

Monetizing Flare and Stranded Gas



Newpoint Gas, LP

High BTU DPNG™
Dense Phase Natural Gas

Technical Introduction
November 2017

Definitions

DPNG - Dense Phase Natural Gas - DPNG is a technical definition associated with a specific product option for flared and stranded gas transport. DPNG combines the value of high BTU natural gas with the space efficiencies of CNG. DPNG defines a product that does not include a gas specification but only to denote a pressure over 180 barg / 2,650 PSI.

SME – Standard Module Engineering - This field-tested design process reduces capital requirements and adds control to the schedule using pre-engineered equipment. Optimized for shipping and installation, modular skid-mounted equipment will benefit any land-based or offshore application.

VANG – Value Added Natural Gas - Used to define the economic properties of the stranded resource being flared. The heating value or BTU of raw natural gas is usually much higher than processed natural gas and therefore contains the Value Added due to the LPG's and NGL's. To accept the raw gas stream in “as is” condition reduces the gas processing and gas treating requirements at the source of the gas production site and captures the Value Added to the gas stream. The higher value gaseous hydrocarbons which include ethane, propane, butane, pentane, hexanes and heavier hydrocarbons are retained in the natural gas. The Value Added concept is to capture the entire gaseous hydrocarbon stream at the source and transport those hydrocarbons to a secure central processing facility (CPF).

VPL - Virtual-Pipe-Line - VPL is a method of transporting natural gas in areas where there is no pipeline infrastructure available. It is based on a modular system of compression or liquefaction, transport, and unloading and/or re-gasification of natural gas. The VPL uses a series of compression/liquefaction of natural gas and is transported by a marine or land-based VPL transporting the raw hydrocarbons to a CPF.

Purpose

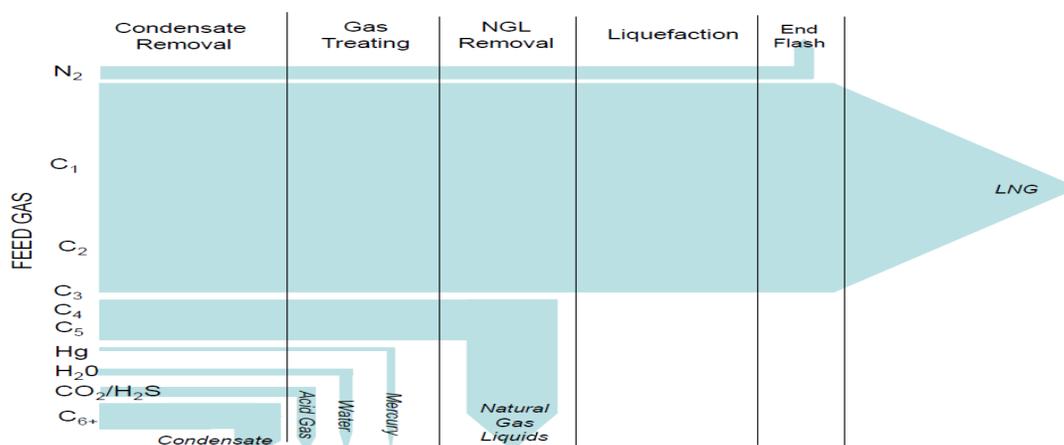
Demonstrate the economic viability of DPNG™ gas transport through a virtual pipeline for the elimination of gas flaring.

Implimentation of an end-to-end business model to monetize stranded flare gas and all hydrocarbon emission.

Economic Comparison of Available Technologies

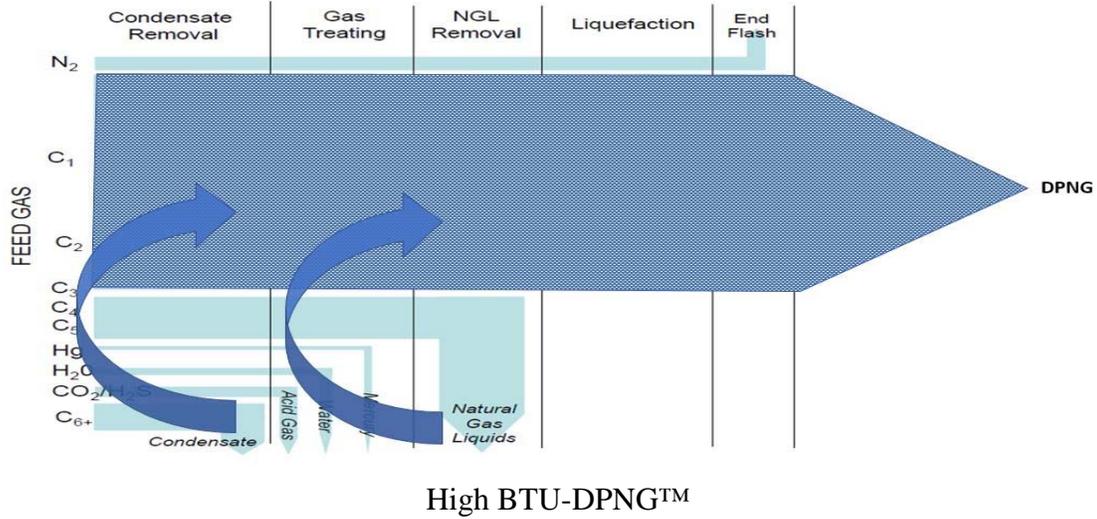
Integrating natural gas into a VPL is not new, as CNG and LNG are proven technologies and have been operating successfully around the world for several years. The challenge these technologies have yet to overcome is the fact that both are uneconomical to install and operate on small to medium scale projects in remote locations. To focus on methane and ethane misses the revenue held in the high BTU - Value Added Natural Gas (VANG) components.

Considering natural gas transportation alternatives, all the existing technologies (LNG, GTL and CNG) require preconditioning and the removal of high energy hydrocarbons. Removal of these hydrocarbons such as liquefied petroleum gas (LPG) and natural gas liquids (NGL) reduce the monetary value of the cargo. Why not reverse the procedure and transport the full value of the gas stream to the market for processing and distribution?

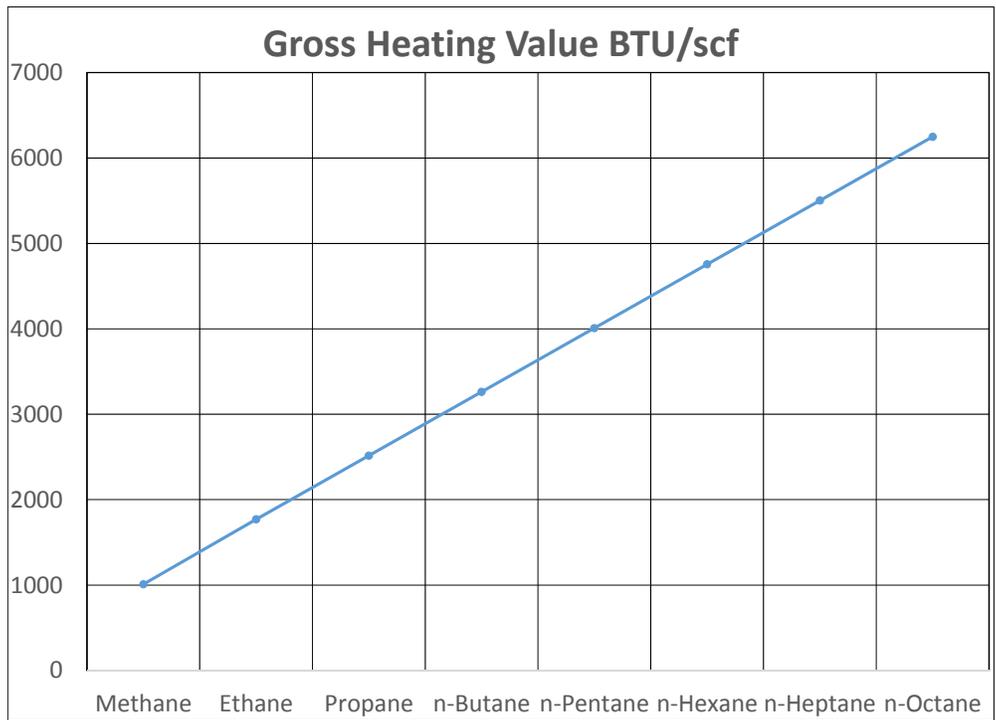


Typical LNG Pre-Processing

LNG condenses the gas to 1/600th and CNG compresses to 1/300th of its original space requirements. Both proven technologies reduce natural gas space requirements so that a larger quantity can be loaded into a smaller area, but both have limited potential in the market. Every facet of LNG is expensive and CNG has a high weight-to-energy ratio making it difficult to transport enough gas volume per load to generate a profit.



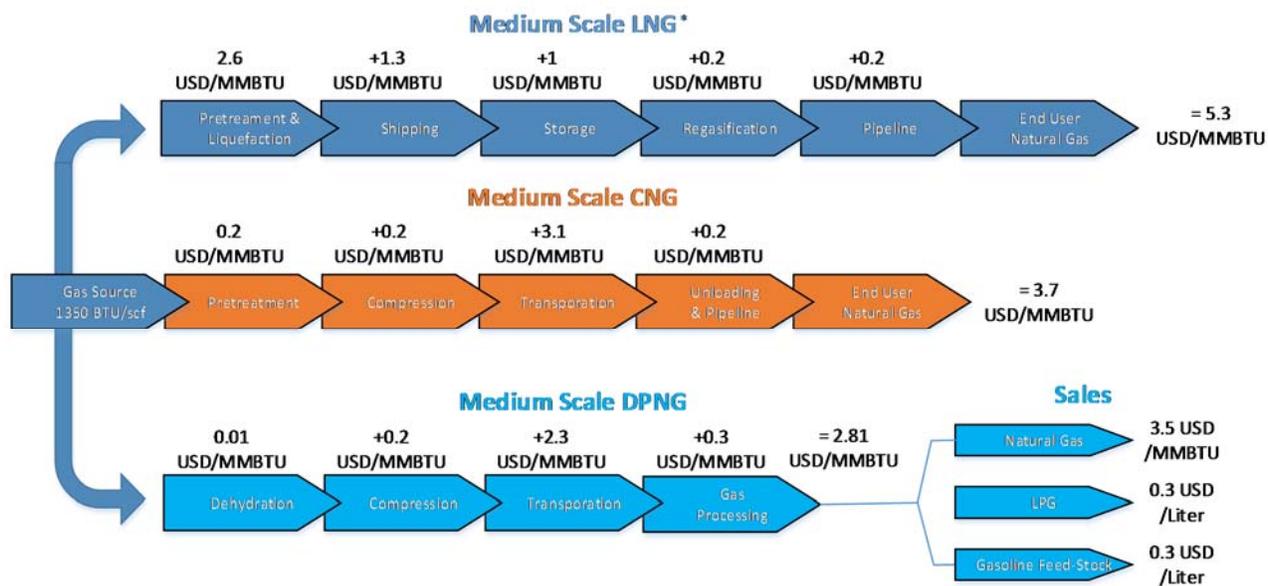
Dense Phase Natural Gas (DPNG) combines the revenue potential of high BTU natural gas with the space efficiencies of CNG. In our test case, natural gas liquids and LPG contain an average caloric content of 3972 BTU collecting a multiple of almost 4X when traded on an MMBTU basis and CNG allows higher volumes of gas to be transported. DPNG and single vessel gas transports produce the revenue to monetize flare and stranded gas without the use of a natural gas pipeline.



(data source: Gas Processors Suppliers Association Engineering Data Book 13th Ed.)

$$DPNG^{TM} \text{ Value} = \text{Price} * \text{Volume} \sum_{k=1}^n \alpha_k \beta_k \quad (\alpha = \text{volume fraction}, \beta = \text{heating value})$$

As demonstrated in the graphic below, stranded gas and gas flares of less than 100 MMSCFD are due to the fact that global markets have not discovered an economically viable solution. LNG has a cost to market of US\$5.30 and CNG a cost of US\$3.70 per MMBTU. LNG and CNG contain a low average caloric value of 1,100 MMBTU, which at US\$3.50 per MMBTU is worth US\$3.85 per MSCF. In this example, with an average MMBTU of 1,350, DPNG delivers product to market at a cost of US\$2.81 per MMBTU. This represents a processed product value of US\$4.73 (spec gas, LPG, gasoline feed-stock) and a margin of US\$1.92 per MMBTU. The DPNG™ process yields greater revenue creating a profitable end-to-end, source to market solution.

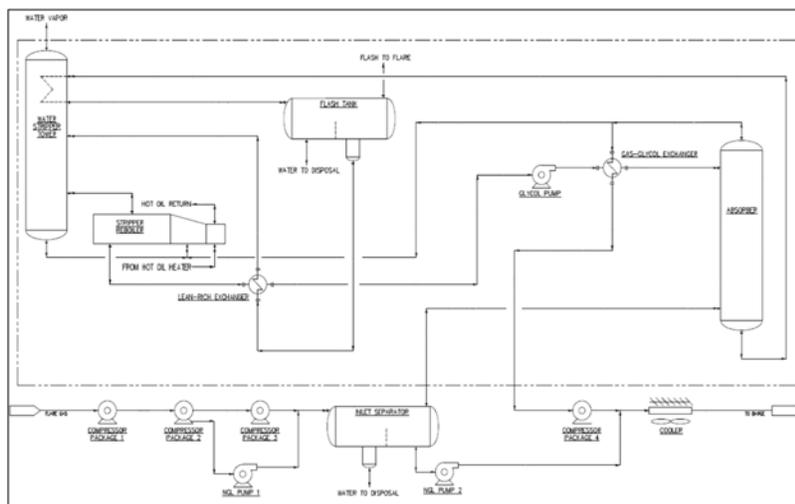


* LNG Information Adapted From Kenneth Engblom
<https://www.linkedin.com/pulse/cost-natural-gas-lng-logistics-kenneth-engblom/>

Note: the model excludes the cost of raw natural gas feedstock as this cost varies

Gas Compression, Dehydration and Loading Hydrocarbons

The raw gas stream, when required, is to be compressed to about 1270 psig (88 barg) and sent to a Natural Gas Dehydration Unit where the water content of the gas is reduced to 7 lb/MMSCF or less. The dried gas then proceeds through a final stage of compression where it reaches a minimum pressure of 3,100 psig (214 barg) and is loaded into the high-pressure DPNG Transportation Vehicle or Vessel (TVV). Any



NGL's that are generated during compression are pumped back into the high-pressure stream and loaded into the TVV. Due to the fact, the hydrocarbons are transported in the single dense phase, all LPG's, NGL's and/or heavy hydrocarbons are "dissolved" into the high-pressure TVV.

Transportation of High Pressure Hydrocarbons

Several unique technologies exist in marine and over the road transportation of high-pressure gas. For marine transport, the analysis included a self-propelled barge, a standard barge using tugs and high-pressure storage using a close-packed long pipe design. For over the road truck transport the analysis included using 40 ft modules with the vessels constructed from steel, composite/steel hybrid, and entirely composite vessels. Each of these vessels has different advantages and disadvantages. In general, the steel construction offers the lowest capital cost, but the weight is high when compared to other hybrid and composite construction options. The most cost-effective modules use composite vessel technology, several manufacturers have had their models approved by the US Department of Transportation. We have found that a 40 ft module with a capacity of 360 MSCF at 3,600 psig has proven the most cost effective in most situations. However, each model of the vessel by each manufacturer must be evaluated to ensure that the right equipment is chosen for each project.

Discharge of High Pressure Hydrocarbons

The gas is unloaded into a pipeline or into a Gas Processing Facility (GPF). As an example if the inlet to the GPF is 950 psig (65.5 barg), the discharge gas must be a continuously controlled to the correct pressure. As the gas is unloaded from the HP-TVV, the pressure will eventually decrease until it is less than 950 psig (65.5 barg). At the point in which the discharge rate of the gas is too low or the pressure equalizes, one stage of compression will be required. As the pressure drops further, a second stage of compression will be brought online to compress the gas to the required pressure. The TVV will be unloaded until about 65 psig (4.5 barg) remains. This equals a total capacity of 98% of the design capacity of the TVV and results in a reduction in recompression requirements at the unloading site.

Conclusion

With the development of DPNG™ through the use of a virtual pipeline, flared gas can now be economically captured and transported to market. Utilizing this process, exploration and production companies now have the flexibility to venture into areas for future development without the possible production restrictions associated with flaring natural gas.

-