THE AMERICAN OIL & GAS REPORTER®
MAY 2012
The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

Gas-To-Liquids Plants Offer Great ROI

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ADDISON, TX.–With natural gas prices below $2, U.S. producers are looking for ways to obtain higher prices for the vast supply of domestic natural gas. Those who employ gas-to-liquids plants to convert methane gas into liquid fuels will find a stable, long-term market and obtain attractive returns on their investments.

Available, commercial-scale GTL processes are based on the original Fischer-Tropsch chemistry for converting coal-to-liquid fuels developed at the Kaiser Wilhelm Institute in Germany in the 1920s. Refinements in catalyst formulation, reactor design, and process design have enhanced the original technology to ensure the production of high-quality products such as ultralow sulfur diesel and specialty waxes. By utilizing these technologies, projects across the globe have demonstrated limited development/technical risk and the flexibility to meet producers' needs.

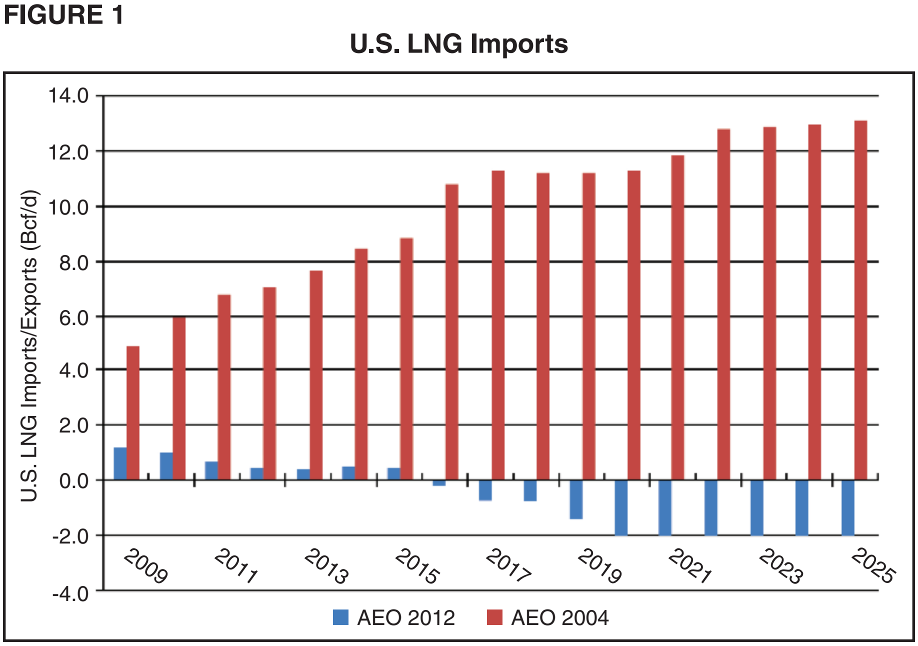
Sustainable economic viability has been a tough hurdle for U.S. GTL project development historically. We need only compare the Energy Information Administration's forecast for U.S. liquefied natural gas demand from 2004 with current forecasts to understand the significance of the impact of shale gas reserve development (Figure 1). Less than a decade ago, the consensus outlook was that the United States would become a significant liquefied natural gas importer. Today, project developers are investing in infrastructure to produce domestic natural gas and retooling existing or announced LNG import facilities to export LNG.

In today's market, converting the U.S. supply of natural gas to high-quality, finished liquid products is particularly attractive because of hydrocarbon gas and liquid pricing differentials, as well as increasingly stringent liquid fuel quality specifications. Figure 2 provides a summary of historical pricing trends for crude oil and natural gas, as well as forecast prices through 2035. As shown, the differential between gas and liquids has grown substantially in the past several years, and the market is recognizing the sustainable, fundamental change in U.S. gas supply in future price expectations.

The quality of liquid fuels has evolved continually within the petroleum refining industry. In the past two decades, quality changes have focused largely on reducing component emissions, with suppliers and automobile manufacturers adjusting fuel blends to meet engine performance requirements. To meet emission standards, most of the diesel utilized in the United States must be blended to meet a maximum sulfur content specification of 15 parts per million, while the sulfur content of diesel supplied to California is limited to 8 ppm. Diesel produced using GTL essentially is sulfur free.

Engine performance for distillate range fuels depends on the cetane number of the finished fuel blend. GTL diesel has a cetane number in excess of 74, in contrast to 40 for diesel refined from liquid petroleum. The very high cetane number for GTL diesel results from a lack of aromatic hydrocarbons contained in the precursor, a synthetic wax. The lack of aromatics significantly affects emissions

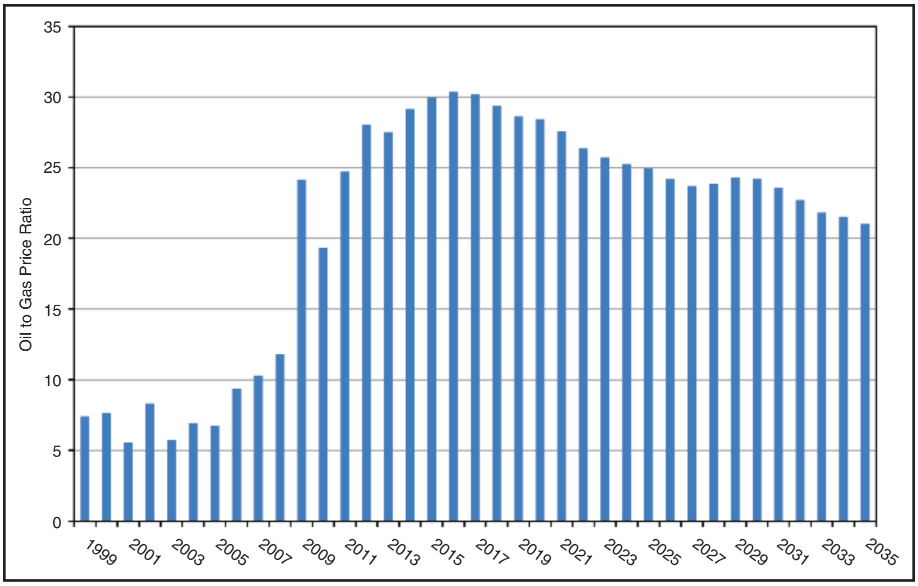
FIGURE 1



Source: EIA, Annual Energy Outlook Reference Cases, 2004 and 2012

FIGURE 2

Crude Oil and Natural Gas Price Ratio



Source: EIA, Annual Energy Outlook 2000-2012

when GTL diesel is burned, and as a result, GTL fuels have been tested extensively in military jet applications where particulate emissions are undesirable. GTL diesel is a very high quality blend stock that can be utilized in formulating ultralow sulfur diesel, California Air Resources Board diesel, and jet fuel to meet both current and expected future emissions and performance requirements.

U.S. petroleum refiners have invested billions of dollars to retool operations in order to produce diesel grades with very low sulfur content. Furthermore, most recent refinery expansions and major capital upgrades have been focused on manufacturing diesel fuels rather than the traditional goal of increasing gasoline output. In today's market, diesel grades are more valuable than gasoline grades at the refinery rack and the retail pump. This shift in relative value generally is expected to be a permanent, long-term change driven by fundamental transportation demand, thus adding to the sustainable value of GTL production.

GTL Technology

The original Fischer Tropsch (FT) process developed in 1923 was focused on converting coal into liquid fuels. The Germans utilized this technology during World War II to meet motor fuel demand and minimize their dependence on imported crude oil. The technology was largely dormant until Sasol developed a coal-to-liquids facility in Sasolburg, South Africa, in 1955. Since that time, Sasol has made significant technological advances and developed numerous projects for converting coal and natural gas to liquid transportation fuels.

Early on, natural gas was identified as a better feedstock for commercial FT operations than coal because of how efficiently it converted to synthesis gas, how easy it was to handle, and how few impurities it had. These factors combine to result in lower capital and operating costs for GTL plants than for coal conversion plants.

Many of the barriers to widespread commercialization of GTL have been reduced dramatically by advances in catalyst life and efficiency, and FT reactor design. Important technological advances have been developed by a variety of energy and technology companies, including Sasol, Shell, Exxon Mobil, ConocoPhillips, Syntroleum, and Statoil. Sasol, Chevron, Shell and Sinopec (via Syntroleum) are developing FT projects based on commercially proven technologies. Additionally, Rentech is pursuing GTL projects based on biomass conversion.

The GTL process contains three steps: natural gas reforming, FT reaction, and fuel refining. The gas reforming step is very similar to the first step in chemical processes for producing methanol or ammonia, and thus is well defined and manageable from a project execution standpoint.

The FT reaction step converts the syngas produced by reforming to long-chained hydrocarbons or FT waxes. The FT section of the facility contains the most proprietary design features and involves complex, licensed technology. Large, successful GTL operations outside the United States have reduced overall project risk drastically, paving the way for pursuing smaller-scale, domestic projects to take advantage of the abundant supply of natural gas and sustainable demand for diesel.

The final step in the GTL process utilizes petroleum refining hydroprocessing and isomerization technology to transform the FT waxes into shorter hydrocarbon chains. The process variables in this step can be manipulated easily to produce varying yield patterns of fuels in the naphtha, jet fuel, and diesel boiling ranges to meet the fuel demand patterns of the local market. North American GTL projects most likely will be focused on producing diesel fuel.

GTL Projects

GTL projects historically have been difficult to develop for a host of reasons, not the least of which was uncertainty with respect to commercial viability. Stranded natural gas deposits led to developing commercial GTL plants in Malaysia, Qatar and Nigeria. For these projects, commercial uncertainty was offset by significant supplies of relatively inexpensive natural gas pledged to specific projects. The Pearl Plant in Qatar is advertised as having free feedstock. The South African plants were justified by the fundamental lack of domestic liquid hydrocarbon resources. Table 1 provides a summary of each of the current projects.

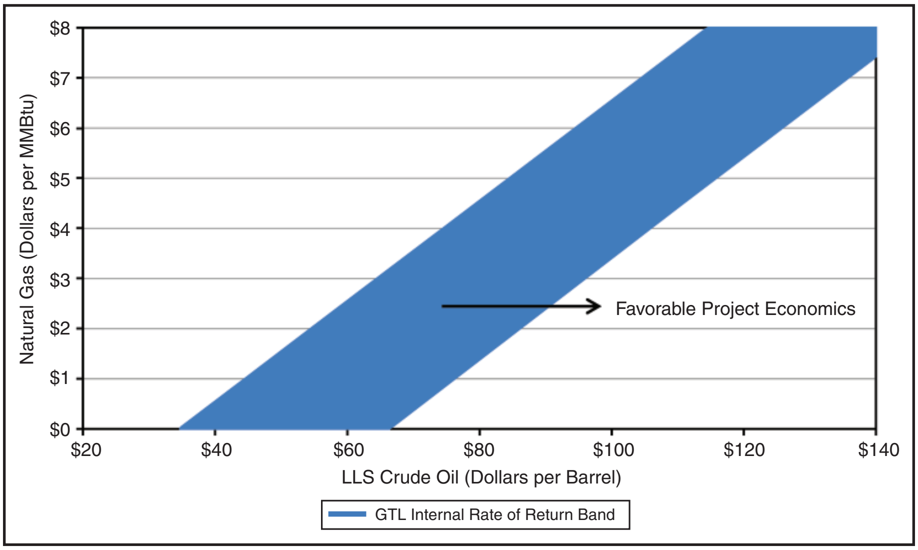
TABLE 1

Existing GTL Plants

Location	Operator	Startup	Capacity (bbl/d)	
Sasolburg, South Africa	Sasol	1955	5,600	Switched to natural gas in 2004
Mossel Bay, South Africa	PetroSA	1992	36,000	
Bintulu, Malaysia	Shell	1993	14,700	
Ras Laffan, Qatar	Oryx GTL	2006	34,000	Owned by Qatar Petroleum and Sasol
Ras Laffan, Qatar	Shell	2011	140,000	Owned by Qatar Petroleum and Shell
Escravos, Nigeria	Chevron	2013	34,000	Owned by NNPC and Chevron

FIGURE 3

Prototypical Gulf Coast GTL Plant Economics



The most recent projects have been associated with well-publicized construction delays and dramatic cost increases. However, these projects have advanced GTL application understanding to the point that smaller, more competitive commercial projects now are feasible.

GTL Economics

North American GTL economics were analyzed by examining the performance of a prototypical U.S. Gulf Coast GTL plant located in Louisiana. Detailed capital and operating costs have been developed for the prototype facility, and after-tax returns have been evaluated to establish range of economic viability based on natural gas and crude oil pricing. Figure 3 presents the results of this analysis.

The GTL plant in this example consumes 200 million cubic feet a day of natural gas and produces 20,000 barrels a day of ultralow sulfur diesel. The chart identifies a commodity pricing band at which this GTL plant would produce an after-tax return on investment of 10-15 percent. For example, a natural gas price of $2 an Mcf corresponds to economic crude oil prices of $55-$85 a barrel at either end of the band. The $30 a barrel variance accounts for differences in project-specific factors, primarily total investment and return, and to a lesser degree, operating expenses.

The capital cost for a stand-alone GTL plant of this size realistically can range from $60,000 to $85,000 per barrel of product capacity. Total operating expenses can range from $12 to $18 dollars a barrel. Other site specific factors, such as location advantages and cost savings from integrated operations, may alter total investment or operating expenses, and will provide substantially superior economics to the base screening evaluation presented here.

In the expected market environment and given increasing gas supplies, GTL has become a viable alternative for the economic disposition of natural gas. Given the range of viable plant sizes and availability of gas supply, GTL projects can be located at many points along the gas value chain.

Competing Options

Other, more traditional, lower-perceived-risk disposition alternatives are being considered by producers and natural gas consumers. Liquefied natural gas export and methanol production are two of the alternatives being evaluated by many companies. Like GTL, LNG projects require significant resource and capital commitments. However, they also carry the burden of political risk associated with export permits, and currency and counterparty risks impact the evaluation and long-term investment outlook for large LNG export facilities.

Methanol projects typically are thought to carry lower project risk and require less capital, but the size of the global methanol market severely limits the number of projects that can be developed. Table 2 highlights the competing investment economics for the three potential uses of U.S. Gulf Coast natural gas.

The competing projects are analyzed

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TABLE 2

Competing Investment Economics

	LNG to Europe	LNG to Asia	Methanol	GTL
Product Sales Price	$10.52/MMBtu	$14.66/MMBtu	$397.07/MT	$116.99/bbl
U.S. Dollars per MMBtu gas processed				
Revenue	9.48	13.21	12.22	11.70
Shipping	(1.00)	(2.80)		
Tolling	(2.50)	(2.50)	(9.11)	(5.49)
Netback per MMBtu	5.98	7.91	3.11	6.21

based on tolling. As such, the economics are evaluated based on the assumption the producer pays the processor a tolling fee that compensates the processor for operating costs and provides a return on the capital investment. The producer takes all of the margin risk on the GTL operations and retains the optionality to deliver gas into the pipeline based on competing net backs for the disposition alternatives.

The analysis compares a grass-roots 20,000 bbl/d GTL plant with a grass-roots 1.27 million metric ton per year methanol plant and a 1,200 MMcf/d brownfield LNG export facility. The GTL net back is compelling when actual 2011 annual average product prices are used as the basis for evaluation. The Asian LNG net back is superior over this time frame, but could experience heavy price pressure in the long term from competing Australian LNG projects. Developing a grass-roots LNG facility would require a higher tolling fee to achieve the same return, and would therefore return a lower net back to the producer.

GTL technology is economically viable in North America, and relevant applications have been identified to meet the needs of domestic producers. GTL can be deployed in the midstream as an alternative to, or integrated with, traditional natural gas processing schemes, or as an alternative to traditional gas marketing channels. Given the high price of oil, now is the time to employ GTL in the North American gas value chain to enhance the value of existing gas reserves and support efforts to achieve U.S. energy independence. ❒