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Gas-to-Liquids

In GCA Focus No. 33 (July, 2003), Richard Poole reviewed the emerging gas-to-liquids (GTL) industry, which encompasses the conversion of natural gas to liquid transport fuels. Now, almost five years on, Richard takes a look at what has happened since then, as an aid to projecting how this complex and interesting technology might evolve further over the next 5-10 years.


Courtesy of Oryx GTL

Back in 2003, it was clear that GTL held a lot of interest for several players as an attractive means of monetizing natural gas reserves. Some of the reasons for this interest were clear. Not all gas resources were suitable for development and monetization by pipeline or LNG, because of a lack of local market or the need to tie-up a liquefied gas 'chain'. Yet, GTL products could be sold into virtually any market in the World. Add to this a growing environmental lobby to minimize gas flaring and the tightening of sulphur specifications for transport fuels, and GTL was an attractive proposition within a company's gas monetization 'tool kit'.

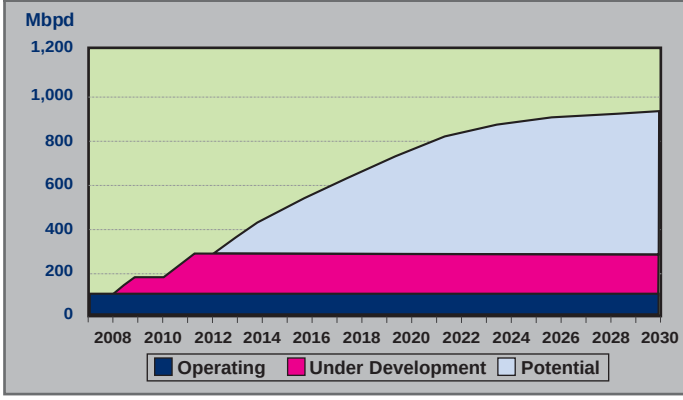
During the early part of this decade, most analyses of the feasibility of developing a GTL project concluded that a crude oil price somewhere above U.S.$30/Bbl was necessary for GTL plants to begin to make economic sense. Today, we are looking at crude oil prices of around U.S.$100/Bbl. So, where are all the new GTL plants?

Naturally, not many players would have predicted the marked change in the crude oil price regime that we are now experiencing. However, a lack of crystal ball aside, the relative complexity and 'newness' of GTL as a concept, uncertainties over the success of plant scale-up to commercial capacities, coupled with the magnitude of capital requirements, have all served to stem the potential flood of projects that were being envisaged back in 2003.

At that time, GCA estimated a potential capacity for the production of petroleum liquid products from planned GTL projects of around 1.6 million barrels per day (1.6 MMbpd). Of this, one plant (Sasol/Qatar Petroleum's 34 thousand barrels per day (34 Mbpd) Oryx facility in Qatar) has now joined the existing small club of producers, while only a further two major projects are under development. These include Shell's Pearl project in Qatar (2 x 70 Mbpd) and the 34 Mbpd Chevron/Nigeria National Petroleum Corporation "EGTL" plant in Nigeria.

Many industry observers (and, no doubt, potential players) were closely monitoring the progress being made by the Oryx plant, potentially using the smoothness or otherwise of its start-up and initial operation as a benchmark for how easy it may be to get other 'second generation' plants up and running. In the event, while the plant came in roughly on budget, a delay to production start-up and subsequent operational problems have highlighted the level of teething troubles that may be encountered. Despite this, Shell remains confident that scale-up from its Bintulu plant in Malaysia to the size of trains at Pearl in Qatar should not prove problematic, while the lessons learnt at Oryx can be used to the benefit of the EGTL plant (which will employ the same Sasol technology).

Fig. 1. Potential GTL Production Capacity, 2007 - 2030



So, while these three new facilities account for new GTL capacity totaling 208 Mbpd over and above that existing in 2003, what about the others? Well, aside from the development of a small 2 Mbpd plant by World GTL at Petrotrin's Point-à-Pierre refinery in Trinidad, some of the other major planned projects appear to have been put on the back burner. Despite this, GCA's current comparable estimate of proposed GTL plant capacity amounts to around 900 Mbpd, suggesting that interest in project development is still real, albeit not at the levels seen back in 2003 (Fig. 1).

continued on page 2

So, what has happened to turn the flood of potential projects into more of a fast-running river? From a product market perspective, nothing has really changed, with GTL-derived diesel, kerosene and naphtha all still likely to be placed relatively easily into worldwide markets. Indeed, the continuing drive towards cleaner transport fuels has, if anything, even improved this situation. Naturally, competition for appropriate gas resources still exists from LNG, a market that is growing strongly as the fuel begins to play an increasing role in the energy mix of more and more countries.

Aside from the GTL industry's nascent state, which will continue to nurture uncertainties over scale-up and reliability until the new plants have demonstrated operational and economic certainty, the major factor inhibiting project development has been the global increase in material and labour costs. My colleague Keith Doherty wrote an informative article on this subject recently in GCA Focus (see issue No. 43) so I will not repeat the reasons here. But suffice to say that the 2003 goal of reducing GTL capital costs down to U.S.$20,000 per barrel per day of plant capacity have not been possible, some estimates now suggesting costs on the order of U.S.$50,000-60,000 per barrel per day of plant capacity may now be more appropriate for plant development in the next few years. This, plus increasing labour/operating costs and upward pressure on feedstock gas prices, has made GTL economics a challenge, even with the current crude oil price regime.

The successful development of future GTL capacity will still need the key ingredients of low-cost feedstock gas (and preferably rich gas so that the recovery of liquids can help to underpin the economics), a good fiscal regime, high crude oil prices and, hence, product prices, and ongoing drivers to reduce capital costs. On this latter point, as plants like Oryx, EGTL and Pearl get underway and are eventually operating as intended, 'learnings' from the development of these will undoubtedly help to improve the design approach for the next generation of GTL plants.

Of course, the market into which products can be placed is likely to be even more receptive to volumes of clean, high-quality products, but one key difference today is the competition from other sources of clean transport fuel. For example, many refiners are already geared-up to produce higher specification refined products and are investing to produce greater product volumes. In parallel, the increased crude oil price regime has helped focus attention in a number of countries (e.g. the U.S.A., China, India) on the conversion of indigenous coal resources into clean transport fuels for cost and energy security reasons. As such, the energy industry's ability to produce super-clean fuels by competing routes is growing rapidly.

Despite this, the market for zero-sulphur diesel is large and continues to grow as other regions follow the lead of the U.S.A., the E.U. and Japan/Australia in introducing tighter transport fuel specifications. In addition to diesel, a growing trend towards identifying the air transport industry as a major contributor to air pollution may help to support demand for GTL-derived kerosene. While the product's impact on aero engine CO_2 emissions may be marginal, its 'zero-sulphur' content may help airlines and aero frame/engine manufacturers towards a greener image. Indeed, Airbus has used its recent test flight of an A380 using a 60:40 mix of regular:GTL kerosene in one engine to help promote the aircraft's environmental benefits. This, plus Qatar Airways' planned use of a 50:50 regular:GTL kerosene mix from 2009 (limited initially but increasing once Pearl is operational), underlines that the market for GTL products should certainly be in evidence.

Overall, the commercial prognosis for future GTL plants appears to remain good, although individual plant economics will still have to be assessed to take account of project specifics. However, if refined product prices remain high and GTL capital costs can again be worked downwards, GTL still appears to have a bright future. What is clear is that, as in 2003, aside from having deep financial pockets, project developers will still need to focus their efforts at tying together government support, gas resource availability, added-value technology, large-project execution capabilities and marketing presence/experience to ensure that their proposed GTL project can be realised successfully.

Richard Poole is a Principal Advisor with GCAUK, providing technical, commercial and strategic support to a broad range of clients active in the upstream and downstream oil and gas sectors, including a focus on the development of optimal gas utilization strategies, refinery investment and the analysis of gas, crude oil and refined product markets.

Gas Supply in the Asia-Pacific Region

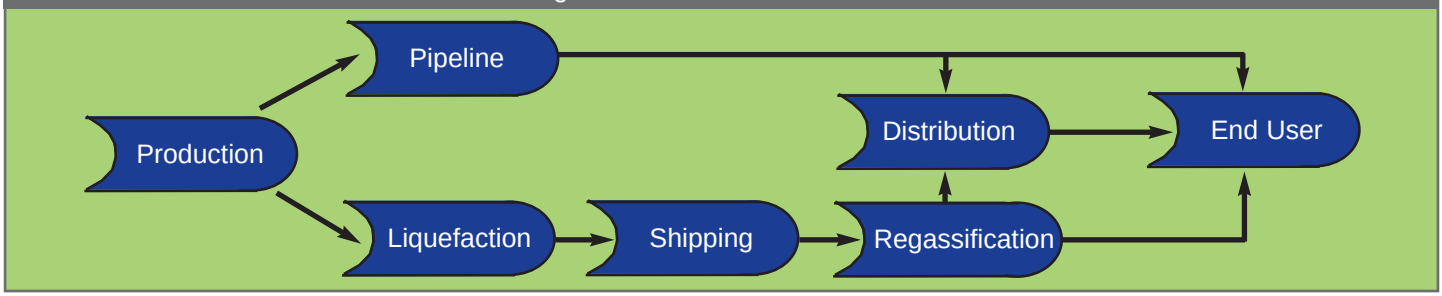
A New Challenge!

Gas production in the Asia-Pacific Region has until recently been dominated by Liquefied Natural Gas (LNG) production for delivery both within and outside of the Region. However, the demand for gas to supply local industry and, in some areas, domestic customers is increasing and is leading to a conflict between export requirements and satisfying the local market (e.g. Indonesia). Stephen Wright observes that continued economic growth in the region is likely to exacerbate this problem unless additional resources can be found to meet the forecast increase in demand.

Global demand for LNG is rising annually with the market now becoming truly global through the introduction of a "spot" market. However, in the Asia-Pacific region increasing demand (6.5% in 2006) has not been matched by regional growth in gas supply (4%). This is, in part, due to the failure to replace production through exploration and development of new resources within the catchment area of the existing large plants, as well as to the increase in domestic demand in the host countries. If the demand for LNG continues to increase, this gap will continue to grow unless additional gas resources are developed.

The challenges to the upstream community are to keep the existing plants working at optimum capacity and to identify new reserves that can replace the existing production (feedstock) as it is depleted. These challenges can be met through a variety of activities, each with a different time scale and resource potential.

Fig. 1. Natural Gas Value Chain



In the short-term, the industry needs to keep the existing facilities operating optimally as the larger fields that supply the feedstock decline. This can be met in part by developing smaller accumulations within the catchment areas of the plants, possibly with increased capital and operating costs. However, near-field exploration and development will only delay the decline of production.

An alternative strategy within the established areas is to find new large gas accumulations close to the infrastructure. This is not straightforward! One way of achieving this may be to explore deeper within the existing basins. In the past, oil exploration often ceased when significant over-pressure or gas-bearing reservoirs were encountered. This may now be an opportunity rather than a problem, and the potential for deep (high pressure and high temperature) gas fields needs to be considered.

This strategy requires a change in the mind-set of the explorers working in these established areas. The techniques and skill-sets of their geoscientists working may not be optimal for the new challenges provided by this type of exploration. New seismic data will be required to identify and de-risk the opportunity. The current geological understanding of the basin will need to be revised to incorporate the new play-based concepts that will have to be developed to generate prospects that are worth drilling. These deep opportunities will, by their very nature, be higher risk than the prospects currently being drilled (in the near field exploration), but they should have larger potential volumes to compensate.

Drilling deep and potentially high-pressure prospects will require specialised drilling equipment and careful well planning to mitigate the associated HSE risks. This work is time consuming and potentially costly. However, the potential prize is significant, because it is possible that large resource volumes located close to existing LNG infrastructure could materialise in the mid-term.

The biggest and most long-term potential challenge is to develop the contingent and prospective resources located in difficult, remote and/or deepwater locations. This will ultimately be the only way of replacing the existing LNG production in the Asia-Pacific Region. It will require substantial investment and time to come to fruition. Many of the opportunities are located in remote areas away from existing infrastructure (e.g. Eastern Indonesia) or where the environmental impact of their development is subject to significant public and regulatory interest (e.g. Western Australia).

The geological challenges fall into two areas: 1) the size of the opportunity; and 2) reservoir quality and thickness. De-risking of the prospects has recently focused on the use of seismic attributes (bright spots) to identify the presence of gas-bearing reservoirs. However, this does not guarantee that the reservoir is of sufficient quality to be commercial.

There is also a finite number of large seismic amplitude supported prospects in any basin. If deeper reservoirs are to be targeted then different methods of de-risking will have to be used.

In these problematic areas, very large finds (often in excess of 5.0 TCF) have to be made to allow commercial development. This, in itself, constitutes a significant hurdle to the initiation of this type of project. However, there are many areas where relatively large volumes of gas are likely, without necessarily clearing this hurdle. The technological challenge is to identify production systems that allow for the monetisation of smaller but significant accumulations in these remote areas.

Technology will also help. For example, mastering the challenges associated with the production of high CO2 gases will unlock the huge potential of the already discovered volumes across the region. This may help to extend the life of existing facilities. It will also permit the development of large volumes of contaminated gas that have remained undeveloped since discovery.

Fig. 2: Asia-Pacific Region

Closing the gap between LNG demand and supply in the Asia-Pacific Region will require significant growth in the resource base whilst retaining the existing infrastructure and building a new one. The discovery of new resources calls for the careful evaluation of all opportunities from near-field to new ventures throughout the region, as well as the advancement of new technologies to allow for the development of smaller or contaminated gas resources.

Stephen Wright is a Senior Project Manager with GCAUK where his principal interests lie in Geoscience and Exploration. These matters are addressed more fully in the GCA report: Gas Resources & Utilization: ASEAN Region, which is currently being completed.

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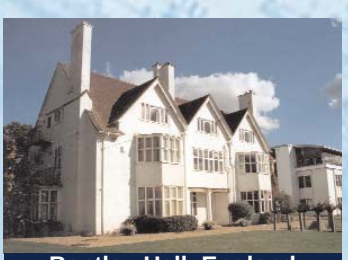
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