TEXAS
METHANE & FLARING
COALITION

Emerging Oil & Natural Gas Technologies

As technology advances, the oil and natural gas industry continuously incorporates enhancements and state-of-the-art equipment to meet environmental goals and operational best practices. Several technologies in existence today provide opportunities to reduce methane emissions, capture natural gas, and create cleaner operations. The following non-exhaustive list does not indicate greater efficacy of any one technology over another and does not evaluate whether an option is technically or economically feasible. Instead, this list illustrates the variety of technological developments that have the potential to improve the environmental performance of oil and natural gas production.

Sale Gas

Oxygen (O_2) Removal from Natural Gas

- O_2 ingress and O_2 reduction technologies remove oxygen from the natural gas for feedstock and transportation purposes. This technology can help in situations where oxygen intrusion into gas makes it unable to meet the quality specifications for sale into the pipeline.

Hydrogen Sulfide (H_2S) Removal

- Removing hydrogen sulfide (H_2S) from natural gas is commonly referred to as ‘sweetening’ the gas, a process necessary to make gas suitable for transport and sale.

- Where gas processing infrastructure includes sulfur removal plants (e.g., in Permian conventional), removal of sulfur compounds may not be a barrier to sales of natural gas. However, this technology can be useful in cases where gas processing infrastructure is unequipped for sulfur removal. Furthermore, typical sulfur removal methods, such as the use of scavengers, are effective at relatively low sulfur concentrations.

Natural Gas Liquids (NGL) Removal

- NGLs can be removed from (associated) natural gas using stationary or mobile equipment on well pads or central facilities resulting in a cleaner, purer natural gas. The valuable extracted NGLs may then be trucked for sale.
- This technology works best with liquid-rich (associated) natural gas.
- Systems that capture natural gas condensate (or C_5) and heavier liquids are relatively simple but provide limited flaring reduction. However, coupling condensate recovery with NGL recovery and other technologies allows for a higher rate of flare reduction.

Fuel

Compressed Natural Gas (CNG)

- Small-scale CNG technologies can compress (associated) natural gas to increase its energy density, thereby allowing economic transport of the natural gas to markets.
- Where a pipeline may be uneconomic or not yet constructed, CNG offers a 'virtual pipeline' to transport natural gas to supply power plants and industrial and domestic natural gas users, or for use as a fuel for cars and trucks.
- A CNG system requires pre-processing of the (associated) natural gas to remove contaminants, such as CO_2 and H_2S. The removal of nitrogen (N2) and/or higher hydrocarbons may also be required to meet natural gas pipeline or delivery specifications.
- The lower capital cost of CNG can make it an attractive option, especially for small (<~5 MMscf/d) natural gas volumes. For larger natural gas volumes and/or distances to market, the large number of trucks needed to transport natural gas can make it economically and/or operationally unattractive.

Liquified Natural Gas (LNG)

- Small-scale LNG technologies used to liquefy (associated) natural gas can increase its energy density, thereby allowing economic transport of the natural gas to markets.

- Where a pipeline may be uneconomic or not yet constructed, small-scale LNG offers a 'virtual pipeline' to transport natural gas to supply power plants, industrial, domestic natural gas users, and/or for use as a fuel for cars and trucks. LNG has a higher energy density than CNG, making it a more attractive option for transporting larger (>~ 5 MMscf/d) natural gas volumes and/or distances to market. Its higher capital cost, however, can make it economically unattractive for small natural gas volumes.

- LNG liquefaction requires pre-processing of the (associated) natural gas to remove contaminants, such as CO_2, H_2S and mercury. The removal of N_2 and/or higher hydrocarbons may also be required to meet natural gas specifications.

- LNG is used in many parts of the world to supply natural gas (following re-gasification) to power plants and industrial/domestic natural gas users. Its use in liquid form is increasing as a fuel for large trucks.

- Natural gas can be liquefied and trucked to an offsite location for use as a fuel.

- This technology is most appropriate when natural gas does not require a large amount of conditioning.

Electric Power Generation

- A variety of technologies are available for local power generation, including reciprocating engines, gas turbines, Stirling engines, Organic Rankine Cycle, etc.

- Gas conditioning may be required to use the gas for electric generation because local systems work best when using lean (conditioned) associated natural gas (e.g. residual natural gas following NGL recovery).

- This technology is generally limited to locations with access to electricity markets or demand.

Enhanced Oilfield Recovery (EOR)

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- Three major categories of EOR are commercially successful to varying degrees:

    - Thermal recovery involves the introduction of heat, such as the injection of steam to lower the viscosity, or thin, the heavy viscous oil, and improves its ability to flow through the reservoir.
    - Gas injection uses gases, such as natural gas, nitrogen, or carbon dioxide (CO_2) that expand in a reservoir to push additional oil to a production

wellbore, or other gases that dissolve in the oil to lower its viscosity and improve its flow rate. Gas injection accounts for nearly 60 percent of EOR production in the United States.

- Chemical injection involves the use of long-chained molecules called polymers to increase the effectiveness of waterfloods, or the use of detergent-like surfactants to help lower the surface tension that often prevents oil droplets from moving through a reservoir. Chemical techniques account for about one percent of U.S. EOR production.

- Each of these techniques have been hampered by their relatively high cost and, in some cases, the unpredictability of its effectiveness.

Products

Gas to Liquids (GTL)

- GTL technology converts natural gas – the cleanest-burning fossil fuel – into high-quality liquid products that would otherwise be made from crude oil. These products include transport fuels, motor oils and the ingredients for everyday necessities, such as plastics, detergents, and cosmetics. GTL products are colorless and odorless. They contain almost none of the impurities – sulfur, aromatics, and nitrogen – that are found in crude oil. GTL production can help countries with natural gas resources grow their economies as new gas supplies emerge to satisfy the growing global demand for liquid products.

- Advances in modular GTL technologies have enabled the economic feasibility of small-scale GTL plants (>~10MMscfd of natural gas), highly flexible mini-GTL units (>~1MMscfd of natural gas), and even remotely controlled micro-GTL “machines” (<~1MMscfd of natural gas). Several technology providers have commercial offers, with the construction of the first few plants underway.

- The final GTL product, syncrude, is beneficial because it can be injected into an oil pipeline, thereby avoiding the need to transport another product to market, or higher-value fuels or chemical feedstocks, such as gasoline, diesel, naphtha, methanol or di-methyl ether (DME).

- Conversion of (associated) natural gas to a liquid significantly increases the value of natural gas and its ease of transport, but the chemical conversion process is obviously more expensive compared with other direct natural gas utilization options such as, CNG or mini-LNG. However, it is the TOTAL cost from flare gas intake through processing and distribution to final use that determines the overall financial return.

- Most of the conversion technologies require no pre-processing of the natural gas other than to remove contaminants. In many cases, the separation of higher hydrocarbons (LPG and condensate) creates valuable income streams, in addition to the GTL product revenue.

- The products produced from this process are methanol and hydrogen, as well as ethylene and hydrogen.

Gas Separation Technology

Gas Separation Technology

- Higher-value products that can be produced from methane include hydrocarbon liquids (methanol), synthetic lubricants and fuels, and olefins (ethylene).

Blanket Natural Gas

Blanket Natural Gas

- A gas phase maintained above a liquid in a vessel can be used to protect the liquid against air contamination to reduce the hazard of detonation or to pressurize the liquid. The gas source is located outside the vessel.

References

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