

# Providing energy security, independence, access and resiliency through LNG

Paul Shields, Director of Marketing at Chart Industries, dives deep into the world of LNG as he explores trends, demands and exactly how the US can seize the European market opportunity.

Recent geopolitical and world events have put a renewed focus on energy security, access and independence. With it brings a hybrid of solutions, as the total energy 'pie' will be a combination of sources. One of the near-term opportunities is LNG, as new liquefaction capacity is coming online in the next few years, and other liquefaction terminals are moving toward final investment decision. One contributor to shorter timelines from the start of construction to exporting is the modular mid-scale LNG concept.

## Modular mid-scale liquefaction

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, particularly for the baseload model, as technologies and manufacturing capabilities improved, the trend has been towards ever larger capacities to realize economies of scale. With modular mid-scale total plant capacity is achieved through multiple identical liquefaction modules instead of a single custom plant. For example, a plant with a total liquefaction capacity of 12 million tons per annum (MTPA) can be achieved through six identical 2 MTPA modules or 12 identical 1 MTPA modules. Using proven, standard equipment packages, maximizing shop build, and minimizing on-site construction results in significant

advantages of the modular approach, including:

- Reduced overall project timescale
- Lower risk profile
- Ability to be brought on-line and operated independently for earlier revenue recognition
- Ability to respond more quickly to demand fluctuations and in turn, providing more opportunity to have the operator control costs associated with the facility

Chart offers a unique capability in this module market, through our patented Integrated Pre-Cooled Single Mixed Refrigerant (IPSMR®) liquefaction process coupled with our brazed aluminum heat exchanger and cold box equipment. ▶

## SAFER DISTRIBUTION COOLER BY DESIGN®

You can rely on Chart for the safe, efficient and cost-effective distribution of Liquefied Natural Gas (LNG). Our ISO intermodal containers allow a maximized payload with a robust design and construction for transporting LNG worldwide by ship, rail or road.



Designed and manufactured at our sites in Europe, China and India.



© Chart Industries | Figure 1 – Modular mid-scale liquefaction - total plant capacity is achieved through multiple identical modules



► **Small-scale LNG value chain**

A derivative of the traditional LNG value chain can utilize imported LNG to bring power to off-grid and remote locations and provide LNG as a vehicle and marine fuel. It is also an excellent solution to augment pipeline natural gas instead of oil-based fuels, as it utilizes the same delivery system to the point of use as the pipeline gas. The liquefaction process refrigerates natural gas to -260°F (-162°C) reducing it to 1/600<sup>th</sup> of its gaseous volume making it economical to transport and store. Until re-vaporized for use as natural gas, LNG is stored and transported in cryogenic tanks. These are available in a range of sizes, nominally from 6,000 to > one million liters, and can be orientated horizontally or vertically. Each tank is double jacketed construction with insulation between the layers to ensure high thermal performance, keep the LNG at temperature and provide safe and effective extended storage. Tanks are shop built with a high degree of standardization making them much smaller than a site built alternative, which means far less site-work, civils and permitting during the installation phase. Standardization 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 import terminal at Klaipeda demonstrates the economic and technological viability of small-scale LNG storage and distribution. Small-scale terminals can be built at a fraction of the cost of big LNG terminals, within a much shorter timeframe while providing operational flexibility that creates an attractive business model for terminal operators and owners. Off-loaded LNG can be decanted into road tankers for onward distribution to off-grid users and to supply vehicle fueling stations, it can be utilized for ship fuelling (bunkering) and also vaporized as a source of energy for local community usage.

**LNG distribution**

From a storage and distribution hub or import terminal LNG can be loaded into road tankers or ISO containers for a complete multi-modal solution throughout Europe and beyond. Most readers will be familiar with the cryogenic transport options for air gases and the LNG solutions are almost identical. Using cryogenic ISO containers means that LNG can be

delivered from source to site efficiently and safely via different modes, for instance road and sea. As demonstrated by Chart at the mega-watt power station on Madeira Island, which has been operating successfully for many years, a full for empty swap system with ISO containers provides even greater cost efficiencies. LNG is loaded into the ISOs in Sines, transported to Madeira with empty ISO containers collected and returned to Sines for refilling. LNG can also be distributed across Europe by rail in tankers designed and built by Chart. Construction of the tankers largely mirrors their road counterparts with a carbon steel outer vessel, stainless steel inner vessel and vacuum perlite insulation. Each one holds 110m<sup>3</sup> of LNG and is fully tested and approved to operate across Europe's entire rail network, including gauge switching required in Spain.

**LNG-to-power**

A regasification station, also referred to as an LNG satellite station, incorporates storage, vaporization, 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 Chart has enabled many enterprises to transition from diesel and heating oils to natural gas, from single business to small municipalities all the way to the 80MW power station at Gibraltar that powers the territory. Standardization and modularization are again key features. All equipment is shop built, standard production and already proven in the field, which minimizes 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 mega watt stations use shop built equipment that can be transported by road and installed with significantly reduced site-work, civils and permitting versus a site built alternative. Modularisation also means that planned facility expansions can be incorporated into the base design. Chart's LNG Drop And Go Regasification (DAGR™) regasification stations supports both standardization and convenience. Originally intended for the US market, but now also available in Europe, the DAGR is designed to vaporize LNG to provide natural gas for use downstream of the system and consists of:

- One horizontal cryogenic storage tank
- Two vertical ambient air vaporizers
- A process skid and LNG offload module
- DAGR™ is designed to operate 24/7 with minimal operator interface and includes all certifications for immediate plug and play operation.

**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 their site where it is off-loaded and stored for use, except they're using stored natural gas to augment pipeline natural gas and can utilize the same delivery system.

**LNG vehicle fueling**

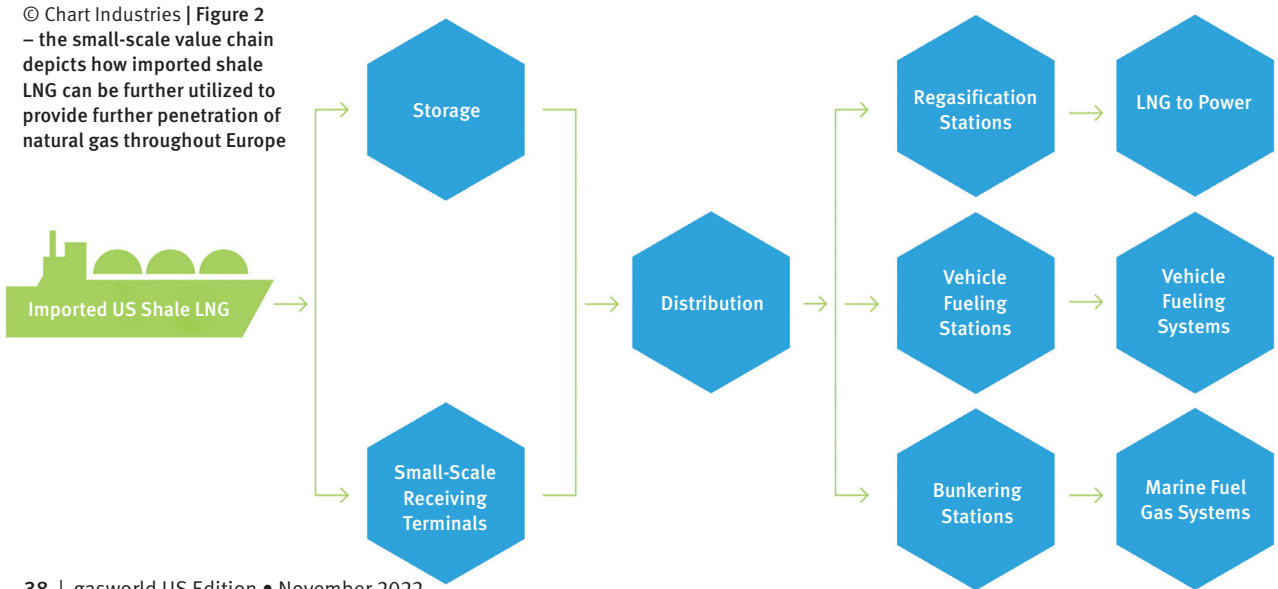
The NGVA recently announced Europe's 500<sup>th</sup> fueling station for LNG powered heavy haulage trucks. Stations are available in a range of sizes, from

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 CNG modules to provide a refueling service for all natural gas fuelled vehicles (NGVs). Imported shale LNG can be taken directly from the import terminal and/or storage and distribution hub to the individual fuel stations in exactly the same way that many readers will associate with bulk and microbulk resupply of air gases.

**Conclusion**

With Europe committed to transitioning away from imported pipeline gas, US shale LNG appears perfectly placed to take up the challenge. In addition to current liquefaction capacity the modular mid-scale model enables more plants to be brought on stream far quicker than a traditional base load model. Once the LNG reaches Europe the small-scale value chain and virtual pipeline combine to create an opportunity for LNG to penetrate areas and provide gas to regions and enterprises that aren't connected to the pipeline grid. [SW](#)

© Chart Industries | Figure 2 – the small-scale value chain depicts how imported shale LNG can be further utilized to provide further penetration of natural gas throughout Europe



© Chart Industries | Figure 3 – a fleet of >50 ISO containers are in constant use supplying the power station in Madeira with LNG from the port of Sines