

**APPENDIX A**  
**INSIDE BATTERY LIMIT COSTS**

The inside battery limit (ISBL) costs presented in this report reflect a current U.S. Gulf Coast battery limits price. The costs consist of a materials and labor (M & L) estimate, a design allowance, engineering and contractor's fees, and overheads and expenses allowance.

The M & L estimates have been derived by scaling detailed estimates prepared for similar units on the basis of U.S. Gulf Coast erection to UOP standards and specifications. The M & L estimates are intended to include all direct material and labor, indirect field costs, and labor benefits that are associated with the erection of the battery limits process equipment, including the following specific equipment, categories, and services as and when required:

Heaters	Compressor shelter
Vessels and internals	Control house
Heat exchange equipment	Catalyst-handling equipment
Pumps	Sundry construction equipment
Drivers	Temporary field office, warehouse, change house, etc.
Compressors	Field testing
Piping	Expendable tools
Instruments	Clerical costs associated with construction
Electrical	Final cleaning
Insulation	Miscellaneous field costs
Structural steelwork	Fringe benefits
Fireproofing	
Paving and concrete work	

An allowance for design, engineering and contractor's fees, and overheads and expenses, primarily based on prior UOP experience, has been added to the total material and labor estimate to reach an overall erected cost estimate for the battery limits plant. These allowances are intended to cover the following charges:

**UOP:** Basic process and engineering design specifications and drawings (Schedule A package), including review of contractor's detailed design of specified equipment items.

**Contractor:** Detailed engineering  
Purchasing, expediting, and inspection  
Construction tools and equipment rental  
Contractor's field and home office expenses  
Erection supervision  
Contractor's fees

Items not included in the estimated UOP ISBL costs are as follows, unless otherwise specified as included:

- Cost of land, site preparation, and soil investigation
- Piling or any unusual foundation requirements
- Docks, marine terminals, or jetties
- Access roads to site
- Home office administration building
- Employees housing, worker's barracks, canteens, recreation facilities, etc.
- Overtime pay during construction
- Owner's expenses in developing the project
- Know-how fees and royalties on licensed processes
- Local permits, taxes, and fees or other specific costs of doing business in the area
- Items concerned with export shipment, such as ocean freight, marine insurance, import taxes, customs, etc.
- Operating capital and investment in goods in progress
- Escalation on materials and labor as a result of price fluctuation or economic conditions
- Contingencies
- Cost of start-up, including testing, manpower, utilities, operating manuals, and training programs
- Spare parts, special tools, or maintenance equipment

- Catalysts, chemicals, and raw materials including initial fill
- Customer or national standards or codes
- Special pollution or noise control facilities
- Electrical main substations
- Power generation
- Water or hydrocarbon pipelines
- Additions or extensions to utilities systems or offsites
- Laboratory supplies
- Special communications or computer systems

The following assumptions are normally made regarding economic conditions at the time the job is bid:

- An adequate supply of skilled labor will be available for construction.
- Contractors will engage in competitive bidding.
- The plant will be constructed in the U.S. Gulf Coast area.
- No time will be lost as a result of climatic conditions.
- The M & L estimates prices are valid as of the date of the estimate.

**APPENDIX B**  
**INTERNAL RATE OF RETURN (IRR)**  
**CALCULATION METHOD**

## **Appendix B**

### **CALCULATION METHOD FOR FIGURING INTERNAL RATE OF RETURN (IRR)**

1. Determine the total fixed investment (INV) for the complex. The INV is composed of three factors:
  - The inside-battery-limits (ISBL) costs (the costs for the process units).
  - An allowance of 50% of the ISBL is added for offsites. The value of 50% is rather arbitrary and depends on many factors, such as the site, existing utility structure, etc.
  - The interest on the capital already spent is added in. Capital expenditures occur over a three-year construction period: 20% of ISBL in the first year, 50% in the second year, and 30% in the third year. The interest on the capital is assumed to be 10% per year.
2. The cash-flow calculations are calculated over a 20-year period. The calculations use three simplifying assumptions: 100% equity basis (no interest charges in the pretax income calculation), constant dollar basis (no inflation), and no taxes. These assumptions will not affect the conclusions because conclusions are drawn by comparing rather than by looking at absolute dollar values.

$$CF(t) = P - F - VE - FE$$

Where:

P = Product Revenue

F = Feedstock cost

VE = Variable expenses (catalyst, utilities, etc.)

FE = Fixed expenses (labor, maintenance, overheads, etc.)

CF(t) = Cash flow for year t

3. The discounted cash flow equation to be solved for the discounted internal rate of return (IRR) is:

$$\sum_{t=1}^{20} \frac{CF(t)}{(1+IRR)^t} = INV + CAT + WC$$

where:

CAT = Cost of initial catalyst loading and royalties

WC = Working capital

**APPENDIX C**  
**ECONOMIC ANALYSIS TABULATIONS**

Arge: Base Case

Synthol: Base Case

Arge: Sensitivity to Product Prices (Base x1.5)

Synthol: Sensitivity to Product Prices (Base x1.5)

Arge: Sensitivity to Feed Costs (Base x1.2)

Arge: Sensitivity to Feed Costs (Base x1.1)

Synthol: Sensitivity to Feed Costs (Base x1.1)

Arge: Sensitivity to Plant Capital (Base x1.5)

Synthol: Sensitivity to Plant Capital (Base x1.5)

## C.1 ARGE: Base Case

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$MM/yr.
Gasoline	MT	2,119.9	242	171.0
Diesel	MT	2,802.4	193	180.3
Total products		4,922.3	214	351.3
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	75.3	694	17.4
Fuel gas	MT	262.4	121	10.6
LPG	MT	48.6	140	2.3
Total by-prds.	MT	386.3	235	30.3
Total Products		5,308.6		381.6
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	533.5	140	24.9
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	1,015.9	160	54.2
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	788.9	193	50.8
C <sub>19</sub> <sup>+</sup>	MT	2,934.2	125	122.3
H <sub>2</sub> rich gas	MT	36.2	694	8.4
Total Feedstocks		5,308.7	147	260.5

### CAPITAL ITEMS

Plant Investment	\$ MM
Cyclar	28.55
Splitter + Alkymax	6.89
NHT plus splitter	8.80
CCR Platformer	13.02
Penex/Molex	10.20
HC Unibon	29.15
Total ISBL	96.61
OSBL @ 50% of ISBL	48.31
Interest @ 10% 3 yrs.	29.16
Total fixed investment	174.07
Catalyst, Adsorbent & Royalties	21.15
Total plant investment	195.22
<b>Working capital</b>	
Total working capital	44.75

### Consumables: catalysts and chemicals

.79

### ECONOMIC ANALYSIS

Utilities	Units	Units per hour		
Power	kWh	9,023	.06	4.33
Steam, HP	Mlb	12.3	4.50	.44
Steam, MP	Mlb	16.7	4.00	.53
Steam, LP	Mlb	22.7	3.00	.54
BFV	Mlb	21.3	.40	.07
Condensate	Mlb	-67.6	.40	-.22
CW circul.	mGal	493.0	.10	.39
Fuel fired	mmBtu	334.2	3.00	8.02
Total Utilities				14.12

	\$MM/yr.	\$/MT products	%
Gasoline sales	171.01	104.22	
Diesel sales	180.29	109.88	
Feedstocks - byproducts	230.19	140.30	80.61%
Gross margin	121.10	73.81	

### Variable costs

Cats. & chemicals	.79	.48	.28%
Utilities	14.12	8.61	4.94%
Total variable costs	14.91	9.09	

### Fixed costs

Labor	3.79	2.31	
Maintenance	3.48	2.12	
Overheads	6.25	3.81	
Other expenses	4.47	2.73	
Total fixed costs	17.99	10.97	6.30%

### Cash cost of production

Cash cost of production	263.09	160.35	
Cash flow	88.20	53.76	

### Capital costs

Plant depreciation	17.41	10.61	
Royalty amortization plus inventory depletion	5.06	3.09	
Total capital costs	22.47	13.69	7.87%

### Net cost of production

Net cost of production	285.56	174.04	100.00%
Pre-tax income	65.73	40.06	

### Simple pre-tax ROI, %

Simple pre-tax ROI, %	27.39		
Simple payback, years	2.72		

### DCF IRR, %

DCF IRR, %	34.91 @ 10 years ; 36.68 @ 20 years		
DCF payback, yrs.	3.75 @ 15% ; 3.33 @ 10%		

Prod. sale price, \$/MT	20% IRR	\$195 @ 10 years ; \$190 @ 20 years	
	30% IRR	\$208 @ 10 years ; \$204 @ 20 years	
	40% IRR	\$221 @ 10 years ; \$219 @ 20 years	

Note: Products reflect the total tonnage of gasoline and diesel

### FIXED COSTS

<b>Labor</b>			
Ops. per shift	13 @ \$36,000 per year	2.25	
Supervision	25% of operating labor	.56	
Direct ovhd.	35% of labor & superv.	.98	
		3.79	

<b>Maintenance</b>			
Mtrls. & labor	2% of fixed investment	3.48	

<b>Overhead expenses</b>			
Plant ovhd.	50% of labor & mainten.	3.64	
Tax & insrnce.	2% of fixed investment	2.61	
		6.25	

<b>Other expenses</b>			
Intrst. on captl. debt	0% per year	.00	
Intrst. wkng. capital	10% per year	4.47	
		4.47	

<b>Depreciation &amp; amortization</b>			
ISBL	10% per year	11.60	
OSBL	10% per year	5.80	

Catalysts, adsorbents and royalties		5.06	
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Total		22.47	
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## C.2 SYNTHOL: Base Case

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$MM/yr.
Gasoline	MT	3,027.5	242	244.2
Diesel	MT	397.3	193	25.6
Total products		3,424.8	236	269.8
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	121.5	694	28.1
Fuel gas	MT	548.7	121	22.1
LPG	MT	80.0	140	3.7
C19+ Fuel	MT	227.0	125	9.5
Total by-prds.	MT	977.2	195	63.4
Total Products		4,402.0		333.2
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	1,418.9	140	66.2
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	2,270.2	160	121.1
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	397.3	193	25.6
C <sub>19</sub> +	MT	227.0	125	9.5
H <sub>2</sub> rich gas	MT	88.6	694	20.5
Total Feedstocks		4,402.0	165	242.8

Consumables: catalysts and chemicals

1.38

Utilities		Units per hour		
Power	kWh	11,710	.06	5.62
Steam, HP	Mlb	-34.6	4.50	-1.25
Steam, MP	Mlb	14.8	4.00	.47
Steam, LP	Mlb	41.0	3.00	.98
BFW	Mlb	66.7	.40	.21
Condensate	Mlb	-76.0	.40	-.24
CV circul.	mGal	1081.0	.10	.86
Fuel fired	mmBtu	491.1	3.00	11.79
Total Utilities				18.45

### FIXED COSTS

<b>Labor</b>				
Ops. per shift	12 @	\$36,000 per year	2.07	
Supervision	25% of operating labor		.52	
Direct ovhd.	35% of labor & superv.		.91	
			3.50	
<b>Maintenance</b>				
Mtrls. & labor	2% of fixed investment		3.84	
<b>Overhead expenses</b>				
Plant ovhd.	50% of labor & mainten.		3.67	
Tax & insnce.	2% of fixed investment		2.88	
			6.55	
<b>Other expenses</b>				
Intrst. on captl. debt	0% per year		.00	
Intrst. wkng. capital	10% per year		3.81	
			3.81	
<b>Depreciation &amp; amortization</b>				
ISBL	10% per year		12.79	
OSBL	10% per year		6.40	
Catalysts, adsorbents and royalties			9.48	

Total

28.67

### CAPITAL ITEMS

Plant investment	\$ MM
Huels/Cyclar	52.48
Splitter + Alkymax	11.01
MHT plus splitter	9.85
CCR Platformer	12.67
Penex/Molex	13.53
Distillate Finishing	6.94
Total ISBL	106.48
OSBL @ 50% of ISBL	53.24
Interest @ 10% 3 yrs.	32.14
Total fixed investment	191.86
Catalyst, Adsorbent & Royalties	31.17
Total plant investment	223.03

### Working capital

Total working capital

\$ MM

38.14

### ECONOMIC ANALYSIS

	\$MM/yr.	\$/MT products	%
Gasoline sales	244.22	213.93	
Diesel sales	25.56	22.39	
Feedstocks - byproducts	179.38	157.13	73.04%
Gross margin	90.40	78.19	
<b>Variable costs</b>			
Cats. & chemicals	1.38	1.21	.56%
Utilities	18.45	16.17	7.51%
Total variable costs	19.84	17.38	
<b>Fixed costs</b>			
Labor	3.50	3.07	
Maintenance	3.84	3.36	
Overheads	6.55	5.73	
Other expenses	3.81	3.34	
Total fixed costs	17.70	15.50	7.21%
Cash cost of production	216.91	190.01	
Cash flow	52.87	46.31	
<b>Capital costs</b>			
Plant depreciation	19.19	16.81	
Royalty amortization plus inventory depletion	9.48	8.31	
Total capital costs	28.67	25.11	11.67%
Net cost of production	245.58	215.12	100.00%
Pre-tax income	24.20	21.20	
Simple pre-tax ROI, %	9.26		
Simple payback, years	4.84		
DCF IRR, %	15.42 @ 10 years ; 19.69 @ 20 years		
DCF payback, yrs.	9.67 @ 15% ; 7.15 @ 10%		
Prod. sale price, \$/MT	20% IRR \$245 @ 10 years ; \$237 @ 20 years		
	30% IRR \$264 @ 10 years ; \$259 @ 20 years		
	40% IRR \$285 @ 10 years ; \$282 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

### C.3 ARGE: Sensitivity to Product Prices (Base x1.5)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

#### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$/MM/yr.
Gasoline	MT	2,119.9	363	256.5
Diesel	MT	2,802.4	290	270.4
Total products		4,922.3	321	526.9
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	75.3	694	17.4
Fuel gas	MT	262.4	121	10.6
LPG	MT	48.6	140	2.3
Total by-prds.	MT	386.3	235	30.3
Total Products		5,308.6		557.2
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	533.5	140	24.9
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	1,015.9	160	54.2
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	788.9	193	50.8
C <sub>19</sub>	MT	2,934.2	125	122.3
H <sub>2</sub> rich gas	MT	36.2	694	8.4
Total Feedstocks		5,308.7	147	260.5

#### Consumables: catalysts and chemicals

.79

Utilities		Units per hour		
Power	kWh	9,023	.06	4.33
Steam, HP	Mlb	12.3	4.50	.44
Steam, MP	Mlb	16.7	4.00	.53
Steam, LP	Mlb	22.7	3.00	.54
BFW	Mlb	21.3	.40	.07
Condensate	Mlb	-67.6	.40	-.22
CW circula.	mGal	493.0	.10	.39
Fuel fired	mmBtu	334.2	3.00	8.02
Total Utilities				14.12

#### FIXED COSTS

<b>Labor</b>			
Ops. per shift	13 @ \$36,000 per year		2.25
Supervision	25% of operating labor		.56
Direct ovhd.	35% of labor & superv.		.98
			3.79
<b>Maintenance</b>			
Mtrls. & labor	2% of fixed investment		3.48
<b>Overhead expenses</b>			
Plant ovhd.	50% of labor & mainten.		3.64
Tax & insnce.	2% of fixed investment		2.61
			6.25
<b>Other expenses</b>			
Intrst. on captl. debt	0% per year		.00
Intrst. wkng. capital	10% per year		7.18
			7.18
<b>Depreciation &amp; amortization</b>			
ISBL	10% per year		11.60
OSBL	10% per year		5.80
Catalysts, adsorbents and royalties			5.06

Total

22.47

#### CAPITAL ITEMS

<b>Plant Investment</b>		<b>\$ MM</b>
Cyclar		28.55
Splitter + Alkymax		6.89
NHT plus splitter		8.80
CCR Platformer		13.02
Penex/Molex		10.20
MC Unibon		29.15
Total ISBL		96.61
OSBL @ 50% of ISBL		48.31
Interest @ 10% 3 yrs.		29.16
Total fixed investment		174.07

#### Catalyst, Adsorbent & Royalties

21.15

Total plant investment

195.22

#### Working capital

\$ MM

Total working capital

71.77

#### ECONOMIC ANALYSIS

	\$/MM/yr.	\$/MT products	%
Gasoline sales	256.51	156.33	
Diesel sales	270.43	164.82	
Feedstocks - byproducts	230.19	140.30	79.85%
Gross margin	296.75	180.86	
<b>Variable costs</b>			
Cats. & chemicals	.79	.48	.27%
Utilities	14.12	8.61	4.90%
Total variable costs	14.91	9.09	
<b>Fixed costs</b>			
Labor	3.79	2.31	
Maintenance	3.48	2.12	
Overheads	6.25	3.81	
Other expenses	7.18	4.37	
Total fixed costs	20.70	12.61	7.18%
Cash cost of production	265.80	162.00	
Cash flow	261.14	159.16	
<b>Capital costs</b>			
Plant depreciation	17.41	10.61	
Royalty amortization plus inventory depletion	5.06	3.09	
Total capital costs	22.47	13.69	7.79%
Net cost of production	288.27	175.69	100.00%
Pre-tax income	238.67	145.46	
Simple pre-tax ROI, %	89.39		
Simple payback, years	1.02		
DCF IRR, %	97.70 @ 10 years ; 97.81 @ 20 years		
DCF payback, yrs.	1.19 @ 15% ; 1.13 @ 10%		
Prod. sale price, \$/MT	20% IRR \$201 @ 10 years ; \$195 @ 20 years		
	30% IRR \$215 @ 10 years ; \$211 @ 20 years		
	40% IRR \$229 @ 10 years ; \$227 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

## C.4 SYNTHOL: Sensitivity to Product Prices (Base x1.5)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	per day	\$/unit	\$MM/yr.
Gasoline	MT	3,027.5	363	366.3
Diesel	MT	397.3	290	38.3
Total products		3,424.8	354	404.7
<u>By-products</u>				
H <sub>2</sub> Rich Gas	MT	121.5	694	28.1
Fuel gas	MT	548.7	121	22.1
LPG	MT	80.0	140	3.7
C19+ Fuel	MT	227.0	125	9.5
Total by-prds.	MT	977.2	195	63.4
Total Products		4,402.0		468.1
<u>Feedstocks</u>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	1,418.9	140	66.2
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	2,270.2	160	121.1
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	397.3	193	25.6
C <sub>19</sub> +	MT	227.0	125	9.5
H <sub>2</sub> rich gas	MT	88.6	694	20.5
Total Feedstocks		4,402.0	165	242.8

Consumables: catalysts and chemicals

1.38

Utilities	Units	per hour		
Power	kWh	11,710	.06	5.62
Steam, HP	Mlb	-34.6	4.50	-1.25
Steam, MP	Mlb	14.8	4.00	.47
Steam, LP	Mlb	41.0	3.00	.98
BFV	Mlb	66.7	.40	.21
Condensate	Mlb	-76.0	.40	-.24
CW circul.	mGal	1081.0	.10	.86
Fuel fired	mmBtu	491.1	3.00	11.79
Total Utilities				18.45

### FIXED COSTS

<u>Labor</u>				
Ops. per shift	12 @	\$36,000 per year		2.07
Supervision	25% of operating labor			.52
Direct ovhd.	35% of labor & superv.			.91
				3.50
<u>Maintenance</u>				
Mtrls. & labor	2% of fixed investment			3.84
<u>Overhead expenses</u>				
Plant ovhd.	50% of labor & mainten.			3.67
Tax & insrnce.	2% of fixed investment			2.88
				6.55
<u>Other expenses</u>				
Intrst. on captl. debt	0% per year			.00
Intrst. wkng. capital	10% per year			5.89
				5.89
<u>Depreciation &amp; amortization</u>				
ISBL	10% per year			12.79
OSBL	10% per year			6.40
Catalysts, adsorbents and royalties				9.48

Total

28.67

### CAPITAL ITEMS

<u>Plant Investment</u>	\$ MM
Huels/Cyclar	52.48
Splitter + Alkymax	11.01
NHT plus splitter	9.85
CCR Platformer	12.67
Penex/Molex	13.53
Distillate Finishing	6.94
Total ISBL	106.48
OSBL @ 50% of ISBL	53.24
Interest @ 10% 3 yrs.	32.14
Total fixed investment	191.86
Catalyst, Adsorbent & Royalties	31.17
Total plant investment	223.03

### Working capital

\$ MM

Total working capital

58.90

### ECONOMIC ANALYSIS

	\$MM/yr.	\$/MT products	%
Gasoline sales	366.33	320.89	
Diesel sales	38.34	33.58	
Feedstocks - byproducts	179.38	157.13	72.43%
Gross margin	225.29	197.35	
<u>Variable costs</u>			
Cats. & chemicals	1.38	1.21	.56%
Utilities	18.45	16.17	7.45%
Total variable costs	19.84	17.38	
<u>Fixed costs</u>			
Labor	3.50	3.07	
Maintenance	3.84	3.36	
Overheads	6.55	5.73	
Other expenses	5.89	5.16	
Total fixed costs	19.77	17.32	7.98%
Cash cost of production	218.89	191.83	
Cash flow	185.88	162.65	
<u>Capital costs</u>			
Plant depreciation	19.19	16.81	
Royalty amortization plus inventory depletion	9.48	8.31	
Total capital costs	28.67	25.11	11.58%
Net cost of production	247.66	216.94	100.00%
Pre-tax income	157.01	137.54	
Simple pre-tax ROI, %	55.69		
Simple payback, years	1.52		
DCF IRR, %	65.43 @ 10 years ; 65.86 @ 20 years		
DCF payback, yrs.	1.85 @ 15% ; 1.73 @ 10%		
Prod. sale price, \$/MT	20% IRR \$251 @ 10 years ; \$243 @ 20 years		
	30% IRR \$272 @ 10 years ; \$266 @ 20 years		
	40% IRR \$294 @ 10 years ; \$291 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

## C.5 ARGE: Sensitivity to Feed Costs (Base x1.2)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$/MM/yr.
Gasoline	MT	2,119.9	242	171.0
Diesel	MT	2,802.4	193	180.3
Total products		4,922.3	214	351.3
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	75.3	833	20.9
Fuel gas	MT	262.4	145	12.7
LPG	MT	48.6	168	2.7
Total by-prds.	MT	386.3	282	36.3
Total Products		5,308.6		387.6
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	533.5	168	29.9
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	1,015.9	192	65.0
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	788.9	232	60.9
C <sub>19</sub> <sup>+</sup>	MT	2,934.2	150	146.7
H <sub>2</sub> rich gas	MT	36.2	833	10.0
Total Feedstocks		5,308.7	177	312.6

### CAPITAL ITEMS

Plant Investment	\$/MM
Cyclar	26.55
Splitter + Alkymax	6.89
NHT plus splitter	8.80
CCR Platformer	13.02
Penex/Molex	10.20
HC Unibon	29.15
Total ISBL	96.61
OSBL @ 50% of ISBL	48.31
Interest @ 10% 3 yrs.	29.16
Total fixed investment	174.07
Catalyst, Adsorbent & Royalties	21.15
Total plant investment	195.22
<b>Working capital</b>	
Total working capital	42.02

### Consumables: catalysts and chemicals

.79

### Utilities

	Units per hour		
Power	kWh	9,023	.06
Steam, HP	Mlb	12.3	4.50
Steam, MP	Mlb	16.7	4.00
Steam, LP	Mlb	22.7	3.00
BFW	Mlb	21.3	.40
Condensate	Mlb	-67.6	.40
CW circula.	mGal	493.0	.10
Fuel fired	mmBtu	334.2	3.00
Total Utilities			14.12

### ECONOMIC ANALYSIS

	\$/MM/yr.	\$/MT products	%
Gasoline sales	171.01	104.22	
Diesel sales	180.29	109.88	
Feedstocks - byproducts	276.23	168.35	83.37%
Gross margin	75.06	45.75	
<b>Variable costs</b>			
Cats. & chemicals	.79	.48	.24%
Utilities	14.12	8.61	4.26%
Total variable costs	14.91	9.09	
<b>Fixed costs</b>			
Labor	3.79	2.31	
Maintenance	3.48	2.12	
Overheads	6.25	3.81	
Other expenses	4.20	2.56	
Total fixed costs	17.72	10.80	5.35%
Cash cost of production	308.86	188.24	
Cash flow	42.43	25.86	
<b>Capital costs</b>			
Plant depreciation	17.41	10.61	
Royalty amortization plus inventory depletion	5.06	3.09	
Total capital costs	22.47	13.69	6.78%
Net cost of production	331.33	201.93	100.00%
Pre-tax income	19.96	12.17	
Simple pre-tax ROI, %	8.42		
Simple payback, years	5.59		
DCF IRR, %	12.26 @ 10 years ; 17.13 @ 20 years		
DCF payback, yrs.	13.05 @ 15% ; 8.59 @ 10%		
Prod. sale price, \$/MT	20% IRR \$223 @ 10 years ; \$218 @ 20 years		
	30% IRR \$235 @ 10 years ; \$232 @ 20 years		
	40% IRR \$248 @ 10 years ; \$246 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

## C.6 ARGE: Sensitivity to Feed Costs (Base xl.1)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$/MM/yr.
Gasoline	MT	2,119.9	242	171.0
Diesel	MT	2,802.4	193	180.3
Total products		4,922.3	214	351.3
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	75.3	763	19.2
Fuel gas	MT	262.4	133	11.6
LPG	MT	48.6	154	2.5
Total by-prds.	MT	386.3	259	33.3
Total Products		5,308.6		384.6
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	533.5	154	27.4
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	1,015.9	176	59.6
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	788.9	212	55.8
C <sub>10</sub> <sup>+</sup>	MT	2,934.2	138	134.5
H <sub>2</sub> rich gas	MT	36.2	763	9.2
Total Feedstocks		5,308.7	162	286.5

Consumables: catalysts and chemicals .79

Utilities		Units per hour		
Power	kWh	9,023	.06	4.33
Steam, HP	Mlb	12.3	4.50	.44
Steam, MP	Mlb	16.7	4.00	.53
Steam, LP	Mlb	22.7	3.00	.54
BFV	Mlb	21.3	.40	.07
Condensate	Mlb	-67.6	.40	-.22
CW circul.	mGal	493.0	.10	.39
Fuel fired	mmBtu	334.2	3.00	8.02
Total Utilities				14.12

### FIXED COSTS

<b>Labor</b>				
Ops. per shift	13 @ \$36,000 per year			2.25
Supervision	25% of operating labor			.56
Direct ovhd.	35% of labor & superv.			.98
				3.79
<b>Maintenance</b>				
Mtrls. & labor	2% of fixed investment			3.48
<b>Overhead expenses</b>				
Plant ovhd.	50% of labor & mainten.			3.64
Tax & insrnce.	2% of fixed investment			2.61
				6.25
<b>Other expenses</b>				
Intrst. on captl. debt	0% per year			.00
Intrst. wkng. capital	10% per year			4.34
				4.34
<b>Depreciation &amp; amortization</b>				
ISBL	10% per year			11.60
OSBL	10% per year			5.80
Catalysts, adsorbents and royalties				5.06

Total 22.47

### CAPITAL ITEMS

<b>Plant Investment</b>		<b>\$ MM</b>
Cyclar		28.55
Splitter + Alkymax		6.89
MHT plus splitter		8.80
CCR Platformer		13.02
Penex/Molex		10.20
MC Unibon		29.15
Total ISBL		96.61
OSBL @ 50% of ISBL		48.31
Interest @ 10% 3 yrs.		29.16
Total fixed investment		174.07
Catalyst, Adsorbent & Royalties		21.15
Total plant investment		195.22

### Working capital

Total working capital	<b>\$ MM</b>
	43.38

### ECONOMIC ANALYSIS

	\$/MM/yr.	\$/MT	%
Gasoline sales	171.01	104.22	
Diesel sales	180.29	109.88	
Feedstocks - byproducts	253.21	154.33	82.09%
Gross margin	98.08	59.78	
<b>Variable costs</b>			
Cats. & chemicals	.79	.48	.26%
Utilities	14.12	8.61	4.58%
Total variable costs	14.91	9.09	
<b>Fixed costs</b>			
Labor	3.79	2.31	
Maintenance	3.48	2.12	
Overheads	6.25	3.81	
Other expenses	4.34	2.64	
Total fixed costs	17.86	10.88	5.79%
Cash cost of production	285.98	174.29	
Cash flow	65.32	39.81	
<b>Capital costs</b>			
Plant depreciation	17.41	10.61	
Royalty amortization plus inventory depletion	5.06	3.09	
Total capital costs	22.47	13.69	7.28%
Net cost of production	308.45	187.99	100.00%
Pre-tax income	42.85	26.11	
Simple pre-tax ROI, %	17.96		
Simple payback, years	3.65		
DCF IRR, %	24.25 @ 10 years ; 27.15 @ 20 years		
DCF payback, yrs.	5.68 @ 15% ; 4.77 @ 10%		
Prod. sale price, \$/MT	20% IRR \$209 @ 10 years ; \$204 @ 20 years		
	30% IRR \$221 @ 10 years ; \$218 @ 20 years		
	40% IRR \$235 @ 10 years ; \$233 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

## C.7 SYNTHOL: Sensitivity to Feed Costs (Base xl.1)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

### VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$/MM/yr.
Gasoline	MT	3,027.5	242	244.2
Diesel	MT	397.3	193	25.6
Total products		3,424.8	236	269.8
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	121.5	763	30.9
Fuel gas	MT	548.7	133	24.3
LPG	MT	80.0	154	4.1
C19+ Fuel	MT	227.0	138	10.4
Total by-prds.	MT	977.2	214	69.8
Total Products		4,402.0		339.6
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	1,418.9	154	72.8
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	2,270.2	176	133.2
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	397.3	212	28.1
C <sub>19</sub> +	MT	227.0	138	10.4
H <sub>2</sub> rich gas	MT	88.6	763	22.5
Total Feedstocks		4,402.0	182	267.1

### Consumables: catalysts and chemicals

1.38

Utilities		Units per hour		
Power	kwh	11,710	.06	5.62
Steam, HP	Mlb	-34.6	4.50	-1.25
Steam, MP	Mlb	14.8	4.00	.47
Steam, LP	Mlb	41.0	3.00	.98
BFW	Mlb	66.7	.40	.21
Condensate	Mlb	-76.0	.40	-.24
CW circul.	mGal	1081.0	.10	.86
Fuel fired	mmBtu	491.1	3.00	11.79
Total Utilities				18.45

### FIXED COSTS

<b>Labor</b>			
Ops. per shift	12 @ \$36,000 per year		2.07
Supervision	25% of operating labor		.52
Direct ovhd.	35% of labor & superv.		.91
			3.50

<b>Maintenance</b>			
Mrls. & labor	2% of fixed investment		3.84

<b>Overhead expenses</b>			
Plant ovhd.	50% of labor & mainten.		3.67
Tax & insrnce.	2% of fixed investment		2.88
			6.55

<b>Other expenses</b>			
Intrst. on captl. debt	0% per year		.00
Intrst. wkng. capital	10% per year		3.72
			3.72

<b>Depreciation &amp; amortization</b>			
ISBL	10% per year		12.79
OSBL	10% per year		6.40

Catalysts, adsorbents and royalties			9.48
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Total			28.67
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### CAPITAL ITEMS

<b>Plant Investment</b>		<b>\$ MM</b>
Huels/Cyclar		52.48
Splitter + Alkymax		11.01
NHT plus splitter		9.85
CCR Platformer		12.67
Penex/Molex		13.53
Distillate Finishing		6.94
Total ISBL		106.48
OSBL @ 50% of ISBL		53.24
Interest @ 10% 3 yrs.		32.14
Total fixed investment		191.86
Catalyst, Adsorbent & Royalties		31.17
Total plant investment		223.03

### Working capital

Total working capital	<b>\$ MM</b>
	37.24

### ECONOMIC ANALYSIS

	\$/MM/yr.	\$/MT products	%
Gasoline sales	244.22	213.93	
Diesel sales	25.56	22.39	
Feedstocks - byproducts	197.31	172.84	74.90%
Gross margin	72.46	63.47	
<b>Variable costs</b>			
Cats. & chemicals	1.38	1.21	.53%
Utilities	18.45	16.17	7.01%
Total variable costs	19.84	17.38	
<b>Fixed costs</b>			
Labor	3.50	3.07	
Maintenance	3.84	3.36	
Overheads	6.55	5.73	
Other expenses	3.72	3.26	
Total fixed costs	17.61	15.42	6.68%
Cash cost of production	234.76	205.64	
Cash flow	35.02	30.67	
<b>Capital costs</b>			
Plant depreciation	19.19	16.81	
Royalty amortization plus inventory depletion	9.48	8.31	
Total capital costs	28.67	25.11	10.88%
Net cost of production	263.43	230.75	100.00%
Pre-tax income	6.35	5.56	
Simple pre-tax ROI, %	2.44		
Simple payback, years	7.43		
DCF IRR, %	5.79 @ 10 years ; 12.08 @ 20 years		
DCF payback, yrs.	9VALUE! @ 15% ; 14.26 @ 10%		
Prod. sale price, \$/MT	20% IRR \$260 @ 10 years ; \$252 @ 20 years		
	30% IRR \$279 @ 10 years ; \$274 @ 20 years		
	40% IRR \$300 @ 10 years ; \$297 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

# C.8 ARGE: Sensitivity to Plant Capital (Base x1.5)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

## VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$MM/yr.
Gasoline	MT	2,119.9	242	171.0
Diesel	MT	2,802.4	193	180.3
Total products		4,922.3	214	351.3
<b>By-products</b>				
H <sub>2</sub> Rich Gas	MT	75.3	694	17.4
Fuel gas	MT	262.4	121	10.6
LPG	MT	48.6	140	2.3
Total by-prds.	MT	386.3	235	30.3
Total Products		5,308.6		381.6
<b>Feedstocks</b>				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	533.5	140	24.9
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	1,015.9	160	54.2
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	788.9	193	50.8
C <sub>19</sub> +	MT	2,934.2	125	122.3
H <sub>2</sub> rich gas	MT	36.2	694	8.4
Total Feedstocks		5,308.7	147	260.5

## Consumables, catalysts and chemicals

.79

Utilities		Units per hour		
Power	kwh	9,023	.06	4.33
Steam, HP	Mlb	12.3	4.50	.44
Steam, MP	Mlb	16.7	4.00	.53
Steam, LP	Mlb	22.7	3.00	.54
BFV	Mlb	21.3	.40	.07
Condensate	Mlb	-67.6	.40	-.22
CW circul.	mGal	493.0	.10	.39
Fuel fired	mmBtu	334.2	3.00	8.02
Total Utilities				14.12

## FIXED COSTS

<b>Labor</b>				
Ops. per shift	13 @ \$36,000 per year			2.25
Supervision	25% of operating labor			.56
Direct ovhd.	35% of labor & superv.			.98
				3.79
<b>Maintenance</b>				
Mtrls. & labor	2% of fixed investment			5.22
<b>Overhead expenses</b>				
Plant ovhd.	50% of labor & mainten.			4.51
Tax & insrnce.	2% of fixed investment			3.92
				8.42
<b>Other expenses</b>				
Intrst. on captl. debt	0% per year			.00
Intrst. wkng. capital	10% per year			4.56
				4.56
<b>Depreciation &amp; amortization</b>				
ISBL	10% per year			17.41
OSBL	10% per year			8.70
Catalysts, adsorbents and royalties				5.06

Total

31.17

## CAPITAL ITEMS

<b>Plant Investment</b>		\$ MM
Cyclar		42.83
Splitter + Alkymax		10.34
NHT plus splitter		13.20
CCR Platformer		19.53
Penex/Molex		15.30
HC Unibon		43.73
Total ISBL		144.92
OSBL @ 50% of ISBL		72.46
Interest @ 10% 3 yrs.		43.74
Total fixed investment		261.11
Catalyst, Adsorbent & Royalties		21.15
Total plant investment		282.26

## Working capital

Total working capital 45.64

## ECONOMIC ANALYSIS

	\$MM/yr.	\$/MT products	%
Gasoline sales	171.01	104.22	
Diesel sales	180.29	109.88	
Feedstocks - byproducts	230.19	140.30	77.18%
Gross margin	121.10	73.81	
<b>Variable costs</b>			
Cats. & chemicals	.79	.48	.26%
Utilities	14.12	8.61	4.73%
Total variable costs	14.91	9.09	
<b>Fixed costs</b>			
Labor	3.79	2.31	
Maintenance	5.22	3.18	
Overheads	8.42	5.13	
Other expenses	4.56	2.78	
Total fixed costs	22.00	13.41	7.38%
Cash cost of production	267.10	162.79	
Cash flow	84.19	51.31	
<b>Capital costs</b>			
Plant depreciation	26.11	15.91	
Royalty amortization plus inventory depletion	5.06	3.09	
Total capital costs	31.17	19.00	10.45%
Net cost of production	298.27	181.79	100.00%
Pre-tax income	53.02	32.31	
Simple pre-tax ROI, %	16.17		
Simple payback, years	3.89		
DCF IRR, %	22.23 @ 10 years ; 25.40 @ 20 years		
DCF payback, yrs.	6.26 @ 15% ; 5.18 @ 10%		
Prod. sale price, \$/MT	20% IRR \$210 @ 10 years ; \$204 @ 20 years		
	30% IRR \$227 @ 10 years ; \$223 @ 20 years		
	40% IRR \$246 @ 10 years ; \$243 @ 20 years		

Note: Products reflect the total tonnage of gasoline and diesel

# C.9 SYNTHOL: Sensitivity to Plant Capital (Base xl.5)

333.33 days/year; 8,000 hours/year; operating factor: 1.000

## VARIABLE COSTS/REVENUES

Products	Units	Units per day	\$/unit	\$/MM/yr.
Gasoline	MT	3,027.5	242	244.2
Diesel	MT	397.3	193	25.6
Total products		3,424.8	236	269.8
By-products				
H <sub>2</sub> Rich Gas	MT	121.5	694	28.1
Fuel gas	MT	548.7	121	22.1
LPG	MT	80.0	140	3.7
C19+ Fuel	MT	227.0	125	9.5
Total by-prds.	MT	977.2	195	63.4
Total Products		4,402.0		333.2

Feedstocks				
C <sub>3</sub> /C <sub>4</sub> LPG	MT	1,418.9	140	66.2
C <sub>5</sub> /C <sub>11</sub> naphtha	MT	2,270.2	160	121.1
C <sub>12</sub> /C <sub>18</sub> kerosn.	MT	397.3	193	25.6
C <sub>19</sub> +	MT	227.0	125	9.5
H <sub>2</sub> rich gas	MT	88.6	694	20.5
Total Feedstocks		4,402.0	165	242.8

## Consumables: catalysts and chemicals

1.38

Utilities		Units per hour		
Power	kWh	11,710	.06	5.62
Steam, HP	Mlb	-34.6	4.50	-1.25
Steam, MP	Mlb	14.8	4.00	.47
Steam, LP	Mlb	41.0	3.00	.98
BFW	Mlb	66.7	.40	.21
Condensate	Mlb	-76.0	.40	-.24
CW circul.	mGal	1081.0	.10	.86
Fuel fired	mmBtu	491.1	3.00	11.79
Total Utilities				18.45

## FIXED COSTS

Labor				
Ops. per shift	12 @	\$36,000 per year		2.07
Supervision	25% of operating labor			.52
Direct ovhd.	35% of labor & superv.			.91
				3.50

Maintenance				
Mtrls. & labor	2% of fixed investment			5.76

Overhead expenses				
Plant ovhd.	50% of labor & mainten.			4.63
Tax & insrnce.	2% of fixed investment			4.32
				8.94

Other expenses				
Intrst. on captl. debt	0% per year			.00
Intrst. wkng. capital	10% per year			3.91
				3.91

Depreciation & amortization				
ISBL	10% per year			19.19
OSBL	10% per year			9.59

Catalysts, adsorbents and royalties				9.48
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Total 38.26

## CAPITAL ITEMS

Plant Investment	\$ MM
Huels/Cyclar	78.72
Splitter + Alkymax	16.52
NHT plus splitter	14.78
CCR Platformer	19.01
Penex/Molex	20.30
Distillate Finishing	10.41
Total ISBL	159.72
OSBL @ 50% of ISBL	79.86
Interest @ 10% 3 yrs.	48.20
Total fixed investment	287.78

## Catalyst, Adsorbent & Royalties

31.17

Total plant investment 318.96

## Working capital

39.13

## ECONOMIC ANALYSIS

	\$/MM/yr.	\$/MT products	%
Gasoline sales	244.22	213.93	
Diesel sales	25.56	22.39	
Feedstocks - byproducts	179.38	157.13	69.10%
Gross margin	90.40	79.19	
Variable costs			
Cats. & chemicals	1.38	1.21	.53%
Utilities	18.45	16.17	7.11%
Total variable costs	19.84	17.38	
Fixed costs			
Labor	3.50	3.07	
Maintenance	5.76	5.04	
Overheads	8.94	7.83	
Other expenses	3.91	3.43	
Total fixed costs	22.11	19.37	8.52%

Cash cost of production 221.33 193.88

Cash flow 48.45 42.44

## Capital costs

Plant depreciation	28.78	25.21
Royalty amortization plus		
Inventory depletion	9.48	8.31
Total capital costs	38.26	33.52
		14.74%

Net cost of production 259.59 227.39 100.00%

Pre-tax income 10.19 8.92

Simple pre-tax ROI, % 2.85

Simple payback, years 7.39

DCF IRR, % 5.91 @ 10 years ; 12.17 @ 20 years

DCF payback, yrs. #VALUE! @ 15% ; 14.10 @ 10%

Prod. sale price, \$/MT 20% IRR \$269 @ 10 years ; \$258 @ 20 years  
30% IRR \$295 @ 10 years ; \$288 @ 20 years  
40% IRR \$324 @ 10 years ; \$319 @ 20 years

Note: Products reflect the total tonnage of gasoline and diesel