

# Gas to Liquids Plants: Turning Louisiana Natural Gas into Marketable Liquid Fuels

by  
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The abundance of natural gas in locations around the United States, some of it being classified as stranded, has created the need for economical options to move these resources to market. One option to create this economic opportunity is exploiting the Gas to Liquids (GTL) technology. This technology provides extremely marketable consumer products such as diesel fuel and regular gasoline.

Natural gas used to create GTL is ethane-rich, and there is a need for new ways to make a low-value ethane product economically viable. The present market price for ethane is well below historical values, and projections indicate that this market condition will persist. One option to create economic opportunity is to exploit GTL technology to utilize stranded gas. Currently, there are 4 major global GTL plants: Pearl, Oryx, Bintulu, and Mossel Bay, with two additional plants of comparable size in the planning and development stages located in Louisiana, the 140,000 barrels per day plant in Sorrento being planned by Shell, and a Sasol plant located in Lake Charles, forecasted to produce 96,000 barrels per day. In addition, smaller, less costly plants have been proposed. These smaller plants produce less product, but are less costly. G2X has proposed one such smaller plant in the Lake Charles, capable of producing 12,500 barrels per day at a cost of \$1.3 billion. Even smaller proposed plants, such as the Juniper proposal in Lake Charles, are in the vetting process. Juniper is exploring a plant that would produce 1,500 barrels per day at a proposed cost of \$100 million.

Table 1. Existing & Proposed GTL Plants

	Name	Location	Company	Capacity (bbl/day)
International	Pearl	Qatar	Shell	120,000
	Oryx	Qatar	Sasol/Qatar Petroleum	34,000
	Bintulu	Malaysia	Shell MDS	14,700
	Mossel Bay	South Africa	PetroSA	45,000
Louisiana (Proposed)	Sasol Louisiana	Westlake	Sasol	96,000
	Shell	Sorrento	Shell	140,000
	Juniper	Westlake	Juniper	1,500
	G2X	Lake Charles	G2X	12,500

Sources: <http://www.sasollouisianaprojects.com/userfiles/Sasol%20projects%20placemat.pdf>  
<http://www.louisianaeconomicdevelopment.com/index.cfm/newsroom/detail/474>  
<http://www.ogj.com/articles/2013/09/shell-selects-louisiana-site-for-12-5-billion-world-scale-gtl-facility.html>  
<http://g2xenergy.com/press/governor-jindal-highlights-g2x-energy-plans-for-1-3-billion-natural-gas-to-gasoline-facility-in-southwest-louisiana/>  
<http://www.shell.com/global/aboutshell/major-projects-2/pearl/overview.html>  
<http://www.oryxgtl.com.qa/index.html>  
[http://www.petrosa.co.za/innovation\\_in\\_action/Pages/Operations-and-Refinery.aspx](http://www.petrosa.co.za/innovation_in_action/Pages/Operations-and-Refinery.aspx)  
<http://www.theoilrum.com/node/7118>

Early capital costs for GTL plants were estimated at \$100,000 per daily barrel. This had been reduced to \$25,000 – \$45,000 per daily barrel by 2000, depending on production scale and site selection. Since

then, advances in GTL technology, particularly the use of better catalysts, have been responsible for this significant drop in costs and the increased commercial viability of GTL projects. Despite this, GTL investment is still very capital intensive when compared to investments in a conventional refinery estimated to cost in the range of \$12,000 – \$14,000 per daily barrel. The market expects at least 10 GTL plants to be built in the next 10 years at a value of \$12 - \$20 billion each. GTL plants are the most attractive way to realize the value in natural gas when oil prices are above \$60 per barrel and gas prices are below \$8 per million British thermal units, according to the 2012 "Global Energy Assessment," a landmark study compiled by the International Institute for Applied Systems Analysis.

### **Pearl GTL Plant - Qatar**

Pearl GTL is the largest GTL plant, located in Ras Laffan Industrial City, 80 km north of Doha, Qatar. Pearl is capable of producing 140,000 barrels of GTL products each day, of which 120,000 barrels are natural gas liquids and ethane. This plant is owned and operated by Shell.

When proposed in 2003, the Pearl GTL plant was estimated to cost \$5 billion; however, with cost escalation, that estimate was increased in 2007 to \$18 billion. Completed in 2012, the final cost for the Pearl GTL plant was \$19 billion. In the ten years for completion, the project's cost escalated by 280%, or \$14 billion.

### **Onyx - Qatar**

Oryx, completed in December 2005, produces approximately 34,000 barrels of GTL products each day, 24,000 barrels of diesel, 9,000 barrels of naphtha, and 1,000 barrels of liquefied petroleum gas. Located in the Ras Laffan Industrial City Complex, it is owned and operated jointly by Sasol (49%) and Qatar Petroleum (51%). The plant's estimated use is 330,000 cubic feet of gas per day.

Construction started in November 2003 on the Oryx plant. At that time, the plant was projected to cost \$900 million to build, and came in at a \$1.2 billion cost, an increase of \$300 million, or 33%. There has been discussion about expanding the plant in a joint venture with Chevron, Sasol, and Qatar Petroleum to reach an output level of 100,000 barrels per day of GTL products. This 66,000 barrel per day increase is expected to cost \$1 billion.

### **Bintulu - Malaysia**

Shell built the first medium-scale commercial GTL plants in 1993 at Bintulu, Malaysia, using the Shell Middle Distillates Synthesis technology. The plant had a capacity of 12,500 barrels a day of GTL products at start-up, which increased to 14,700 barrels a day of GTL products in 2005.

With the original plant costing \$850 million, capital costs have exceeded \$1 billion with the 2005 expansion. That is a capital cost of \$68,000 per daily barrel. In addition, Shell is expected to spend an additional \$15 million on the plant by 2015 to enable further product development. Approximately 95 per cent of Shell GTL products from this plant are exported worldwide.

## **Mossel Bay - South Africa**

Commissioned in 1992 as the world's first gas-to-liquids refinery, Mossel Bay remains the third largest GTL refinery among the five now operating worldwide. It is capable of producing a crude oil equivalent of 45,000 barrels per day of GTL product. Developed by Sasol and run by PetroSA, Mossel Bay cost \$4 billion to build in 1992. Current production of GTL liquids is at 40,000 barrels per day. There is discussion about expanding the plant another 13,000 barrels a day, with the proposed online date of 2019.

## **LOUISIANA**

### **Shell Geismar Proposed Plant**

In September 2013, Shell announced that it was proceeding to the planning and environmental planning stages for a new GTL plant located in Geismar, Louisiana. With a planned expenditure of \$12.5 billion for the GTL plant, the expected capacity for the proposed plant will be 140,000 barrels per day of GTL liquids. The exploration phase is scheduled to last until 2015. If approval is granted from Shell to proceed, construction is expected to last until 2019, when it becomes operational.

### **Sasol Westlake Proposed Plant**

Sasol has proposed the first GTL plant in the United States, to be built in Westlake. The \$14 billion plant is expected to produce in excess of 96,000 barrels of GTL liquids per day. Coupled with an ethylene cracker unit, which is being built at the facility, Sasol is expected to invest \$21 billion for both of these projects. Construction on the GTL plant is expected to start in 2016, with completion expected in 2020. The feasibility study for this project was completed in December 2012, and Sasol decided to proceed with the projects.

### **G2X GTL Proposed Plant**

G2X is currently conducting a feasibility study for a \$1.3 billion dollar GTL plant to be constructed in Lake Charles. The study, which is expected to be completed by the end of 2013, will determine whether or not G2X will continue with the construction of the plant, which is expected to produce 12,500 barrels of GTL liquids per day. If green-lighted, the plant will start construction in 2014, with an expected completion date of 2017.

### **Juniper Proposed Plant**

Juniper has proposed constructing a small GTL plant in Westlake. The company will invest \$100 million to renovate a dormant steam methane reformer and convert it to a natural gas-to-liquids facility. This plant is expected to produce 1,500 barrels of GTL liquids per day. Construction is expected to start by the end of 2013, with a completion date of 2015.

Table 2.

Internal Rate of Return Calculations for Different Price Points							
	Unit Capex/day	\$50,000	\$80,000	\$110,000	\$140,000	\$170,000	\$200,000
	\$/barrel						
\$50.00	\$1.50	11.8%	5.5%	0.7%	Neg	Neg	Neg
	\$2.50	7.7%	0.7%	Neg	Neg	Neg	Neg
	\$3.50	0.7%	Neg	Neg	Neg	Neg	Neg
	\$4.50	Neg	Neg	Neg	Neg	Neg	Neg
	\$5.50	Neg	Neg	Neg	Neg	Neg	Neg
	\$6.50	Neg	Neg	Neg	Neg	Neg	Neg
\$75.00	\$1.50	20.9%	13.6%	9.3%	6.1%	3.2%	0.7%
	\$2.50	18.2%	11.3%	7.3%	3.7%	0.7%	Neg
	\$3.50	15.2%	8.8%	4.4%	0.7%	Neg	Neg
	\$4.50	12.4%	6.4%	2.1%	Neg	Neg	Neg
	\$5.50	9.6%	4.0%	Neg	Neg	Neg	Neg
	\$6.50	6.7%	1.6%	Neg	Neg	Neg	Neg
\$100.00	\$1.50	28.0%	19.3%	14.3%	11.0%	8.5%	6.3%
	\$2.50	25.8%	17.5%	12.8%	9.6%	7.1%	4.7%
	\$3.50	23.4%	15.6%	11.1%	8.0%	5.3%	2.9%
	\$4.50	21.1%	13.8%	9.5%	6.5%	3.8%	1.2%
	\$5.50	18.8%	11.9%	7.9%	5.0%	2.2%	Neg
	\$6.50	16.5%	10.1%	6.3%	3.5%	0.6%	Neg
\$125.00	\$1.50	34.0%	24.0%	18.5%	14.8%	12.0%	9.9%
	\$2.50	32.1%	22.5%	17.2%	13.6%	10.9%	8.8%
	\$3.50	30.1%	20.9%	15.8%	12.3%	9.8%	7.7%
	\$4.50	28.2%	19.4%	14.5%	11.1%	8.7%	6.6%
	\$5.50	26.2%	17.8%	13.1%	9.8%	7.6%	5.5%
	\$6.50	24.3%	16.3%	11.8%	8.6%	6.5%	4.4%
\$150.00	\$1.50	39.2%	32.4%	28.3%	23.6%	20.2%	17.5%
	\$2.50	37.6%	30.2%	26.9%	22.8%	19.4%	16.8%
	\$3.50	35.8%	28.6%	25.5%	21.9%	18.6%	16.0%
	\$4.50	34.1%	27.2%	24.1%	21.1%	17.8%	15.3%
	\$5.50	32.4%	26.6%	22.7%	20.2%	17.0%	14.5%
	\$6.50	30.7%	25.4%	21.3%	19.4%	16.2%	13.8%