Marine CNG trade: the time has come

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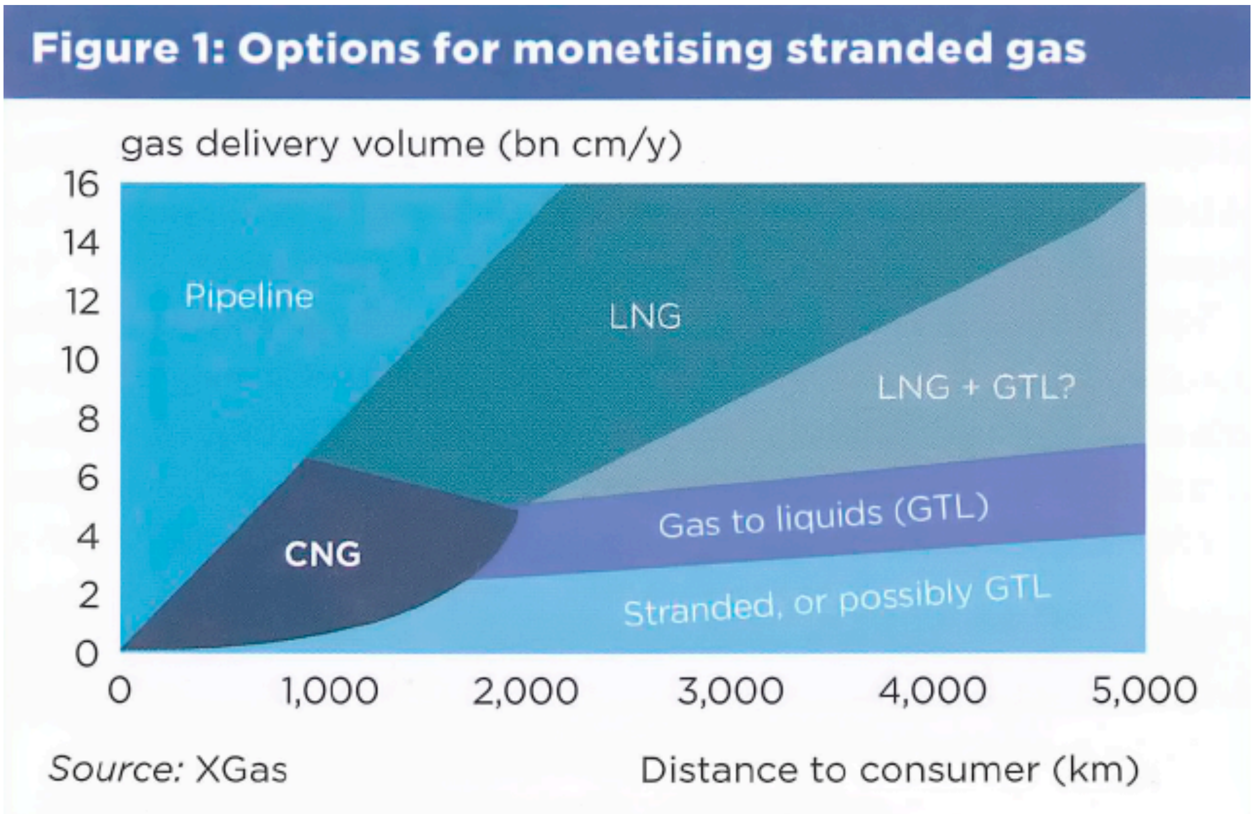
For smaller gas volumes, delivered over relatively short sea-borne routes CNG offers an economical alternative to LNG. The time for marine CNG transport has come.



With natural gas set to play a growing role in meeting world energy demand, the traditional means of delivering resources to market must be reviewed if a significant volume of stranded reserves are to be monetized. Over 70% of global gas trade is conducted trans-naturally by pipeline, with just under 30% traded in the form of LNG, according to Cedigaz.

Pipelines are the most efficient way to transport gas onshore, but their offshore potential is limited by high costs – offshore pipelines cost about 10 times more than onshore line, compounded by the distance between the gas source and the market, water depth and underwater terrain.

LNG is widely used to transport large volumes of gas by sea, over long distances. But the LNG supply chain is complicated and costly – the initial required investment is large, and liquefaction and regasification facilities are expensive to build.

A niche, but significant role

For shorter distances (less than 2,000 km, for example) and smaller gas volumes (for example, 2bn cubic metres a year (cm/y)), recent studies strongly suggest that compressed natural gas (CNG) could play a niche, but significant role in gas trading, providing a more economical marine-transportation option than LNG (see Figure 1).

Although sea-borne CNG transportation is a conceptually mature technology and ready for deployment, it is yet to be applied commercially, on a large scale. But CNG will play an increasingly important role in the future.

In Figure 2, the blue zones highlight the areas where CNG is profitable and more cost effective when LNG under four price situations. CNG's application range is a function of many factors, but particularly gas price, distance and physical location. When market prices are high, such as $8-$12/m British thermal units (Btu), for demand of 2bn cm/y, CNG can encroach on the LNG market and be attractive economically even over distances of up to 3,600 km.

Figure 2 assumes infrastructure must be built from scratch and that cost recovery is included in delivered-gas prices. Additional factors must be taken into account when prices are distorted as a result of an existing infrastructure bas (such as LNG terminal in Qatar, or a large fleet of tankers), or when supply and demand vary drastically as a result of economic growth, or downturn. When there is an economic downturn or price reduction, as seen in 20087 and 2009, this economic evaluation must be revised – as shown in the left two zones in Figure 2.

The reason that, at higher gas prices, CNG's applicable range can secure a portion of the LNG market is because the main cost in a CNG project is the cost of the vessels (a positive factor, with the vessels being movable assets), while the main cost for LNG is liquefaction and regasification infrastructure.

When the gas volume or distance to market rises, the number of CNG vessels increases, forcing up overall costs. In Figure 3, the tariff is the transportation cost (which is the breakeven point when assuming the gas price at source equals zero).   For a volume less than 2bm cm/y, the tariff for LNG is higher than for CNG, but declines sharply as volume increases. CNG's tariff decline is far flatter, reflecting the cost of an increased number of vessels required for the rising gas volume. CNG tariffs, unlike those for LNG, are not affected by volume increases.

At 10bn cm/y, the tariff for LNG is slightly above $1/m Btu, while it is just under $4/m Btu for CNG. Because many LNG exporters, such Qatar, have plentiful, low-cost gas resources and excess liquefaction capacity and vessels, they can sell LNG at $3-4/m Btu. CNG, however must sell for at least $6-7 m Btu to make a project economically attractive. Consequently, in today's gas-price environment, a CNG project must be even smaller than previously thought – although markets for such volumes are still plentiful.

Figure 1: Options for monetising stranded gas

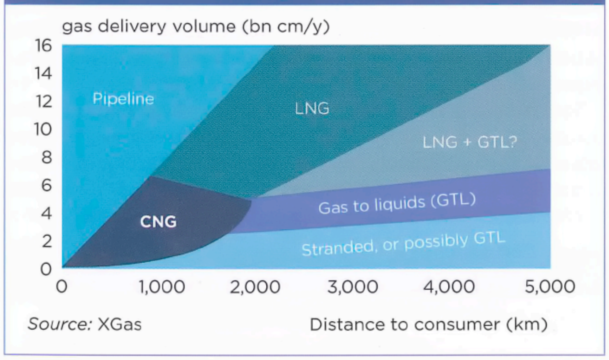


Figure 3: Tariffs for CNG and LNG over 2,100 km

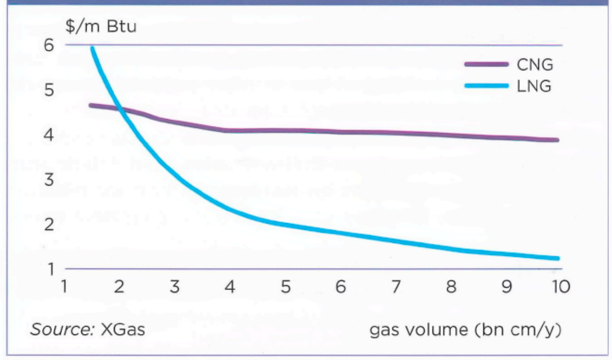


Figure 2: Gas-price effect on CNG application

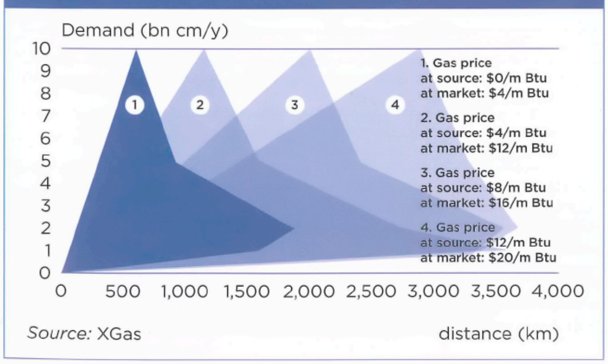
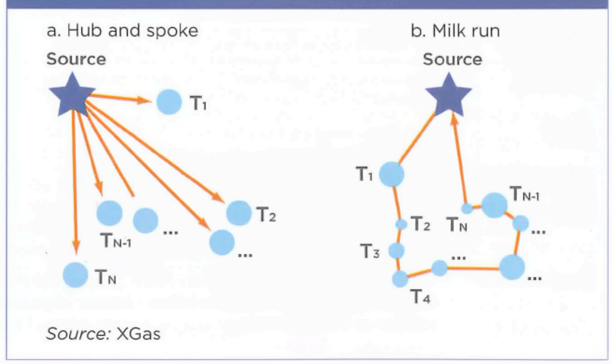


Figure 4: CNG distribution options



Optimized CNG marine transport

To make the marine transport of smaller CNG volumes economically attractive, the size and the itinerary of a CNG fleet must be optimized. Optimization can result in substantial reduction in the total capacity of a CNG fleet and, consequently, the costs.

For bigger markets, larger vessels are more suitable and a hub-and-spoke trading pattern is preferable (see Figure 4a). The hub in this distribution scheme could be a gas-production site, or even an LNG regasification terminal where LNG is delivered and converted to CNG. Each vessel could serve as storage facility while offloading gas consumption.

For smaller markets, which cannot justify dedicated vessels, a milk-run pattern is appropriate (see Figure 4b). Vessels visit multiple sites and offload volumes to storage facilities with the capacity to hold enough gas until the next vessel visits. A mix of hub-and spoke and milk-run schemes, delivering to multiple markets with different demand requirements is also possible.

Optimization includes both physical (as described previously) and economic solutions. Physical optimization alternatives can be developed based on transportation logistics and, then, on specific values of economic parameters (such as gas prices, facilities costs, availability of vessels) until economic optimization can be accomplished. Because economic performance over such fluctuations.

So, if for short distances and low gas demand, marine CNG is more economical than LNG, why has its commercial application been so slow to take off?

Growing global gas demand will create market conditions where CNG is certain to play a role

In the past, many CNG advocates tried, mistakenly, upscale CNG vessels and compete for the same markets as LNG, ignoring CNG's niche potential – this is particularly true while gas prices are depressed, as they are today. CNG advocates have also failed to educate the public. Those unfamiliar with CNG have an unjustified fear of marine CNG safety.

In addition, typically, the midstream industry in conservative and reluctant to take risks with innovative technologies. Many of them would prefer to be second, rather than first, to commercialize a CNG project.

But growing global gas demand will create market conditions where CNG is certain to play a role. Potential CNG applications do not have to infringe on the traditional LNG industry – the two can co-exist. The time has come for marine CNG transportation.

CNG technology

LNG technology reduces the natural gas's volume to 1/600 of its stranded-conditions through liquefaction at temperature of around -163°C, under atmospheric pressure. CNG reduces the gas's volume to around 1/200-1/250 by compressing it at a pressure of 2,000 to 3,000 psi at temperatures ranging from ambient down to -40°C, depending on the containment technology.

CNG technology is proved both technologically and commercially. CNG has been transported by ship, truck and barge, and is used to fuel taxis, private vehicles and buses world-wide. The first commercial CNG transport ship was introduced in the 1960's, classified by the American Bureau of Shipping (ABS) for service and awarded a certificate of compliance by the US Coast Guard.

A new-generation of CNG ships are optimized to carry around one-third of the volume of gas transported in the LNG carrier of the same size, but at far lower costs per unit of gas than for short LNG journeys. Several companies have developed CNG delivery systems, many of which have classification-society approval and are ready for commercial deployment.