

Executive Summary

Current state and growth prospects for small-scale LNG

Small-scale LNG (SSLNG) can refer to a range of applications, both in terms of production of LNG in smaller facilities (typically with a capacity of <1mtpa) and the utilisation of LNG in smaller quantities, typically delivered to end-users as a liquid fuel, rather than regasified and pumped into a gas supply system for delivery to end-users as natural gas. In this report we have considered various technologies and markets for SSLNG, and analysed and reviewed a number of forecasts for different sectors, including our own forecasts from the 2014 Cedigaz report, *LNG in Transportation*, and those provided by a range of other companies and industry bodies. We have used these to describe the current status and future prospects of SSLNG.

A brief introduction to LNG

SSLNG sits within the wider global LNG industry. LNG is a well-established and rapidly growing energy source with expanding production capacity and strong growth prospects through the next two decades. Key stages of the large-scale LNG supply chain include gas production, liquefaction, shipping and regasification. Major world LNG markets include Asia-Pacific, Europe and the Americas, with growing demand in the Middle East. Traditionally LNG prices have been indexed to oil, with significant differences in overall price levels by region, but recent years have seen the growth of hub-based LNG pricing with increasing convergence between regions. Within this wider LNG industry SSLNG is a growing area, both small-scale production facilities and with the use of LNG (which may be supplied from large-scale or small-scale production) as a liquid fuel for trucking, marine, off-grid or power generation demand, rather than as regasified LNG injected into a pipeline system.

Small-scale liquefaction

Until now, much attention has been focused on the large-scale LNG liquefaction industry, which currently has a global capacity of around 360mtpa. However, there is a significant and increasing quantity of small-scale LNG liquefaction capacity of which we have identified 219 facilities with an estimated total capacity of 28.8mtpa. The great majority (185) of the facilities are based on liquefaction of pipeline gas and most of these are in China (163). There are also facilities liquefying gas directly from source, either gas fields (10) or biomethane production (2). Finally, we have identified 22 LNG peak-shaving gas storage facilities, mostly in the USA, which typically liquefy gas slowly to store as LNG in preparation for short-term demand peaks. In some cases these also provide limited quantities of SSLNG into the market.

Supply infrastructure

LNG sold into SSLNG markets may be sourced from SSLNG production or from large-scale LNG facilities, typically delivered from regasification terminals. However, delivering the SSLNG, typically as a liquid fuel, to markets requires significant additional supply infrastructure. Within the marine sector supply of fuel is typically referred to as bunkering. SSLNG bunkering approaches includes truck-to-ship, ship-to-ship and shore-to-ship, as well as break bulking (splitting up of large shipments into smaller cargoes). Whilst marine SSLNG supply infrastructure has been slow to develop initially, it is now growing rapidly with good supply coverage especially in North-West Europe, but also many other ports around the world. SSLNG supply to the road transport sector typically requires road refuelling, although there are also ways of delivering LNG by road tanker or ISO tank. As well as large-scale infrastructure, such as liquefaction trains and regasification terminals, and small-scale

liquefaction capacity, we have identified 414 LNG facilities that could potential supply LNG into the wholesale market, in addition there are many more smaller supply facilities in terms of bunkerships, road refuelling stations (164 currently recorded in Europe and over 3,500 in China) and other supply infrastructure.

Marine transportation

Marine fuel is a huge energy market which is currently dominated by oil products. However, tighter environmental regulations, particularly MARPOL Annex VI, are driving changes in fuel requirements, especially with regards to Sulphur emissions, and especially in the Emission Control Areas (ECAs) which include around the coasts of Northern Europe and North America. LNG has opportunities in this sector as a low-sulphur fuel, although it also faces strong competition from low-sulphur oil products, sulphur scrubbing technology, and potentially from electric vessels. Currently there are known to be around 120 merchant vessels using LNG as a fuel, with a similar number on order (in addition to over 400 large-scale LNG carriers, most of which may burn boil-off gas as fuel at times). Whilst LNG-fuelled shipping has been slow to take off, it is now growing rapidly, particularly as supply infrastructure coverage has improved significantly in recent years. Most LNG marine activity is in Europe, and particularly around Norway.

LNG for road transport

As a low-emission road vehicle fuel, LNG competes with CNG, LPGs and electric vehicles. At present the key road fuel market for LNG is for heavy-duty, long distance trucks, where none of the alternatives are able to match LNG's combination of power and energy density. However, LNG trucks require a specific LNG or dual fuel engine which tends to be significantly more expensive to purchase than diesel trucks. Thereafter fuel costs are typically significantly lower, allowing a comparatively short payback for long-distance haulage. Various types of refuelling facility are in use with increasing coverage in North America, Europe and especially in China, where there are now reported to be over 90,000 LNG trucks (compared to 4,000 in Europe). The LNG trucking sector grew rapidly in China from 2010 and has been expanding quickly in Europe from 2015 onwards, with a number of announcements of major operators developing LNG fleets.

LNG for off-grid applications

LNG can also compete with oil products (and potentially renewables) as an energy source for industrial and other facilities that are not connected to gas supply systems. A range of different technologies are available. This sector remains (and is likely to remain) comparatively small, although it does provide opportunities for isolated infrastructure. In addition, in China, price differentials between LNG and pipeline gas at times have encouraged industrial switching to LNG, even for facilities that may be connected to the gas supply system.

SSLNG for power generation

SSLNG is also suitable for the power generation market, particularly for small island or other isolated markets, dependent on oil products. There are various small-scale generation applications, although, typically costs for SSLNG are relatively higher than for large-scale LNG or pipeline gas power generation. Therefore, it remains a niche market, and potentially faces growing competition from renewable generation and energy storage. However, the drive to improve electricity supply, particularly in the developing world, creates many opportunities for SSLNG-to-power.