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Natural Gas to Gasoline

A firm claims to have a cheaper way to harness natural gas.

By Tyler Hamilton

A Texas company says that it has developed a cheaper and cleaner way to convert natural gas into gasoline and other liquid fuels, making it economical to tap natural-gas reserves that in the past have been too small or remote to develop.

The company behind the technology, Dallas-based Synfuels International, says that the process uses fewer steps and is far more efficient than more established techniques based on the Fischer-Tropsch process. This process converts natural gas into syngas, a mixture of hydrogen and carbon monoxide; a catalyst then causes the carbon and hydrogen to reconnect in new compounds, such as alcohols and fuels. Nazi Germany used the Fischer-Tropsch process to convert coal and coal-bed methane into diesel during World War II.

A Synfuels gas-to-liquids (GTL) refinery goes through several steps to convert natural gas into gasoline but claims to do so with better overall efficiency. First, natural gas is broken down, or "cracked," under high temperatures into acetylene, a simpler hydrocarbon. A separate liquid-phase step involving a proprietary catalyst then converts 98 percent of the acetylene into ethylene, a more complex hydrocarbon. This ethylene can then easily be converted into a number of fuel products, including high-octane gasoline, diesel, and jet fuel. And the end product is free of sulfur.

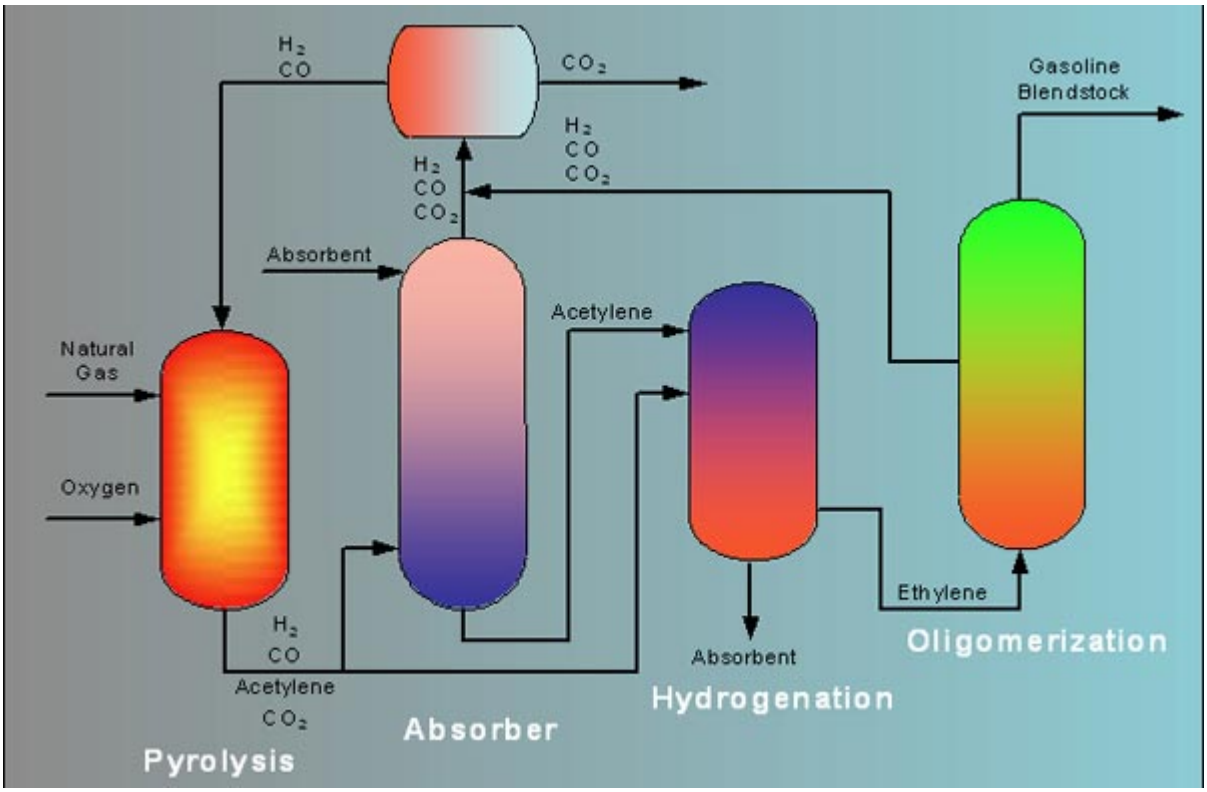
"We're able to produce a barrel of gasoline for much cheaper than Fischer-Tropsch can," says Kenneth Hall, coinventor of the process and former head of Texas A&M University's department of chemical engineering. Hall says that a Fischer-Tropsch plant is lucky to produce a barrel of gasoline for $35 but that a much smaller Synfuels refinery could produce the same barrel for $25. Under current fuel prices, such a plant could pay for itself in as little as four years, the company says.

Texas A&M University licensed its approach to Synfuels and partly owns the company, which has been operating a $50 million demonstration plant in Texas since 2005 and says that it is close to signing a deal for its first commercial refinery near Kuwait City.

Synfuels president Tom Rolfe says that the company has developed some proprietary components and catalysts, but he adds that much of the approach is based on off-the-shelf technologies. He says that Synfuels' main advantage is the efficiency by which it breaks down and reassembles hydrocarbon molecules. "Nobody has achieved as high a conversion rate of natural gas into acetylene as we have," Rolfe says.

Ali Mansoori, a professor of chemical engineering and physics at the University of Illinois at Chicago, says that the process seems far less complicated than those found in a Fischer-Tropsch plant. "The numbers reported for conversion efficiency and selectivity look quite promising," he adds.

But Synfuels isn't alone in trying to make GTL more economical. Gas Reaction Technologies, a spinoff from the University of California, Santa Barbara, has developed a process that converts natural gas into bromine-based compounds that are later converted into liquid fuels.



Gas to go: Several steps are needed to turn natural gas into gasoline. Natural gas is broken down under high temperatures into acetylene and a liquid-phase step converts the acetylene into ethylene. This can be converted into a number of fuel products, including high-octane gasoline, diesel, and jet fuel.

The goal for both companies is the same: to tap into natural-gas reserves that are too small or too remote to economically access with a dedicated pipeline. Much of this gas is a by-product of oil extraction. The World Bank estimates that more than 150 billion cubic meters of natural gas--equivalent to the combined gas consumption of France and Germany--are flared or released into the air every year by oil companies that have no

economical way of getting the gas to market. The resulting greenhouse-gas emissions are a major contributor to climate change, the World Bank adds.

"With our technology, you can go into the field and process that natural gas into gasoline," Rolfe says. "Now it's a liquid, so it can be sent in existing oil pipelines. There's a huge opportunity for this in places like Russia, the Middle East, and South America."

There is also opportunity in Alaska's North Slope, where oil giants such as BP have been considering GTL projects as a way of getting natural gas to market as a by-product of oil extraction. BP spent $86 million on a demonstration Fischer-Tropsch plant in the late 1990s, with the idea that natural gas could be converted into diesel and mixed with crude oil being shipped through the 1,200-kilometer trans-Alaska oil pipeline. But the BP project never proved commercially viable.

Shirish Patil, a professor of petroleum engineering at the University of Alaska Fairbanks, says that the high cost of Fischer-Tropsch and rising oil prices now have the industry tilting toward building a dedicated natural-gas pipeline. But lower GTL costs could change that. "If there's any process that removes some of the steps of Fischer-Tropsch and reduces overall cost of conversion, that will certainly bear out in the economics," Patil says. "And it's the economics that will prevail."

Rolfe says that Alaska is certainly on Synfuels' radar. "We're working with the state of Alaska to use our plants as an alternative," he says. "The Fischer-Tropsch solution for the North Slope is not elegant at all. It's like getting an elephant up there to do your hard work, when all you need is two or three thoroughbred horses." Rolfe adds that a Synfuels refinery can be self-sufficient in remote areas because half the natural gas it taps can go toward power and heating requirements of the plant while the rest is converted into fuels. And unlike a Fischer-Tropsch plant, no hard waxes or toxic by-products result from the Synfuels process.

Synfuels estimates that only 200 of the 15,000 gas fields outside North America are big enough to justify the high capital costs of a Fischer-Tropsch plant. A handful of such plants exist today, including a Shell refinery in Malaysia and the Mossgas plant in South Africa. Another two plants are also under development, in Qatar and in Nigeria.

Devinder Mahajan, a chemical engineer with the Brookhaven National Laboratory, in New York, says that the industry will be somewhat skeptical until Synfuels has a commercial plant in operation. "There are a lot of investors out there who would put the money in if it has the claimed advantages over Fischer-Tropsch."

But such interest is building. In January, Kuwait-based AREF Energy Holding invested $28.5 million in Synfuels for a minority stake in the company and exclusive rights to market the refineries in the Middle East and North Africa. Rolfe says that sales interest is also building in Australia, Argentina, Egypt, and Kazakhstan.

Hall hopes that the last quarter of 2008 will be a "breakout" year for Synfuels and how it is perceived by the major oil companies. He understands, however, the industry's reluctance. "In this industry, everybody wants to be first to be second when adopting new technology. The Fischer-Tropsch process is at least proven. They know it works." By contrast, he says, Synfuels' approach, "hasn't been proven because there aren't any big facilities out there."