ENSURING ENERGY SECURITY WITH SMALL SCALE LNG

COVER STORY

Paul Shields, Chart Industries, explains how small scale LNG could be the answer to achieving energy security and independence.

With natural gas viewed as the gateway fuel to a lower carbon energy future, and Europe committed to transitioning away from imported pipeline gas, North American LNG is viewed as a near-term solution for many, with new liquefaction capacity coming online and other liquefaction terminals moving toward final investment decisions. However, as well as replacing pipeline gas, LNG also affords the opportunity to provide gas to regions and enterprises that are not connected to the pipeline grid and provide energy security during peak times, curtailment of pipeline supply, and to supplement renewables when unfavourable climatic conditions do not generate sufficient supply.

LNG virtual pipelines and the small scale value chain

The process of bringing LNG from its source to the point of use is called the virtual pipeline and typically covers four stages; liquefaction, distribution, storage, and end-use, collectively known as the value chain.

Liquefaction reduces natural gas to 1/600th of its gaseous volume, making it economical to transport and store. Traditionally, liquefaction plants were defined as peak shaving or baseload depending upon their function and capacity. Regardless of size, a single custom plant design was used to achieve total capacity; hence, as technologies and manufacturing capabilities improved (particularly for the baseload model), the trend has been towards ever larger capacities to realise economies of scale. However, particularly in the US, modular mid scale has gained significant traction. Here, total plant capacity is achieved through multiple identical liquefaction modules instead of a single custom plant. By utilising proven, standard equipment packages, shop build is maximised, which reduces on-site construction and results in significant cost and schedule savings. Other advantages of the modular approach included an overall reduced risk profile, the option for trains to be brought online and operated independently for earlier revenue recognition, and operators being able to have greater opportunity to respond to demand fluctuations.

At the other end of the scale, it is now possible to economically liquefy much smaller quantities of LNG and plant capacities nominally between 10 – 725 tpd (3000 – 450 000 gal./d) of LNG are available. This means that as well as liquefying pipeline gas to create the source for a regional virtual pipeline, captured methane (biogas) can also be liquefied and added to the energy mix, reducing carbon emissions further.

From liquefaction to end use, LNG is transported and stored in cryogenic containers. Cryogenic storage tanks are available in a range of sizes, nominally from 6000 l to > 1 million l, and can be orientated horizontally or vertically. Each tank is specially constructed to keep the LNG at temperature and provide safe and effective extended storage. Tanks are shop-built with a high degree of standardisation, making them much smaller than a site built alternative – this means far less site-work, civils, and permitting during the installation phase. Standardisation also facilitates modularisation so, just like modular liquefaction, total storage capacity is made up of multiple identical storage modules rather than a single large tank.

The same tank technology is also applied to vehicles used to transport LNG. Readers will be familiar with seeing trucks delivering liquefied air gases and the solutions for LNG are basically identical. Cryogenic ISO containers facilitate multi-modal transportation, for example road and sea. A perfect example of this solution in action is the megawatt power station on Madeira Island, which has been operating successfully for many years. LNG is loaded at the import terminal in the Port of Sines and transported to the island in a fleet of ISO containers. A full for empty swap system, where empty ISO containers are collected and returned to Sines for refilling, makes the whole process highly efficient and sustainable.

End-use

This section will demonstrate how the small scale model operates in practice for two key applications: gas to power and natural gas vehicle fuelling.

Figure 1. The standard plant model has enabled the cost effective liquefaction of natural gas for smaller quantities of gas, including liquefaction of bio-methane.

Figure 2. Modularised cryogenic storage reduces project complexity, lead time, permitting, and civil engineering.

Figure 3. Storage and revaporisation plants are an integral part of the virtual pipeline, bringing natural gas to businesses and regions not connected to the pipeline grid.

A regasification station, also referred to as an LNG satellite station, incorporates storage, vaporisation, pressure regulation, and control systems to deliver natural gas exactly as if it were from a physical pipeline. They can be configured for any demand requirement and enable businesses, regions, and municipalities to transition from diesel, heating oils, and other sources to natural gas. There are hundreds of examples where this has been applied to single businesses and many larger scale examples, including the 80 MW power station at Gibraltar that powers the territory and a series of five regasification stations

Standardisation and modularisation are again key features. All equipment is shop built, standard production, and already proven in the field, which minimises engineering and production costs, schedule, and risk. Total capacity is achieved by connecting multiple storage modules. Smaller capacity stations are typically supplied skid mounted to facilitate simplified transport and installation. Even the larger megawatt stations use shop-built equipment that can be transported by road and installed with significantly reduced site-work, civils, and permitting vs a site built alternative. Modularisation also means that planned facility expansions can be incorporated into the base design.

Providing flexibility

The virtual pipeline and LNG regasification can also benefit users who are connected to a grid but looking to supplement insufficient or unreliable pipeline capacity to meet additional load and seasonal variations or provide emergency fuel back-up during outages. Using LNG is far more efficient than diesel or LPG back-up, as the model simply mimics their current supply solution; liquid fuel is delivered to the site where it is off-loaded and stored for use, except they are using stored natural gas to augment pipeline natural gas and can utilise the same delivery system.

The small scale LNG model is also an effective supplement to renewable resources for when the sun does not shine or the wind does not blow.

LNG vehicle fuelling

Earlier this year, the NGVA announced Europe's 500th fuelling station for LNG powered heavy haulage trucks. Stations are available in a range of sizes, from private relocatable ones through to stations with multiple dispensers and open to the public. Larger stations are typically located in strategic locations, such as ports and major motorway intersections and can also be equipped with compressed natural gas modules to provide a refuelling service for all natural gas-fuelled vehicles.

LNG is loaded at source, which can be an import terminal, storage/distribution hub and/or liquefaction plant, and delivered to the individual fuel stations in exactly the same way as discussed.

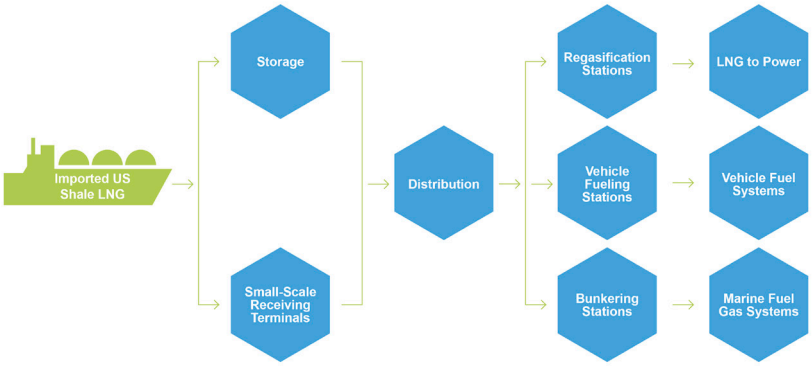

Figure 4. The small scale LNG value chain enables natural gas to penetrate beyond simply replacing imported pipeline gas.

Summary

LNG helps with what is referred to as the 'energy trilemma', finding the balance between affordability, security of supply and driving down emissions. The small scale model is an excellent vehicle for increasing natural gas penetration enabling LNG to go beyond simply replacing imported pipeline gas and is an important tool in the journey towards a low carbon future. LNG