Suffocating GTL developments

Ras Laffan Industrial City, Qatar — Source: Qatar Petroleum

Five years ago, the conversion of methane into synthetic diesel (gas-to-liquids, or GTL) was all the rage, with prospects of significant volumes being produced by 2012. That seems along time ago, as two major developments have since taken place, writes John Baldwin, *Managing Director, CNG Services.*

The first of these developments has been the significant rise in capex (capital expenditure), which has made it almost impossible to finance new GTL projects. For example it is now 18 months since Shell confirmed approval for its massive Pearl GTL project in Qatar, with capex now forecast at $18bn. If the price of oil falls to $60/b, this project will probably be underwater financially – irrespective of rising sea-levels.

Which leads to the second development. Five years ago, concern about carbon dioxide (CO_2) emissions was still a fringe activity – not anymore, with UK companies like M&S and Tesco competing to have the lowest carbon footprint and all political parties now keen to be seen as 'green'. As a result, well-to-wheel CO_2 emissions are now being recognised as the ones that matter. It is no good if you run your car on 10% biodiesel if a rainforest had to be chopped down in order to make the palm oil feedstock.

True carbon costs

The European Union (EU) is addressing this issue in the draft Renewables Directive. It shows CO_2 savings of anything from 21% (wheat ethanol using lignite for distillation) up to 88% for biogas. It also shows that rape biodiesel typically saves 44% and palm oil 57% (as long as there are no biodigestor methane emissions). Crucially, the proposed legislation also indicates that the EU is aiming for rigorous sustainability targets.

The same is now happening to GTL. It has been very difficult to uncover the true CO_2 emission cost of taking the humble methane molecule, bashing it, heating it, pulling it, forcing it to become a C12 diesel molecule. However, the proposed EU Fuel Quality Directive should introduce some transparency into the GTL manufacturing process and allow customers to understand the carbon cost of their decisions.

It may be possible to reduce tailpipe CO_2 emissions from running a specially tuned diesel vehicle on GTL. Indeed, Audi has claimed a 13% reduction for a fleet of 81 A8 vehicles recently used to chauffeur the world's most powerful politicians and industry-leaders at the World Economic Forum annual meeting in Davos, Switzerland, this past January.

Unfortunately for all concerned in this project, the tailpipe may be the good news story – look to the desert of Qatar at what is claimed to be the world's largest construction project to date and you can anticipate the CO_2 emissions that will occur when the new Pearl GTL facility starts producing 150,000 b/d of oil products in 2010.

An independent EU well-to-wheel study carried out by car manufacturers and oil companies in 2006 (see **http://ies.jrc.ec.europa.eu/wtw.html**) found that to go a mile on GTL required almost 50% more energy than to go a mile on normal diesel, with a 9% increase in CO_2 emissions – the energy and CO_2 inefficiency arising primarily as a result of the large amount of energy consumed to convert natural gas into synthetic diesel.

Let us assume that the well-to-wheel inefficiency of GTL is only 9% and compare that additional CO_2 burden with the savings from biodiesel by 2010. Shell's 150,000 b/d plant in Qatar will produce around 7.5mn toe by 2010, giving an increase in CO_2 emissions of over 2mn tonnes.

In the same timeframe, it is estimated by the EU that EU biodiesel production will be 9mn toe. Giving the biodiesel industry the benefit of the doubt in relation to CO_2 savings, let us assume that they save 50%, then this would give a reduction in CO_2 emissions in the EU of around 16mn tonnes.

So, more than a tenth of the CO_2 saving from the entire EU biodiesel effort is required to overcome the 'dis-benefit' of the Qatar GTL. Given this, it is important that the EU Fuels Directive makes it clear that for GTL to have a future it must be accompanied by carbon capture and storage (CCS) and clear reporting of its total carbon footprint.

What else could be achieved for $18bn? 'The Pearl GTL project is huge', it says on the Shell website. It continues: 'The full magnitude of the undertaking, however, only really emerges when we look [at it] from a construction perspective. The dimensions are impressive. For

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Driving LPG development

Nigeria has huge gas reserves, currently estimated at 187tn cf and projected to last 109 years. At present, about 75% of associated gas produced as a consequence of oil production activities is flared – equivalent to 19.79% of the total gas flared worldwide and the highest flare rate of all Opec members. Gordon Feller *reports.*

A key factor driving development in Nigeria's LPG sector is the government's commitment to phase out gas flaring in 2008 through a number of gas monetising projects. It also plans to increase Nigeria's domestic LPG consumption level to 1mn tonnes in 2010, to at least meet the West African average of 3.7 kg/person/y. The official government target for 2010 translates to a 20% increase from current Nigerian LPG consumption – a figure that is still low by global standards.

Nigeria's recent deregulation of the downstream oil and gas sector and its commitment to phase out gas flaring by 2008 has opened up the country's oil and gas industry to foreign players, especially for investment in product supply and the distribution chain. As part of the downstream reforms and energy development goals, the government has initiated several programmes aimed at encouraging domestic development and utilisation of LPG, with a policy to grow local consumption from its current 60,000 t/y to about 450,000 tonnes by 2008 and 1mn tonnes by 2010.

LPG is totally separate from the gas industry, requiring different expertise in its operations. In Nigeria, it is a $292mn/y (Naira 37bn) industry that has a 50% rate of return on investment. In addition to offering opportunities in the equipment and services sector, including infrastructure development, the government also plans to promote the local manufacture of 5mn gas cylinders between 2007 and 2015. This will require an estimated $50mn to $100mn of investment. Nigeria is forecast to require 2mn new cylinders every year.

Running behind

Nigeria currently consumes about 60,000 t/y of LPG. According to industry observers, this is a far cry from where it ought to be when compared to West African countries such as Ghana, Cote d'Ivoire, Cameroon and Senegal, which had an average LPG consumption growth of 9.5% annually from 1990 to 1999 (see **Table 1**). Of the total volume of LPG consumed in Nigeria, some 24,000 t/y are imported through neighboring Benin, while 48,000 tonnes are imported through coastal depots.

In the 1980s, Nigeria's domestic LPG consumption rate was much higher – between 100,000 tonnes and 120,000 tonnes. However, due to unstable supply and price instability, volumes steadily decreased to between 48,000 tonnes and 54,000 tonnes in 2004, the latest year for which figures are available. By all accounts this is the lowest level in sub-Saharan Africa. Indeed, Nigeria's 2004 LPG consumption rate translates to about 0.4 kg/person/y, a far cry from West Africa's average of 3.7 kg/person/y.

With a rapidly increasing population estimated at 143mn, oil reserves of about 36.24bn barrels (including 4bn barrels of condensates), and gas reserves estimated at 187tn cf, Nigeria is well endowed with the resources required to produce LPG, crude oil and natural gas. Its refineries have an installed capacity to produce about 400,000 t/y of LPG. In fact, Nigeria is the largest producer of LPG in West Africa, with exports in 2004 of over 2mn tonnes, about 3mn tonnes in 2005 and slightly above 2mn tonnes in 2006 from its Bonny and Escravos export terminals. These volumes were produced at Nigeria's three large natural gas liquids (NGL) facilities – ExxonMobil's OSO NGL plant in Bonny, the NLNG plant and the Escravos NGL plant. In the future, a number of other LPG producers such as Addax Petroleum, Brass LNG and Olokola LNG will add to available supply, as well as smaller ones, such as the Global Gas refinery, which produces 60,000 t/y.

Country	Population (mn)	LPG consumption (t/y)
Cameroon	14.9	28,000
Cote D'Ivoire	15.7	50,000
Ghana	19.2	40,000
Senegal	9.5	100,000
Nigeria	125	58,000

Table 1: Average LPG consumption growth by country (1990–1999)
Source: Nidogas Company and Owel-Linkso Group

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example, the plot size of 1.6 x 1.4 km, or 230 hectares, is [equivalent to] more than 450 football fields. The Pearl GTL project will require 3,000 items of equipment, including pumps, compressors, columns and vessels. In comparison, the two LNG plants now operating in Ras Laffan have around half that amount of equipment between them.'

For the EU to produce its forecast 9mn tonnes of biodiesel in 2010, it has been estimated that a total capital of just over £1bn will be invested – which is only a fraction of the Pearl GTL plant cost. No wonder GTL plants are being cancelled, with such projects proposed by ExxonMobil in Qatar and in Algeria recently abandoned.

It does not matter if it was capex that killed these projects, or the realisation that GTL is a PR disaster waiting to happen. The question is: Will there be any new GTL plants in the future? The answer – unlikely, unless someone can crack open the basic laws of chemistry or work out how to capture and store CO_2 in gas-rich Middle East countries.

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sustainability objective for many years (see box).

A key theme is to manage resource scarcity and environmental challenges through mitigation of air pollution. As part of this drive, the Chinese government is planning to increase the development and use of coal bed methane (CBM) and coal mine methane (CMM) to meet the growing demand for primary energy sources, improve the safety of mining operations and help to achieve significant reductions in China's GHG emissions.

The commercial production and exploitation of surface CBM has so far been limited to a few sites where gas is compressed and transported by truck or piped a short distance to consumers. While CMM is used widely in some coal mining areas, only less than 5% of the total CMM released is currently captured and utilised. Further improvement is being hindered by institutional, legal and regulatory barriers, together with technical considerations.

In order to meet its targets, China's government needs to improve the administrative framework for CBM resource management, introduce more effective CBM/CMM development incentives, raise technical capacity, and promote gas market development.