Gasoline From Natural Gas?

Low gas prices revive gas-to-liquids plans.

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Data Sources for This Publication
CME Group
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To discover more about the data sources used, click here.

Robust Margins

A proposed plant producing 2,800 barrels/day of gasoline from 29,000 million British thermal units of natural gas in the West Texas Permian region would have enjoyed operating margins averaging $60/barrel during 2018 and 2019. The margins reflect very low natural gas prices in the Permian due to a surplus of stranded associated gas produced with oil. A natural gas to gasoline plant would also enjoy robust margins above $45/barrel using CME Nymex Henry Hub, Louisiana natural gas and New York Harbor gasoline contracts. Despite good prospects today there are risks associated with this type of gas-to-liquids venture. This note estimates plant economics and reasons it may not be built.

Technology

In December 2019, Primus Green Energy Systems owned by listed private equity firm Kenon Holdings announced a front end engineering and design study for a 2,800 barrel/day plant converting natural gas to gasoline in the Permian region of West Texas. The FEED study, expected to conclude in mid-2020 will determine feasibility and investment cost for the plant before a final investment decision. The proposed plant is a joint venture between Primus and an unnamed global petrochemical company. If successful it would be the first of many small scale plants the investors plan to build in the U.S.

Primus' syngas to gasoline, or STG, technology produces high-quality gasoline from a range of hydrocarbon gas types including methane (dry natural gas) and heavier "wet" gas containing natural gas liquids. Each STG unit is modular and produces quantities as small as 500 barrels of gasoline/day. Primus runs a demonstration plant in Hillsboro, New Jersey using the same technology that has operated successfully since 2013.

The STG process has three phases. First, natural gas inputs are combined with steam at high temperature and pressure (steam methane reforming) to produce syngas—a mixture of hydrogen, carbon monoxide, or C0, and carbon dioxide, or C02. Second, a series of catalytic fixed-bed reactors convert syngas into gasoline and water. Third, the products are cooled and condensed with the gasoline stored, the water recycled for steam and any residual natural gas used as fuel. The Primus Texas project is designed to produce 2,800 b/d of ready-to-use gasoline blend stock. The plant will be in the Permian Basin that has surplus natural gas as well as demand for transport fuels from booming oil production activity. Primus says the planned 2,800 b/d plant requires about 28 million cubic feet of natural gas, which is the equivalent of 29,000 mmBtu.

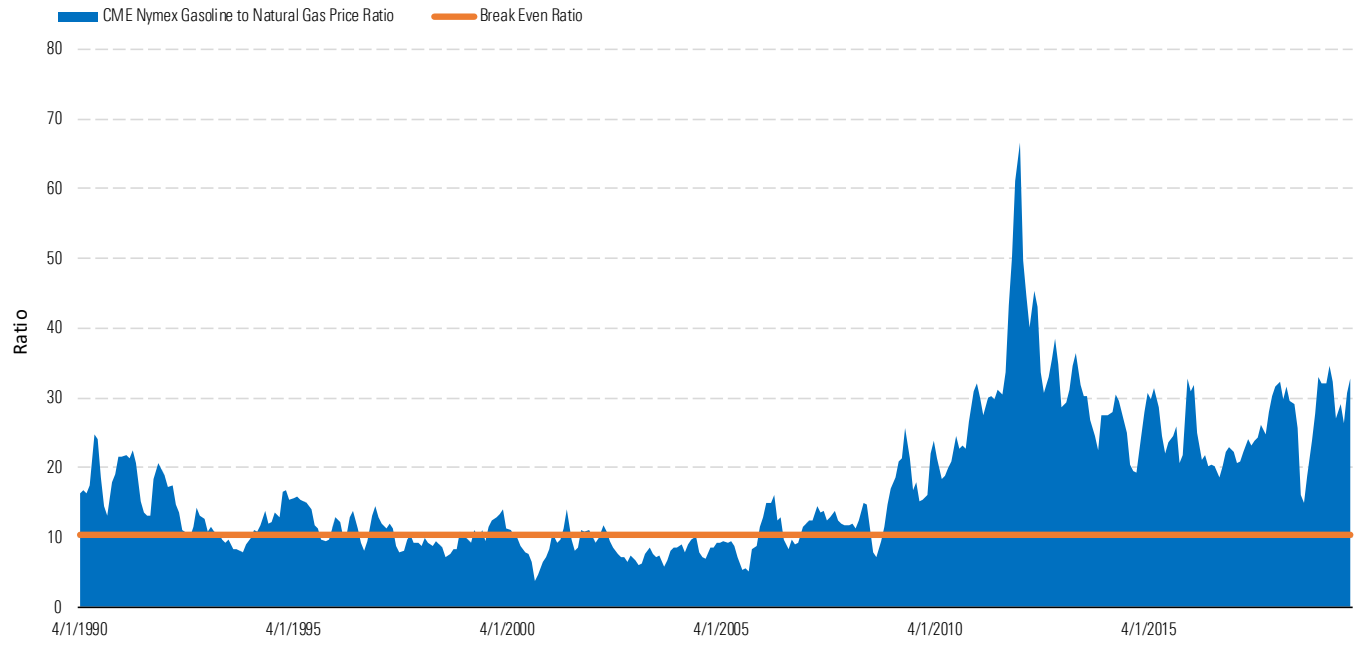
Other examples of gas to liquids, or GTL, technology exist worldwide with most dedicated to producing methanol—a chemical building block used in cleaning materials and as a blend stock for gasoline outside the U.S. Several large-scale methanol plants have come online at the U.S. Gulf Coast in recent years to take advantage of abundant cheap natural gas supplies. These industrial scale plants use the Fischer-Tropsch process to react heated syngas with catalysts to convert to a liquid hydrocarbon. The same process has been used to produce transport fuels, most notably by Shell and SASOL at large plants in Qatar. Plans to use the Fischer-Tropsch process to produce transport fuels in the U.S. in the shale era haven't so far progressed beyond the planning stage. Larger scale GTL plants than the proposed Primus project have operated successfully but are expensive to build and complex to operate. The Shell GTL plant in Qatar produces up to 140 thousand b/d of diesel fuel but cost $19 billion to build—more expensive than a new oil refinery. The Primus plant is expected to cost in the low hundred million dollars.

Cheap Natural Gas

Interest in GTL investment is cyclical—increasing when the spread or ratio between oil and natural gas prices widens to make these plants more profitable. Hydrocarbon wells produce a range of hydrocarbons usually designated as type crude or natural gas based on majority output. In the shale era proliferating natural gas production has reduced its value relative to crude and gas liquids, encouraging GTL conversion. We detailed the crude/gas ratio in a June 2016 note (see "Narrow Crude to Gas Ratio Threatens Infrastructure Investment.") The Primus proposal involves converting 29,000 mmBtu of natural gas to 2,800 barrels of gasoline—a ratio of 10.36 mmBtu to each barrel. It follows that the price of gasoline in $/barrel must be at least 10.36 times the $/mmBtu natural gas price for the plant to generate revenue. Exhibit 1 shows the price ratio between monthly average prices for CME Nymex prompt gasoline delivered to New York Harbor and CME Nymex prompt natural gas delivered to Henry Hub, Louisiana (blue shaded area). These are the U.S. benchmark gasoline and natural gas contracts. The orange line represents break even at 10.36 times the natural gas price.

Over the life of the Henry Hub contract since April 1990, New York gasoline prices have averaged 17.2 times natural gas. The ratio has averaged a higher 28 times since 2010 when natural gas from shale wells began to impact the U.S. market, lowering prices relative to crude and refined products. During 2012, the ratio averaged 45 times and reached 67 times during April of that year when natural gas prices last collapsed below $2/mmBtu. Recently the ratio averaged 27 times in 2018 and just under 29 times in 2019. Of concern for GTL technology is the 20-year period prior to 2010 when the gasoline ratio in Exhibit 1 averaged 11.58 times—not much above break even. If the gasoline/natural gas ratio returned to those levels for an extended period, the Primus plant wouldn't be profitable.

Exhibit 1 Monthly Average CME Nymex Gasoline to Natural Gas Price Ratio



Source: CME Group, Morningstar.

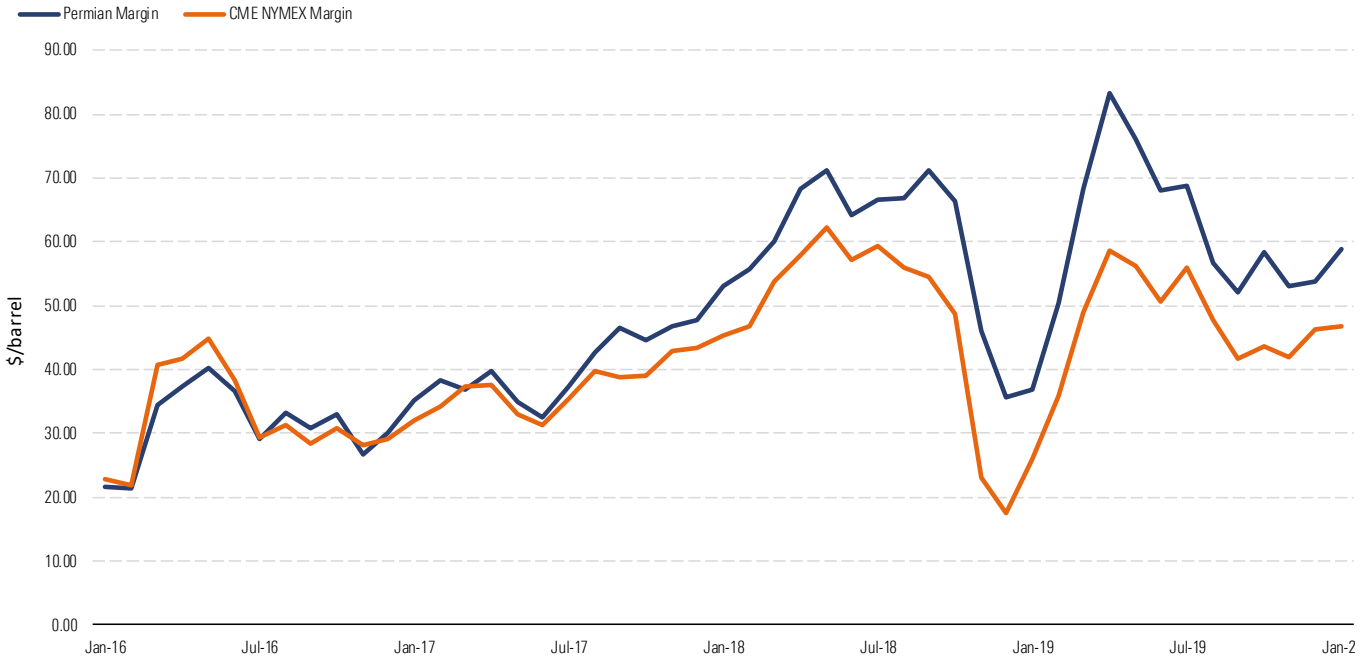
The recent high gasoline/natural gas ratio averaging 33 times in January 2020 is a direct result of abundant U.S. natural gas supplies this winter that have pushed prices below $2/mmBtu. U.S. production of dry gas averaged 84 billion cubic feet/day in 2018 and 91.4 bcf/d between January and October 2019 according to the U.S. Energy Information Administration. A surplus of domestic supply has prompted increasing exports from newly built coastal liquefaction terminals that averaged just under 3 bcf/d in 2018 and 4.6 bcf/d between January and October 2019 according to EIA. Although increased exports help temper falling domestic prices, a world market surplus, the ongoing trade dispute with China, the coronavirus epidemic, and a mild U.S. winter have all weighed on prices. That makes GTL plant investments look very attractive anywhere in the U.S. today.

Permian Advantage

Converting natural gas to liquids is an even more attractive proposition in shale-producing regions where circumstances strand gas supplies at very low or even negative prices. Natural gas prices in production regions such as the West Texas Permian make GTL plant investments seem too good to be true. Gas prices in the Permian are under pressure due to a lack of takeaway capacity. Gas production in the region remains robust because it is mostly output as associated gas from oil wells. Producers continue drilling for oil and flare the associated gas at the wellhead until infrastructure investment provides a route to market. In a November report, Rystad Energy estimated an all-time high 0.75 bcf/d of natural gas was flared in the Permian during the third quarter of 2019. Plant margins for GTL conversions in the Permian are therefore higher than for the CME Nymex New York gasoline and Henry Hub gas ratio illustrated in Exhibit 1.

Exhibit 2 shows the monthly average estimated performance of Primus' proposed plant since January 2016. The orange line is the operating margin using CME Nymex New York gasoline and Henry Hub natural gas and the blue line is based on Permian gas. The margin is the $ price for 1 barrel of gasoline minus 10.36 times the price of natural gas in $/mmBtu. The CME Nymex margin (orange line) averaged $41.13/barrel over the entire period. The equivalent margin for Permian plant economics is estimated based on Permian natural gas prices and gasoline prices at the U.S. Gulf Coast. The Permian margin (blue line) averaged $48.34/barrel since January 2016 but increased to an average $60/barrel during 2018 and 2019.

Exhibit 2 Natural Gas to Gasoline Plant Operating Margins



Source: CME Group, Morningstar.

Risks

Although our analysis suggests a very profitable plant based on recent market conditions, the rosy picture is tempered by several risk factors. These can be grouped into two broad categories. The first is market risk and the second (that we'll get to in a minute) is the investment risk associated with the plant's carbon footprint. The market risk for a GTL plant is the potential for the gasoline/natural gas price ratio to collapse from recent highs—most likely through a recovery of natural gas prices—as well as from reduced demand for gasoline in the plant region. The high gasoline/gas ratios seen in the past decade depends on abundant cheap natural gas. If production retreats in response to lower prices and then demand picks up for LNG exports, natural gas could quickly become more expensive. And although current demand for transport fuels in the Permian is high because of the production boom, the region is infamous for a boom and bust economy. In case of another bust, the region's six local refineries (detailed

in our September 2018 note: "Sweethearts of the Permian – Refinery Margin Jackpot") can easily meet local demand and have greater flexibility to serve other markets compared with a small supplier like Primus.

Carbon Footprint

Arguably a larger risk to the Primus investment is that the plant process involves a relatively expensive conversion of natural gas to gasoline that requires significant energy produced by burning natural gas, which outputs carbon into the atmosphere. While that process is arguably more beneficial than just flaring wellhead natural gas, it still creates a carbon footprint that investors are increasingly wary of. The carbon-intense nature of the process, notwithstanding its potential profitability is likely to attract direct attention from the environmental lobby as well as indirect discrimination by investors.

Conclusion

We believe that in this new decade, proposed investments such as the Primus GTL plant face a conflict of interest between profit based on energy supply demand fundamentals and investor sentiment based on carbon footprint. The wider investment community is now pushing back on carbon intense investment and may make it difficult for projects like Primus' GTL plant to reach a final investment decision. In addition, the investment return is also threatened by slowing production in basins like the Permian that could realign the crude/gas ratio to less profitable levels seen in the pre-shale era.

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