY FACTOR
PLANT OUTPUT: 12.726×10^9 BTU/HR

Fixed Costs	Basis	Unit Cost	Cost 1982 $\$10^3$/Yr	$\$/10^6$ Btu Output[c]
Operating Labor	60 jobs/shift	$17.25/man-hr	9,067	
Maintenance Labor	40% of total maintenance cost[a]		23,949	
Maintenance Material	60% of total maintenance cost		35,923	
Administrative and Support Labor	@ 30% of Operating & Maintenance Labor		9,905	
General & Administrative Costs[b]	@ 0.7% of Plant Facilities Investment (see Table 8-12)		20,404	
Taxes & Insurance	@ 2% of Escalated Plant Facilities Investment (see Table A-11)		48,576	
Total Fixed Costs			147,824	1.47
Variable Costs				
Raw Water	16,624 gpm	60¢/10^3 gal	5,243	
Catalyst & Chemicals	See Table 8-9		8,968	
Ash Disposal (Dry)	2,646 st/sd	$5.65/st	5,457	
Total Variable Costs			19,668	0.18
Total Operating Costs (Nonregulated Producer)				1.65

[a] Total maintenance costs based on applying the factors presented in Table 8-5 to the section capital costs presented in Table 8-12.

[b] Nonregulated producer only - not included in the regulated, investor-owned utility case.

[c] Unit costs calculated for 90% Annual Capacity Factor.

PRODUCTION COSTS

Using the investment and operating requirement data developed in earlier parts of this section, required selling prices have been developed for the fuel products produced in the three cases under study. Required selling price for a nonregulated producer, in mid-1982 dollars, is defined as the price which, if escalated at the general inflation rate, together with coal and other operating costs, will yield the producer a stipulated minimum acceptable rate of return of common equity. As noted in Table 8-2, the inflation rate is assumed to be 8.5 percent per year and the after tax rate of return on common equity is 18.3 percent per year. This rate of return is equivalent to 9.0 percent per year in the absence of inflation (1.09 x 1.085 = 1.183).

For a regulated producer, the year-by-year price is determined which would provide the specified return on investment. Also, for comparison purposes, a levelized price is calculated in mid-1982 dollars, which is financially equivalent.

These required selling prices, as well as development of the capital outlay schedules, have been developed using the EPRI E&EE computer program. This program accomplishes several objectives including accounting for the annual requirements for funds during construction, the annual rates of capital recovery (both debt and equity), the annual revenue requirements, and the levelized required selling price. A more complete discussion of the program outputs and examples of these outputs for the cases under study are presented in the Appendix.

Tables 8-16 and 8-17 present the results of this computer analysis for the non-regulated and the utility cases, respectively. Also included are the outputs of several computer runs made to assess the sensitivity of the required selling price to several important variables.

Table 8-16

PLANT INVESTMENT AND REQUIRED PRODUCT SELLING PRICES
NONREGULATED PRODUCER

Case	HE	HW	CM
Process	H-Coal	H-Coal	Lurgi Methanol
Coal	Illinois No. 6	Wyodak	Illinois No. 6
Plant Investment - $\$10^6$			
Plant Facilities - Mid-1982 basis	2,615	3,341	2,915
Total Capital - Jan 1990 startup	5,733	7,198	6,367
Required Product Selling Price - Base Case Mid-1982 $\$/10^6$ Btu - Levelized	9.06	10.46	10.94
Return on equity when product is sold at competitive fuel price, %/yr[a]	12.86	11.27	8.22
Sensitivity Studies - impact on required selling price - $\$/10^6$ Btu (% change)			
After tax return on equity increases to 25%	12.85 (+41.8)	15.98 (+52.8)	15.63 (+42.9)
35% increase in plant facilities investment	10.71 (+18.2)	12.90 (+23.3)	12.99 (+18.7)
3%/yr increase in real cost of coal	10.24 (+13.0)	10.85 (+3.7)	12.46 (+13.9)
10% decrease in thermal efficiency	10.07 (+11.1)	11.62 (+11.1)	12.16 (+11.1)
10% increase in thermal efficiency	8.24 (-9.1)	9.51 (-9.1)	9.95 (-9.1)
Inflation rate decreases to 5%/yr	8.95 (-1.2)	10.27 (-1.8)	10.80 (-1.3)
75% debt financing @ 12% interest	6.50 (-28.3)	6.68 (-36.1)	7.75 (-29.2)
Expensing of investment during construction			
100% equity	7.72 (-14.8)		
50% debt @ 12%, 50% equity	6.01 (-33.7)		

[a] Return on equity, base case, 18.3% per year. Assume competitive fuel price (mid-1982 basis) is $\$6.50/10^6$ Btu.

Table 8-17

PLANT INVESTMENT AND REQUIRED PRODUCT SELLING PRICES
REGULATED PRODUCER - INVESTOR-OWNED UTILITY

Case	HE	HW	CM
Process	H-Coal	H-Coal	Lurgi Methanol
Coal	Illinois No. 6	Wyodak	Illinois No. 6
Plant Investment - $\$10^6$			
Plant Facilities - Mid-1982 basis	2,615	3,341	2,915
Total Capital - Jan 1990 startup	5,300	6,640	5,882
Required Product Selling Price - Base Case Mid 1982 $\$/10^6$ Btu			
Levelized	5.78	5.66	6.88
First Year (1990)	9.55	11.26	11.54
Third Year (1992)	7.91	8.85	9.51
Fifth Year (1994)	6.57	6.87	7.86
Tenth Year (1999)	5.36	5.07	6.36
Fifteenth Year (2004)	4.87	4.32	5.76
Thirtieth Year (2019)	4.53	3.73	5.36
Sensitivity Studies - impact on required selling price - $\$/10^6$ Btu (% change)			
3%/yr increase in real cost of coal	7.59 (+31.3)	6.28 (+11.0)	9.22 (+34.0)
35% increase in plant facilities investment	6.36 (+10.0)	6.52 (+15.2)	7.60 (+10.5)
10% decrease in thermal efficiency	6.42 (+11.1)	6.29 (+11.1)	7.64 (+11.1)
Inflation rate decreases to 5%	5.85 (+1.2)	5.73 (+1.2)	6.97 (+1.3)
10% increase in thermal efficiency	5.25 (-9.1)	5.15 (-9.1)	6.25 (-9.1)