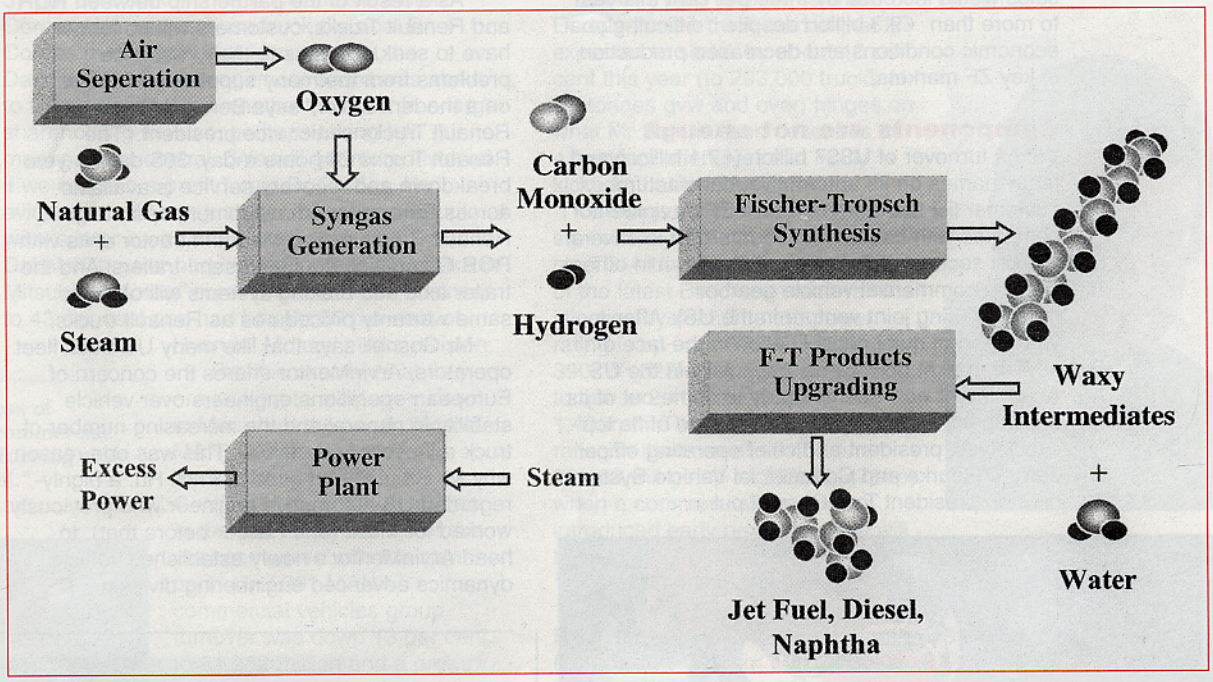
Why gas is liable to become a liquid asset



Fischer-Tropsch catalytic synthesis: at the heart of the multi-stage gas-to-liquid production process. Source: Mitretek Systems.

Alan Bunting reports from a London conference focused on a century-old chemical process that could be the key to clean road transport fuels of the future.

Diesel engine manufacturers spending millions to keep pace with exhaust emissions legislation must sometimes dream of a super-clean fuel which would allow unmodified engines of today to satisfy Euro-5 exhaust limits, even with no catalyst or filter exhaust after-treatment. The dream could be about to come true, it seems, thanks to liquid hydrocarbon converted from natural gas by the Fischer-Tropsch GTL (gas-to-liquid) process, first developed almost 100 years ago by the two German chemical engineers who gave it their names.

As exhaust emission limits tighten and the price of crude oil rises, so Fischer-Tropsch fuels become more and more viable for road transport and other applications. This was the message from several speakers at a recent oil-and-gas-industry London conference devoted to the subject of gas-to-liquid fuels.

Like methanol and dimethylether (DME), F-T fuels are liquid at ambient temperature: a key advantage over liquefied natural gas. A diesel engine and its fuel injection system needs no modification to allow it to run on F-T fuel.

There is no sulphur in the fuel, and engines running on it emit none of the tailpipe methane that plagues most of today's lean-burn natural-gas engines. And a high cetane number promises significantly better per-litre fuel efficiency from F-T fuel than from methanol or DME.

F-T fuel can even be blended with diesel to lower the diesel's sulphur content, though as with ultra-low-sulphur diesel, poor lubricity resulting from lack of sulphur has to be tackled with additives.

Evasive

Why is the industrial world not rushing to embrace an environment-friendly fuel offering so many advantages? Cost would seem to be the main reason: though the fuel's raw material (natural gas) is plentiful and cheap, Fischer-Tropsch plants are neither. So what does it cost exactly to produce a barrel (159 litres) of F-T fuel? The length of a piece of string is easier to pin down. Oil company bosses become evasive when asked about the precise cost of F-T fuels, apparently because it depends so much not only on the cost of feedstock gas but also on the volatile world oil market. One speaker at the conference, David Gray, director of energy systems analysis at Mitretek Systems of the US, says that "the minimum premium for GTL above crude is probably about US$ 3.40 a barrel because GTL is a superior atmospheric gas oil."

Yet some oil industry sources suggest that it is already possible, given a high enough output, for a modern plant to produce a barrel of GTL at less than the current price of a barrel of diesel. One thing is clear: that the price of GTL fuel relative to diesel is coming down. And though estimates of global reserves of oil and natural gas vary wildly, it is generally accepted that oil will run out long before gas.

Natural gas fields continue to be discovered, but most of them are in remote regions like Alaska's North Slope – where conference speakers estimated there are between 35 and 100 trillion (million million) cubic feet (TCF). Crude oil reserves are reckoned to hold about 5,000 trillion cubic feet of "associated" gas which is described as "stranded", meaning it cannot be reached.

It became clear at the London conference that future prospects for F-T fuels depend not so much on technological challenges as on the economics and logistics of setting up their huge processing plants, and then transporting the fuel to where it can be marketed viably.

Several small F-T pilot plants have been established over the past decade by oil companies such as Exxon-Mobil, BP and Conoco. More are now being built. But huge investment would be needed to make F-T fuel available on a commercial scale. Dr Gray told the conference that GTL plants need to be "as large as possible, for obvious reasons of barrels/day unit cost, and as close as possible to the gas fields."

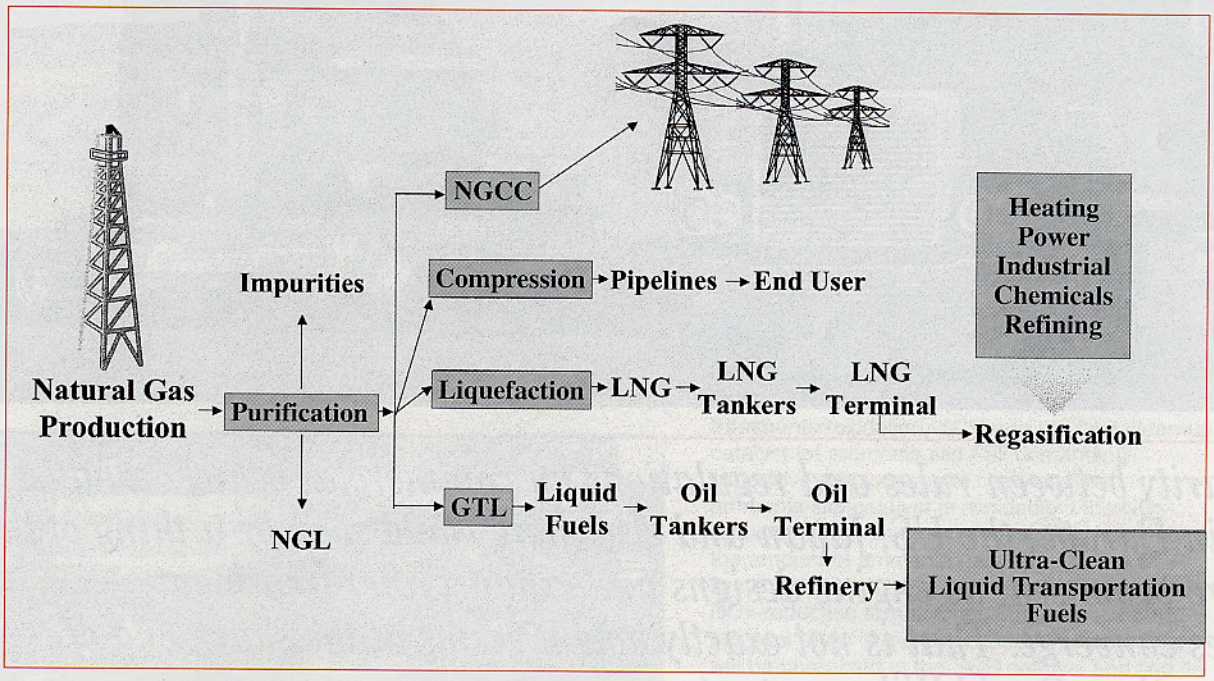
Modest output

No country is paying more attention to gas-to-liquid projects than the US, where the government's Department of Energy has commissioned much of the recent research. In 1992 the DoE funded the first GTL pilot fuel plant anywhere, at LaPorte, Texas, on the Gulf of Mexico. Its output is a modest 35 barrels a day.

One problem is that energy in natural gas is consumed in the multi-stage gas-to-liquid processing. Plant efficiency has been improved and now can be as high as 65 per cent, the conference was told, but that hardly seems impressive when it still means a 35 per cent loss of energy in the production process.

Before the Fischer-Tropsch process is applied, natural gas has to be converted into what the chemical industry refers to as a synthesis gas, or "syngas", comprising a mixture of hydrogen and carbon monoxide in various proportions (ideally around two to one for F-T production). Syngas technology was outlined at the London conference by Sanjiv Ratan, from Technip-Coflexip of the Netherlands. "This typically accounts for more than two-thirds of GTL processing energy input and more than half the total process plant investment," said Mr Ratan.

Rachid Oukaci, responsible for Fischer-Tropsch research and development at the Energy International division of the US-based Williams group, described various F-T synthesis techniques. "Even now, 100 years on, the Fischer-Tropsch chemical mechanism is not well defined and still the subject of much debate," said Mr Oukaci. "Incoming syngas is passed over a catalyst, typically cobalt, in one of several types of reactor. An installation like this is already being used commercially by Shell in its F-T plant in Malaysia."



Developments in the pipeline: natural gas is plentiful and cheap but the plants needed to process it are costly. Source: Mitretek Systems.

Various fractions

An F-T plant's output, like that from an oil refinery, is divided into various fractions. From the initial process only about 25 per cent of the output can be turned into a "diesel-usable" fuel, though it is possible for some of the largely valueless wax by-products to be reprocessed (at additional cost) boosting the percentage-usable figure to more than 30 per cent. Other fractions which can be drawn off from an F-T plant include naphtha and a gas able to be used in LPG (liquefied petroleum gas) engines.

The latest gas-to-liquid plant has been built at De Meern in the Netherlands. It has been developed and financed jointly, at a cost of around €20 million (£13 million) by Sasol, a South African oil company, and catalyst specialist Engelhard. The plant is expected to start production at the end of this year, though much depends on oil prices set by Opec (Organisation of Petroleum Exporting Countries). Marketing of the De Meern GTL fuel will be in the hands of Sasol-Chevron, a joint venture formed as a result of Chevron's supplying the De Meern plant with natural gas. ■