

Gas Monetisation in the E&P Industry

Maximising value from natural gas presents E&P companies with a particular challenge. Governments are demanding the maximum socio-economic benefit from their hydrocarbon resources. Investors want to maximise returns. Production and transportation of natural gas costs far more than crude oil, mainly due to volume (~600 x greater than the corresponding liquid) and the cost of compression. The most economic way is often to transport large quantities of gas over long distances by pipeline or as LNG (Liquefied Natural Gas). Alternative gas monetisation options include converting the gas to various liquid fuels, fertilizers, or petrochemicals. There are many trade-offs to consider - the further down the value chain, the greater the market value of the final product, the larger the financial investment involved and the greater the potential local socio-economic benefit. As a result E&P companies need to demonstrate that they have considered all credible gas monetisation options, some of which are listed below.

Physical Conversion of Gas

- **Fuel Gas via Pipeline.** Typically the most economically viable option where large volumes of gas are to be routed to markets up to 2000km away (primarily over land). Trade-offs include pipeline operating pressure and frequency and location of pressure boosting (compression) stations. Terrain, pipeline maintenance and security all have a significant impact on costs.
- **CNG (Compressed Natural Gas).** Gas is compressed to ~4,000 psia, reducing volume to ~1/250th, and then transported by CNG vessels. This is an option for offshore locations where a pipeline to shore might be technically or economically problematic. Revenue from gas sales may be an enabler for a related oil field development by dealing with the gas that is otherwise uneconomic. CNG can be competitive for reserves of 0.3 to 3tcf to markets up to 1500km away.
- **Gas to Wire. Convert to power, export electricity.** Effectively incorporating a power generation and electrical distribution facility as part of the 'gas monetisation' development. Typically applicable for gas flowrates of 300 MMSCFD and a market within 1000 km. The electricity market must also be within a 1000 km radius.
- **LNG (Liquefied Natural Gas).** Removing LPGs and contaminants and liquifying the methane rich gas requires a relatively complex plant and major investment. Most viable for gas reserves (>2tcf) and when distance to market exceeds 2000km. Also needs specialised transportation tankers and regassification plant at the market. The producer can deliver to multiple consumers, unlike a pipeline which has fixed source and delivery.
- Floating facilities (**FLNG**) have recently come on-stream and can be viable for developing remote offshore gas reserves.

The gas market is becoming increasingly dynamic: The largest LNG consumer by far is Japan, followed by S. Korea then China. Gas demand is increasing in part due to environmental concerns. There is an increasing diversity of suppliers. Australia will soon overtake Qatar as the largest LNG exporter. The rise of shale gas in the US gives it the potential to become the largest LNG exporter in the near future. Major LNG developments for large gas reserves in East Africa and East Mediterranean are also under consideration or development. Whilst most LNG production is 'locked in' to long term sale contracts (to justify the large capital investment) there is a rapidly growing 'spot market'. The price mechanism in Asia is related to the oil price: it is under increasing pressure to change to the more 'market force' arrangements seen in the West.

Chemical Conversion of Gas. Gas is converted to alternative fuels and commodity chemicals. Considerations include access/location to market, price achieved (order of magnitude greater than for gas), capital investment required (high) and socio-economic benefits. Typically used for small gas volumes (c.50 MMSCFD) and where markets are over 2000 km distant.

- **Gasoline, Diesel & Naphtha.** The GTL (Gas To Liquids) process involves a large, complex facility and high costs. These high quality (very clean) products command premium prices. Typically seen as a alternative for medium-sized gas reserves more than 2000 km from market.
- **DME (Di-Methyl Ether).** DME is substitute for LPG in household fuels, for diesel, and is a turbine fuel.
- **Methanol.** Natural gas is the feedstock used in most of the world's production of methanol, a chemical building block as well as being used as a specialised fuel. Methanol can also be subsequently converted directly to Gasoline.
- **Olefins (Ethylene & Propylene) and Polyolefins (LLDPE, LDPE, HDPE and PP).** Olefins are produced from LPGs, and can also be derived from methanol, and then transported to market. Production of Polyolefins requires an additional step, which is often located nearby. These processes require moderately complex plant and significant investment.
- **Fertilizers.** The Haber Bosch process enables the hydrogen from Methane to be combined with Nitrogen from air to use as the basis for Ammonia and subsequent conversion to urea and ammonium nitrate.

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