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Flame Off!: Turning Natural Gas Pollution into Gasoline

Rather than pollute the atmosphere by venting or flaring the natural gas that comes out of oil wells, a new technology would turn it into gasoline or other products

By David Biello
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As if burning oil and all of its derivatives wasn't bad enough for the environment, there's also the natural gas that bubbles up as the oil is pumped out. This byproduct cannot be easily harvested in many cases—some oil fields are far from pipelines that can transport it and other options are very expensive. As a result, oil companies either release it into the atmosphere—a process known as venting—or burn it in a flare.

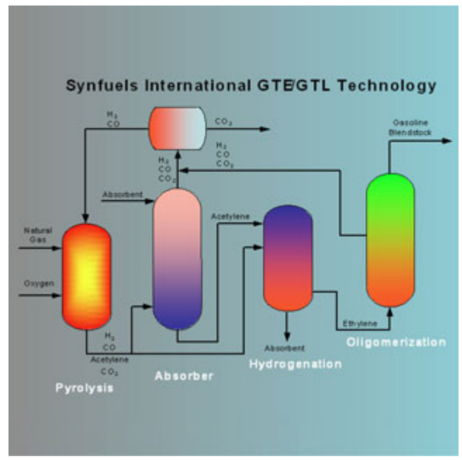
Using either method produces gases that the atmosphere doesn't need more of: venting discharges methane, a potent greenhouse gas, whereas flaring generates carbon dioxide. The World Bank estimates that the 5.3 trillion cubic feet (150 billion cubic meters) of natural gas that bubbles up at oil wells worldwide adds some 400 million metric tons of CO2 to the atmosphere each year—as well as more methane.

Existing technologies allow oil producers who cannot pump the natural gas into a pipeline to simply reinject it back underground, use it to generate electricity or, by installing a so-called Fischer–Tropsch conversion system, change the former nuisance gas into liquid fuel, among other options. But those approaches cost much more than the approximately 50 cents per thousand cubic feet (28 cubic meters) for flaring, and add up to millions of dollars for a large oil field. A Fischer–Tropsch system, for example, starts at a billion dollars.

Now a new process offers hope of turning that stranded natural gas into something useful and transportable instead: gasoline. Dallas-based company Synfuels International peddles a process that converts oil well emissions into the building blocks of plastics or fuel. Since 2005 the company has been running a demonstration plant in Texas and is in negotiations to put up its first commercial facility near Houston.

"Our process can go into oil fields and operate without the need for electricity or water to convert what otherwise would be flared gas into gasoline or it can be mixed with crude [oil] to increase quality and quantity," says Synfuels president Tom Rolfe. "Any transportation fuel that is salable is really our end goal."

Here is how it works: The natural gas is cracked with heat—produced by burning some of the natural gas to generate temperatures from 1,650 to 2,550 degrees Fahrenheit (900 to 1,400 degrees Celsius)—into acetylene, a simple hydrocarbon. The acetylene is absorbed by a liquid solvent and then reacted to produce ethylene, a longer hydrocarbon chain that is the starting constituent of many plastics, detergents and other products. When liquid fuel is the goal, then the ethylene is chemically bound together to form even longer hydrocarbon chains that we know as gasoline or kerosene (jet fuel). "We're still developing a process to produce diesel," Rolfe says.



The process converts roughly 50 percent of the natural gas to acetylene—the other half is burned for the heat that drives the process, which still releases CO2 into the atmosphere—and nearly all of that acetylene to ethylene, and then ethylene to fuel. "Overall conversion rates from the [natural] gas to fuel-grade liquids is as high as 46 percent in optimal, real-world conditions," Rolfe says—as good or better than established facilities employing Fischer-Tropsch, such as Johannesburg-based Sasol, Ltd.'s plants in South Africa.

The resulting fuel has no sulfur. (Sulfur and mercury are removed as solids and can be buried or converted to useful materials.) And, it can be directly used in cars or other vehicles in some countries. (In the U.S., air pollution regulations would make it necessary to ship it to a refinery for final processing or blend it with a less aromatic gasoline.) "In a country like Saudi Arabia, you could fill your car up with the gas we make and drive away," Rolfe notes.

In the U.S. generating electricity or putting the natural gas into a pipeline often makes sense because of existing infrastructure. But in Nigeria, for example, oil companies flare some 850 billion cubic feet (24 billion cubic meters) per year at oil platforms that have no need to generate electricity because of the platform's remote location and no pipelines to carry off the natural gas. At such locations, Synfuels's process or Fischer–Tropsch could make financial sense. But the $150 million to $200 million that Rolfe says a Synfuels process plant will cost is just a fraction of the Fischer–Tropsch price. "If there's no pipeline, you're just burning money [by flaring] and hurting the Earth," Rolfe notes.

In addition, the Synfuels process can handle small volumes of natural gas—ranging from one to 300 million cubic feet (8.5 million cubic meters) per day. That is important because most oil wells do not spew a lot of natural gas, which makes the Synfuels approach useful even at smaller fields. Depending on the quality of the natural gas itself, the process can then make gasoline at a cost of roughly $31 to $63 per barrel (73 cents to $1.50 per gallon), depending on whether the natural gas is pure methane (more costly to transform) or has other hydrocarbons mixed in.

But the technology is not just useful for so-called stranded natural gas in the developing world; in Alaska, much natural gas is simply reinjected back into the oil wells from which it came either to boost oil production or simply avoid atmospheric venting or flaring. "With Synfuels plants, if you captured and processed all the natural gas that is being reinjected and wasted today, you could make 550,000 barrels (87.5 million liters) of gasoline a day," Rolfe says. That translates into money: Converting just 10 percent of the flared natural gas worldwide to gasoline sold at $70 per barrel would net $3.1 billion in revenue.

"From an environmental point of view, any use of natural gas is preferable to flaring," notes chemical engineer James Miller of Sandia National Laboratories. But "the economics would be highly dependent on what you do with the syngas components of this [process]."

"All of the syngas goes into heat or energy production," Synfuels chemist Ed Peterson says, and the company cuts down on cost by using such by-products to make energy and employing components built with cheaper steel alloyed with carbon as well as easy to maintain low pressures. Within the next three years, the company hopes to build four such plants in the U.S., Trinidad and Tobago, Nigeria, and Iraq and is negotiating in Argentina, Australia, Kazakhstan and Kuwait. "There's a huge impetus to stop gas flaring around the world," Peterson says. "This is just one of those ways."