PIVOTING THE BUSINESS

Expanding Natural Gas Service with Micro-LNG

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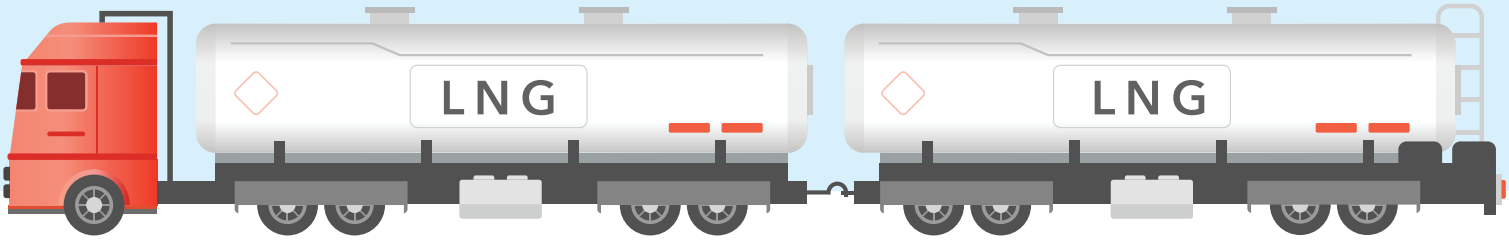


> NGC is on a mission to develop the non-energy and transportation industries even further through the provision of innovative energy solutions that empower these nationally critical sectors.

It is a well-known fact that NGC has fuelled the development of the natural gas-based sector for over 46 years. Lesser known, however, is NGC's role in growing and developing the non-energy sector through its support of Light Industrial Commercial (LIC) businesses and the provision of Compressed Natural Gas (CNG) for transportation. Starting in 1994, NGC embarked on a strategy to link the energy sector directly to the local commercial, manufacturing, food and transportation industries.

Over the years, the company's LIC customer base has more than doubled, standing at 96 at the end of 2020. NGC is on a mission to develop the non-energy and transportation industries even further through the provision of innovative energy solutions that empower these nationally critical sectors. One such solution currently under active consideration is a micro–Liquefied Natural Gas (micro-LNG) plant.

A team comprising representatives from NGC's Commercial Group as well as NGC CNG has been established to explore the potential for implementing a micro-LNG project. If implemented, the project will result in the delivery of a reliable natural gas supply to traditionally underserved locations in the country.

What is micro-LNG and how does it work?

Where natural gas fields are located far away from gas markets and pipeline distribution is not feasible, the gas can be shipped in the form of Liquefied Natural Gas (LNG). Traditional LNG plants can be massive in size. For example, Trinidad and Tobago's Atlantic Trains 1 – 4 have a combined full capacity of 15 million tonnes/year of LNG. Micro-LNG plants are significantly smaller, typically having production capacities of less than 50,000 tonnes/year.

In the last two decades, micro-LNG has emerged as a viable option for niche industries that require small amounts of natural gas for their operations. Throughout the world, micro-LNG is finding increasing application in heavy land-based and marine transportation, off-grid power generation and light industrial facilities.

The micro-LNG process generally involves four main elements: liquefaction, storage, transportation and regasification, as shown in Figure 1 on the following page.

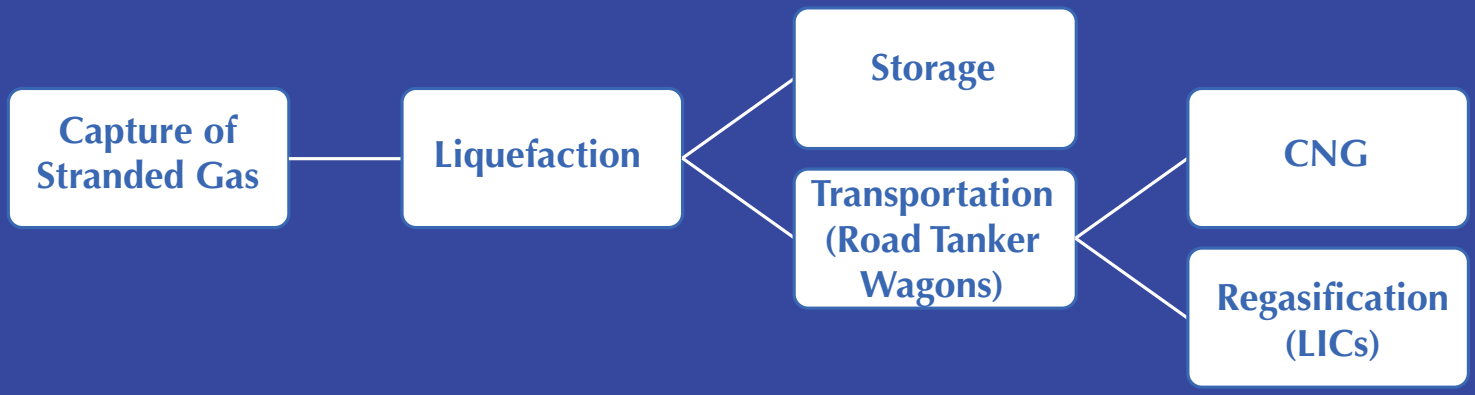


FIGURE 1: MICRO-LNG MODEL UNDER CONSIDERATION

Liquefaction – This involves cooling the natural gas until it is liquefied, reducing its volume by a factor of about 600. During the liquefaction process, heavy hydrocarbon elements and impurities are removed. There are many technologies available for liquefying natural gas, with the most used being:

- Nitrogen and gas expansion
- Mixed refrigerant
- Single mixed refrigerant.

Energy requirements and costs are usually the main decision criteria for selecting the appropriate solution. For example, cascade refrigeration, which involves use of single refrigerants in sequence, has fallen out of favour due to its exorbitant cost.

Storage – Of the two main methods for storing LNG, vacuum insulated pressurised (bullet) tanks are generally preferred for storage of small volumes (Tractebel Engineering, S.A., 2015). These tanks are simple and less expensive to install as opposed to vertical cylindrical self-supporting tanks.

Transportation – Micro-LNG is transported on land via trucks or trailers, specially designed for cryogenic temperatures (-162°C/-259°F). The vehicles are equipped with safety equipment to prevent over-pressurising. In some countries, LNG tanks are transported via railway.

Regasification – At the regasification facility, LNG trucks dock into unloading bays. Pumps are then used, along with unloading arms or flexible hoses, to transfer the LNG into storage tanks where it is depressurised. The LNG is then vapourised and transmitted to the customer.

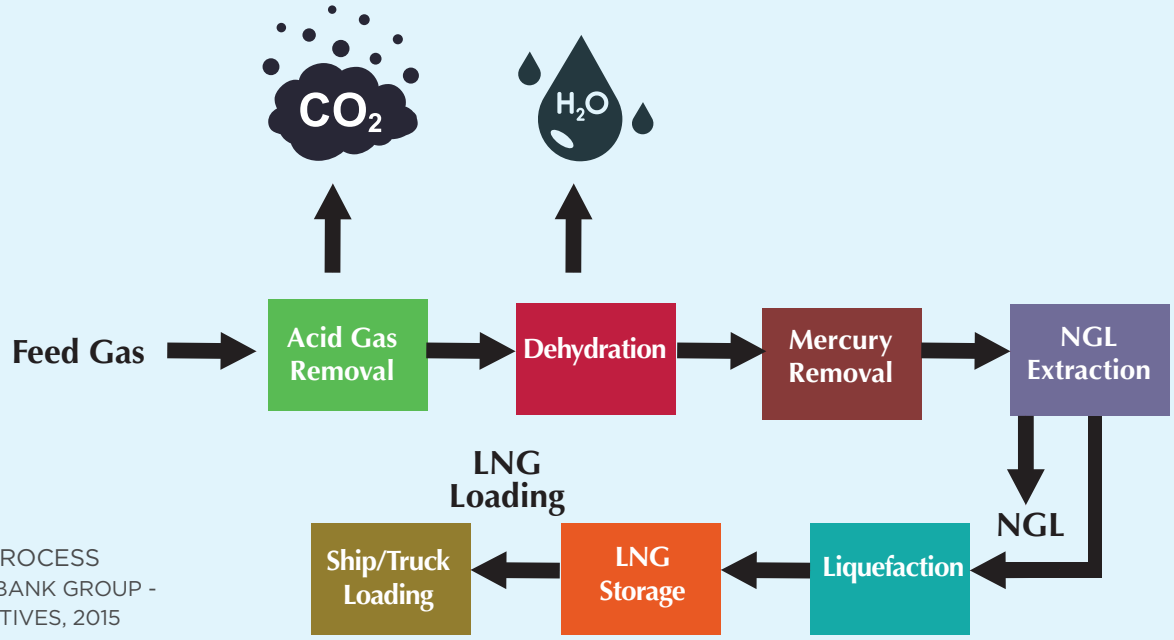


FIGURE 2:
LIQUEFACTION PROCESS
SOURCE: WORLD BANK GROUP - ENERGY & EXTRACTIVES, 2015

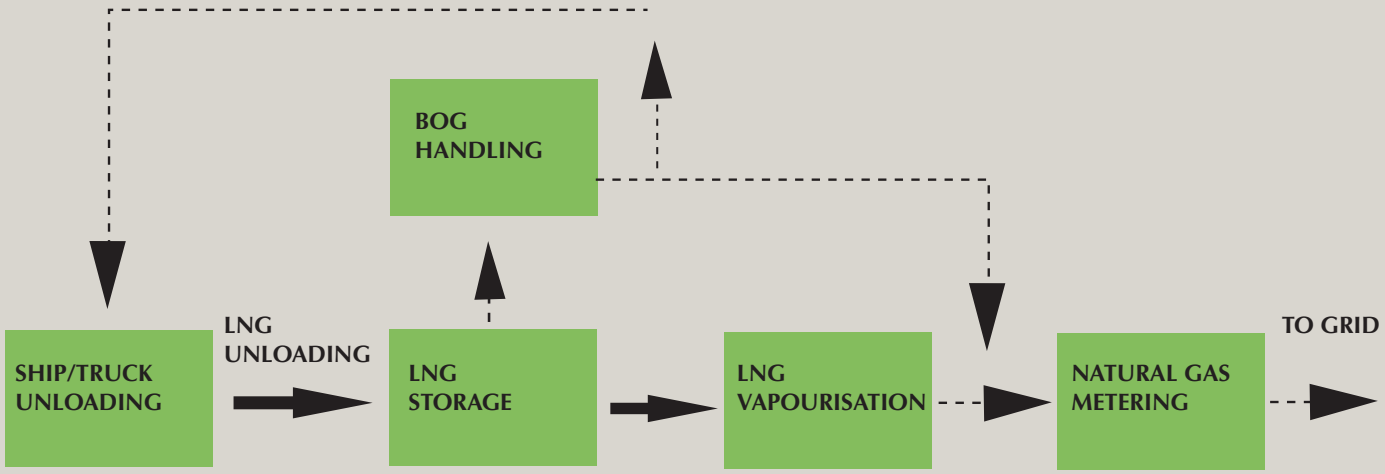


FIGURE 3: REGASIFICATION PROCESS
SOURCE: WORLD BANK GROUP - ENERGY & EXTRACTIVES, 2015

Various vapourisation methods can be employed, including open rack; submerged combustion; shell and tube; and ambient air. Ambient air vapourisation, which utilises natural atmospheric air for heating, is the most common type for micro-LNG volumes.

Potential benefits of micro-LNG

The target market for gas from NGC's micro-LNG project includes LICs located more than 5km away from existing gas pipelines and service to prospective Compressed Natural Gas (CNG) customers. LNG would be supplied to these customers via a virtual pipeline, in which Road Tanker Wagons (RTWs) would transport LNG to end-users. As such, the economic and environmental costs of constructing pipeline infrastructure would be eliminated.

The potential for reduction of greenhouse gas (GHG) emissions is another driving factor behind the project. Stranded gas would be the gas sourced for micro-LNG liquefaction. Stranded gas in our case includes associated gas that is considered uneconomic to produce, as well as gas that is currently vented in the production of crude oil. If implemented, the micro-LNG project could significantly reduce GHG emissions from onshore oil and gas production, while optimising usage of gas molecules.

Technology is reducing the cost of micro-LNG solutions. The manpower requirements for micro-LNG plants are relatively low, as the facilities are highly automated. Also, modularisation has been introduced, resulting in relatively straightforward design and construction of micro-LNG plants and regasification terminals.

The Ten Man LNG facility in Pennsylvania, USA is an example of an effective modular micro-LNG plant where stranded gas from Tenaska Resources' Mainseburg field was successfully monetised in 2016. The entire portable liquefaction system was transported on eight trucks.

The relationship between capital expenditure and capacity size of LNG plants is non-linear. However, scalable micro-LNG systems have allowed producers to minimise capital expenditure by altering production capacity to match demand. An example of this type of technology is the high-pressure micro-LNG liquefaction system built by Dresser-Rand (now Siemens Energy) for Altgas in British Columbia, Canada (Offshore Energy, 2018).

What are the main challenges?

Developing a micro-LNG project is not without its challenges. The commercial viability of the project is of utmost importance. The economics must be favourable on both the supply and demand sides of the equation. Factors such as the cost of liquefaction, storage and transportation to remote locations must be considered when determining the commercial feasibility of the project.

The returns to be derived from micro-LNG must be at least comparable to that of traditional pipeline delivery, to warrant further exploration.

Based on the growth of the LIC sector over the past three decades, there may be a potential market for micro-LNG in Trinidad and Tobago. However, stakeholder engagement with prospective new clients will be required to ensure that sufficient demand is generated to sustain profitable operations.

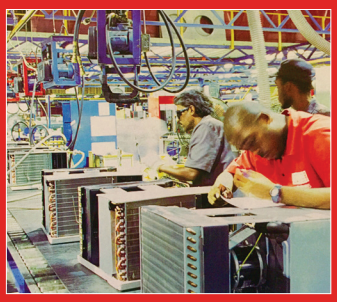
While micro-LNG does not require pipeline infrastructure, RTWs require appropriate road infrastructure to ensure access to remote sites. Other potential challenges include distance from the liquefaction facility; traffic intensity on the roadways; road conditions and clearance height from utility lines. A safety assessment would be conducted to ascertain and mitigate risks related to the roadways so that RTWs can operate safely and with minimum disruption.

Next Steps

The micro-LNG project is being managed in accordance with The NGC Group's Project Management Methodology.

The project is currently in Stage 1 – Initiation – and the business opportunity has been identified. A preliminary schedule has been developed to guide the team and assist with managing deliverables in preparation for the first stage-gate review later this year.

Detailed evaluation of technology options is ongoing, and discussions are in progress with producers regarding supply. Project assumptions are being refined while the preliminary economics are analysed. A commercial operating framework is also under development.



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Should the project satisfy the economic requirements of the first stage gate, it would be advanced to Stage 2 – Feasibility Analysis, Concept Optimisation and Final Selection. During this period, pre-FEED (Front End Engineering Design) would be conducted, and a contractor selected. As the project concept is refined, a budget would be developed. The commercial structure for the project, for example, the type and source of financing to be utilised, would be determined in this stage. Further, preliminary terms and conditions for both purchase and sale agreements would be articulated in the second stage.

Conclusion

In 2018, The NGC Group made a commitment to LIC customers that the Group would do its part to strengthen the LIC sector. The exploration of the micro-LNG concept brings us a step closer to delivering on that promise. While the project is still in its germination phase, we are excited by the potential it holds. Should micro-LNG be deemed feasible, it would increase economic activity and boost employment in rural communities.

In addition to creating economic value, micro-LNG could further The Group's green agenda by directly reducing GHG emissions, while simultaneously optimising the use of natural gas molecules. NGC is pleased to be at the forefront of yet another transformative initiative that has the potential to develop the local economy while advancing our global imperative of GHG emission reduction.

References

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Tractebel Engineering, S.A. (2015). *Min/Micro LNG for Commercialization of Small Volumes of Associated Gas.* World Bank Group - Energy & Extractives. ■