

Small GTL

A New Midstream Opportunity

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EMERGING FUELS
TECHNOLOGY

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Some Definitions:

In this presentation, GTL (Gas-To-Liquids) refers to the conversion of natural gas into hydrocarbon liquids, primarily middles distillates (diesel and jet) and naphtha via Fischer-Tropsch Synthesis.

(Some Definitions)

Large GTL – Over 30,000 BPD (Shell and Sasol)

Medium GTL – 10,000 to 30,000 BPD

Small GTL - 500 BPD up to 10,000 BPD

Goal of all: Monetize Natural Gas via the liquid Petroleum Markets

GTL becomes a viable option when:

The “oil/gas ratio” (WTI/Henry Hub) is at least 20

or

**Synergies exist with other revenue opportunities
that enhance the overall economics**

and

**There is a “financeable” mechanism to hedge the
oil/gas ratio risk over the finance term of the plant**

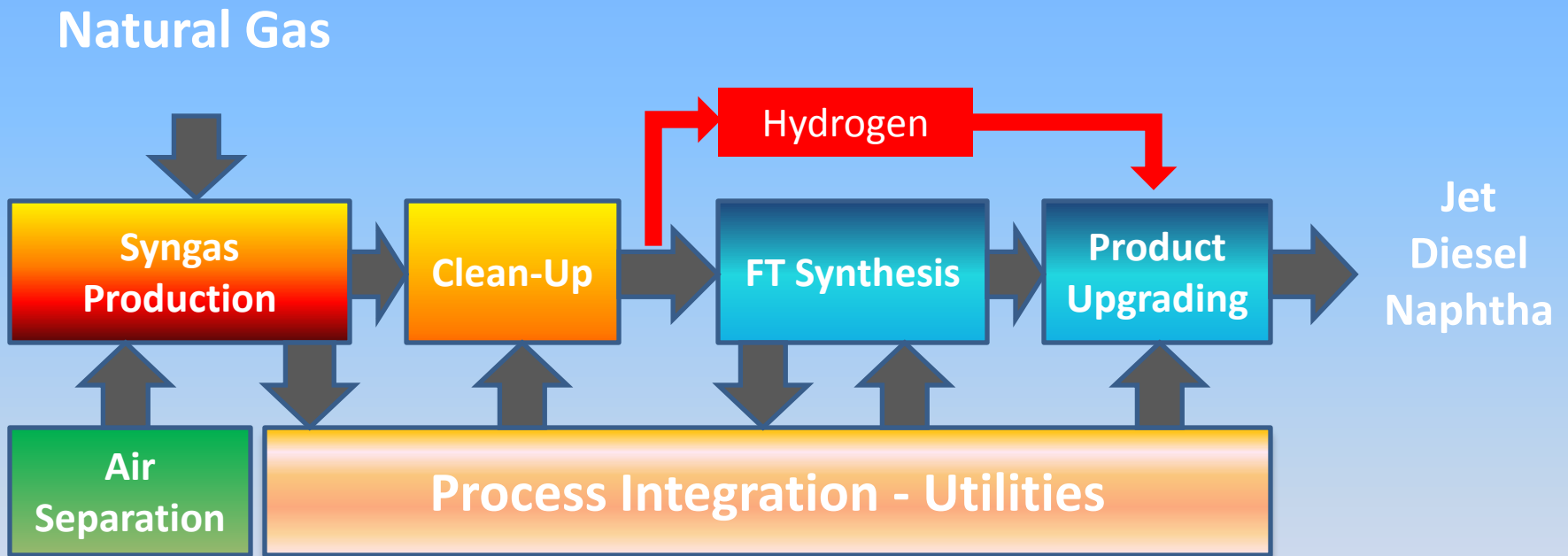
GTL Synergies/Opportunities:

Trapped oil - flaring no longer allowed, no available market for gas

Curtailed NGL production - due to Ethane Bubble or Methane Bubble

Pipeline constraints – regional oversupply, prices depressed significantly below Henry Hub

GTL Basics



Typical GTL Product specs:

ASTM D-975 No. 2-D Diesel Fuel					Blend Stock (4)
Parameter	ASTM Method	Unit	Value	Ref Criteria	Value
Water and Sediment	D-2709	% Vol	0	0.05 Max	0
Ash %	D-482	Wt %	0	0.01 Max	0
Sulfur (S-15)	D-5453	ppm (ug/g)	0	15 max	0
Copper Strip Corrosion	D-130		1	No. 3 Max	1
Cetane number	D-613		> 70	40 Min	> 70
Cetane Index	D-976		75.5	40 Min	> 70
Lubricity HFRR @ 60 °C	D-6079	Microns	450 (3)	520 Max	n/a
Conductivity	D-2624	C.U.	50-600 (3)	25 Min	n/a
Flash Point	D-93	°C	54	52 Min	60-64
Cloud Point	D-2500	°C	-17 (1)	(2)	-20
Kinematic Viscosity @ 40 °C	D-445	cSt	1.984	1.9 Min	< 1.9
Kinematic Viscosity @ 40 °C	D-445	cSt	1.984	4.1 Max	> 4.1
Distillation 90% Vol Recovered	D-86	°C	313	Min 282	290
Distillation 90% Vol Recovered	D-86	°C	313	Max 338	330
Ramsbottom Carbon	D-524	% Mass	<.35	0.35 Max	<.35

(1) Data from EFT lab method

(2) Based on specific geographic location and time of year

(3) with Additive

(4) directional only

Note: Finished fuels require additives per EPA and DOT regulations.

Blend Stock Yields as high as 83% (17% Naphtha)

D-975 Yields around 75% (25% Naphtha)

Diesel Blend Stock is the most common product because the value is the same, yield is higher and is usually sold to others to make finished fuels.

Typical GTL Product Specs

JP-8 Appendix A GTL -SPK				
Specification	Units	Minimum	Maximum	Commercial Lab Value
Distillation				
10% recovered	°C		205	164.8
Final BP	°C		300	280.1
Freeze Point	°C		-47	-64
Flash Point	°C	38		46
Density	kg/L @ 15 °C	0.751	0.770	0.753
Viscosity (+/1 20 °C)	cSt		8.0	4.506

**Yields as high as 65%
(35% naphtha)**

**More economical:
50% Diesel
30% Jet
20% Naphtha**

**SPK jet is always blended with
petroleum jet per ASTM 7566
requirements**

Fischer-Tropsch Paraffinic Naphtha			
Parameter	ASTM Method	Unit	Value
Flash Point	D-93	°C	-23
Freeze Point	D-5972	°C	-102 (1)
Density @ 15 °C	D-1298	Kg/m ³	0.69 (1)
Distillation 10% Vol Recovered	D-2887	°C	89.4(2)
Distillation 50% Recovered	D-2887	°C	98.8 (2)
Distillation End Point	D-2887	°C	184.6 (2)

**Naphtha characteristics
vary based on what
other products are**

(1) Data from EFT lab method

(2) D-86 Correlation

Baseline Assumptions - 2,000 BPD GTL Plant:

TIC: \$213 million

Debt: 60%
Equity: 40%

Products:

81% Diesel at \$3.00/gal \$126/Bbl

19% Naphtha at WTI + 5% \$105/Bbl

Baseline Assumptions - 2,000 BPD GTL Plant:

(Continued)

Nat Gas consumption: 19.5 MMSCFD (9700 SCF/Bbl)

Electric Power:

Plant total 9900 KW

Plant Generated 7410 KW

Net Purchased 2490 KW

Cooling water: 658 GPM

Waste water: 253 GPM to local utility

Land Requirements: 15-20 Acre (depends on storage capacity)

Project Summary Information Base Case \$4 Gas Feedstock

Estimated Construction Costs

Site Prep/Earth Work	\$	845,000
Land		1,000,000
Structures/Foundations		3,425,000
Process Equipment		91,600,000
Support Equipment (Loading, etc)		19,200,000
Oxygen plant		16,000,000
Permitting		225,000
EPC related		24,000,000
Other fees		6,964,130
Total Direct Construction Costs		<u>163,259,130</u>
Indirect Construction Costs		22,000,000
Contingency (15%)		<u>27,788,870</u>
		<u><u>\$ 213,048,000</u></u>

Project Summary Information
Base Case \$4 Gas Feedstock

Labor Costs

Operating Labor	Staff	Salary	Benefits	Total
Plant Manager	1	\$140,000	35%	\$ 189,000
Operations Manager	1	\$80,000	35%	108,000
Lab Manager	1	\$80,000	35%	108,000
Lab Techs	2	\$60,000	35%	162,000
Process Engineer	1	\$100,000	35%	135,000
Plant Reliability Engineer	1	\$100,000	35%	135,000
Environmental Health Safety Engr.	1	\$80,000	35%	108,000
Office Mmnger/Admin Assistant	1	\$43,000	35%	58,050
Product Shipping/Logistics	1	\$55,000	35%	74,250
Shift Supervisors	4	\$72,000	35%	388,800
Control Room Operators	8	\$65,000	35%	702,000
Auxiliary Operations	12	\$65,000	35%	1,053,000
Total Headcount and Costs	34			\$ 3,221,100

Project Summary Information

Capital Cost

Facility	\$	205,674,450
Initial Catalyst	\$	7,373,550
Total	\$	213,048,000

Funding:

Equity	40%	\$	90,400,000
Debt Commitment	60%	\$	135,600,000
Term in months			120
Interest Rate			7%
Commitment Fee			0.5%

Revenues:

Price/BBL	Product Split
\$ 126.00	81%
\$ 105.00	19%

Production BBL/Day

2,004

Leveraged IRR on Equity

16.1%

NPV after debt service

\$ 156,547,515

Note- IRR and NPV used 20 year operating cash flow assumption using average of last 5 years for non-forecasted years.

Base Case \$4 Gas Feedstock

Example of Annual Operations (\$000s)

Annual Operating at 340 days of production 681,360.00 BBLs

Year 3 of Operations

Revenue

Diesel	\$	69,829.20		84%
Naphtha		<u>13,351.80</u>		16%

Total revenues

83,181.00 \$ 122.08 100%

Fixed Expenses:

Labor Costs	3,221.10	4.73	4%
Routine and Major Maintenance	4,830.11	7.09	6%
General Consumables & Tools	125.00	0.18	0%
Environmental Testing	225.00	0.33	0%
General and Admin	555.00	0.81	1%
Insurance and Tax	<u>1,940.48</u>	<u>2.85</u>	2%

Total Fixed Costs

10,896.68 15.99 13%

Variable Expenses:

Feedstock Gas	26,436.77	38.80	32%
Royalties	1,635.26	2.40	2%
Catalysts and Chemicals (net of metals recoveries)	2,973.05	4.36	4%
Power	660.90	0.97	1%
Make-up Water and Wastewater	284.07	0.42	0%
Marketing & Delivery	<u>1,717.03</u>	<u>2.52</u>	2%

Total Variable Expenses

33,707.07 49.47 41%

Total Fixed and Variable

44,603.75 65.46 54%

EBITDA

38,577.25 56.62 46%

Depreciation

10,307.49 15.13 12%

Interest

6,429.40 9.44 8%

Net income (loss) before taxes

\$ 21,840.35 \$ 32.05 26%

\$000s, except per BBL and Days

	Construction		Operating					Revenue or Cost Per BBL
	Year 1	Year 2	Year 1	Year 2	Year 3	Year 4	Year 5	
Revenue								
Diesel			\$54,631.08	\$67,364.64	\$69,829.20	\$67,364.64	\$69,829.20	
Naphtha			10,445.82	12,880.56	13,351.80	12,880.56	13,351.80	
Total revenues			65,076.90	80,245.20	83,181.00	80,245.20	83,181.00	\$ 122.08
Cost of sales								
Feedstock and supply costs			20,682.88	25,503.71	26,436.77	25,503.71	26,436.77	38.80
Direct labor and overheads			3,163.05	3,163.05	3,163.05	3,163.05	3,163.05	4.64
Catalyst			3,309.31	3,309.31	2,973.05	2,973.05	2,973.05	4.36
Total cost of sales			27,155.24	31,976.06	32,572.87	31,639.81	32,572.87	47.81
Gross profit (loss)			37,921.66	48,269.14	50,608.13	48,605.39	50,608.13	74.28
Operating expenses								
Royalties	0.00	0.00	1,279.35	1,577.55	1,635.26	1,577.55	1,635.26	2.40
Utilities	0.00	0.00	810.70	923.19	944.96	923.19	944.96	1.39
Operating materials	0.00	0.48	5,178.95	5,179.52	5,180.11	5,180.65	5,181.39	7.60
Selling and G&A Labor	0.00	14.51	1,401.37	1,714.48	1,775.08	1,714.48	1,775.08	2.61
General & administrative and other costs	485.12	1,940.48	2,495.48	2,495.48	2,495.48	2,495.48	2,495.48	3.66
Construction train and operations	0.00	939.26	0.00	0.00	0.00	0.00	0.00	-
Total operating expenses	485.12	2,894.73	11,165.85	11,890.21	12,030.88	11,891.34	12,032.17	17.66
EBITDA	(485.12)	(2,894.73)	26,755.81	36,378.93	38,577.25	36,714.06	38,575.97	56.62
Depreciation	0.00	5.86	10,298.47	10,305.12	10,307.49	10,309.42	10,309.72	15.13
Interest	334.88	5,599.23	8,899.49	7,725.25	6,429.40	5,233.23	4,186.59	9.44
Net income (loss) before taxes	\$ (820.00)	\$ (8,499.82)	\$ 7,557.85	\$ 18,348.55	\$ 21,840.35	\$ 21,171.40	\$ 24,079.66	\$ 32.05
Cummulative	\$ (820.00)	\$ (9,319.82)	\$ (1,761.97)	\$ 16,586.58	\$ 38,426.94	\$ 59,598.34	\$ 83,677.99	
Production in BBLs			533,064	657,312	681,360	657,312	681,360	
Production Days			266	328	340	328	340	

**Nominal 2,000 Diesel Fuel Facility
Sensitivity Analysis Matrix**



Debt Assumptions

i-rate	7.0%
Commit Fee	0.5%
Term in Mnths	120
PIK Period	27
Payments	Quarterly

Diesel Price/BBL \$ 126.00
Naphtha Price/BBL \$ 105.00

(\$000s, except Per BBL) Condition Description	Financing Conditions				Feed	Annual Capacity Operations 340 Days				Levered
	Capex	Funding Commit	Equity %	Debt %	Gas Cost /MSCF	Revenue	Operating Expenses	EBITDA	IRR	
Capex Base + 10%	\$ 234,353	\$ 248,000	40%	60%	\$ 2.00	\$ 83,181	\$ 31,865	\$ 51,316	20.9%	
Capex Base + 10%	\$ 234,353	\$ 248,000	40%	60%	\$ 3.00	\$ 83,181	\$ 38,474	\$ 44,707	17.4%	
Capex Base + 10%	\$ 234,353	\$ 249,000	40%	60%	\$ 4.00	\$ 83,181	\$ 45,083	\$ 38,098	13.8%	
Capex Base + 10%	\$ 234,353	\$ 252,000	40%	60%	\$ 5.00	\$ 83,181	\$ 51,692	\$ 31,489	9.9%	
Capex Baseline	\$ 213,048	\$ 226,000	40%	60%	\$ 2.00	\$ 83,181	\$ 31,385	\$ 51,796	23.6%	
Capex Baseline	\$ 213,048	\$ 226,000	40%	60%	\$ 3.00	\$ 83,181	\$ 37,995	\$ 45,186	20.0%	
Capex Baseline	\$ 213,048	\$ 226,000	40%	60%	\$ 4.00	\$ 83,181	\$ 44,604	\$ 38,577	16.1%	
Capex Baseline	\$ 213,048	\$ 228,000	40%	60%	\$ 5.00	\$ 83,181	\$ 51,213	\$ 31,968	12.0%	
Capex Base -10%	\$ 191,743	\$ 204,000	40%	60%	\$ 2.00	\$ 83,181	\$ 30,906	\$ 52,275	26.8%	
Capex Base -10%	\$ 191,743	\$ 204,000	40%	60%	\$ 3.00	\$ 83,181	\$ 37,515	\$ 45,666	22.8%	
Capex Base -10%	\$ 191,743	\$ 204,000	40%	60%	\$ 4.00	\$ 83,181	\$ 44,124	\$ 39,057	18.7%	
Capex Base -10%	\$ 191,743	\$ 204,000	40%	60%	\$ 5.00	\$ 83,181	\$ 50,734	\$ 32,447	14.5%	
Capex Base -10%, Debt 70%	\$ 191,743	\$ 206,000	30%	70%	\$ 2.00	\$ 83,181	\$ 30,906	\$ 52,275	29.3%	
Capex Base -10%, Debt 70%	\$ 191,743	\$ 206,000	30%	70%	\$ 3.00	\$ 83,181	\$ 37,515	\$ 45,666	24.6%	
Capex Base -10%, Debt 70%	\$ 191,743	\$ 206,000	30%	70%	\$ 4.00	\$ 83,181	\$ 44,124	\$ 39,057	19.9%	
Capex Base -10%, Debt 70%	\$ 191,743	\$ 208,000	30%	70%	\$ 5.00	\$ 83,181	\$ 50,734	\$ 32,447	14.8%	
Capex Base -20%, Debt 75%	\$ 170,438	\$ 184,000	25%	75%	\$ 2.00	\$ 83,181	\$ 30,427	\$ 52,754	36.1%	
Capex Base -20%, Debt 75%	\$ 170,438	\$ 184,000	25%	75%	\$ 3.00	\$ 83,181	\$ 37,036	\$ 46,145	30.4%	
Capex Base -20%, Debt 75%	\$ 170,438	\$ 184,000	25%	75%	\$ 4.00	\$ 83,181	\$ 43,645	\$ 39,536	24.6%	
Capex Base -20%, Debt 75%	\$ 170,438	\$ 186,000	25%	75%	\$ 5.00	\$ 83,181	\$ 50,254	\$ 32,927	18.6%	

How Would a GTL plant work next to an NGL Plant?

Marcellus Region NGL Plant Data

Name		Plant Inlet	Ethane Stream	
Vapor Fraction		1.0000	1.0000	
Temperature	degF	110.0	120.0	
Pressure	psia	855	115	
Flow	LbMole/Hr	21,961	1,373	
Flow	Lb/Hr	450,621	40,946	
Density	Lb/ft3	3.4330	0.5824	
Mol Weight		20.5192	29.8293	
Viscosity	cP	0.0134	0.0104	
Std Gas Flow	MMscfd	200.01	12.50	Sufficient for 2,285 BBL/Day of GTL
Nitrogen	Mol %	0.190%	0.000%	
CO2	Mol %	0.000%	0.000%	
Methane	Mol %	78.980%	2.427%	
Ethane	Mol %	13.870%	96.862%	
Propane	Mol %	4.460%	0.711%	
iButane	Mol %	0.440%	0.001%	
nButane	Mol %	1.060%	0.000%	
iPentane	Mol %	0.240%	0.000%	
nPentane	Mol %	0.300%	0.000%	
nHexane	Mol %	0.460%	0.000%	

Comparing Natural Gas and Ethane as GTL Feedstocks

Natural Gas:

9,700 SCF of C1 = 1 BBL of GTL

@ \$2/MSCF feedstock costs =	\$ 19.40	Per BBL
@ \$3/MSCF feedstock costs =	\$ 29.10	Per BBL
@ \$4/MSCF feedstock costs =	\$ 38.80	Per BBL
@ \$5/MSCF feedstock costs =	\$ 48.50	Per BBL

Ethane (Net-back to Plant):

159.6 Gallons of C2 = 1 BBL of GTL

@ \$.15/Gallon feedstock costs =	\$ 23.94	Per BBL
@ \$.20/Gallon feedstock costs =	\$ 31.92	Per BBL
@ \$.25/Gallon feedstock costs =	\$ 39.90	Per BBL
@ \$.30/Gallon feedstock costs =	\$ 47.88	Per BBL

**For more information about GTL and EFT
please visit our website:**

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Questions?