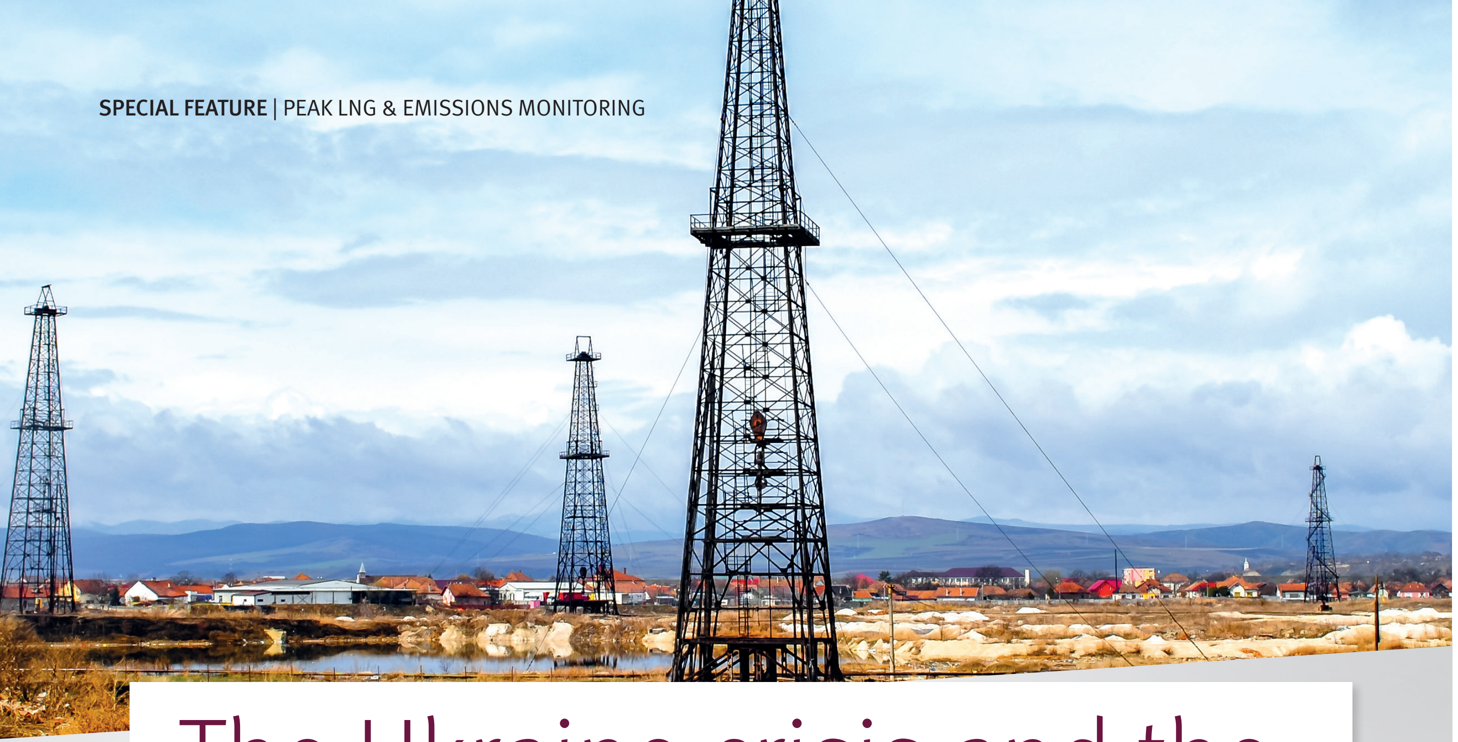

The Ukraine crisis and the imperative for additional LNG shipments to Europe

Implications for 'peak-LNG' and greenhouse gas emissions monitoring

By Stephen B. Harrison, sbh4 consulting

LNG is a highly transportable energy vector that has proven its potential as an alternative to coal and refined petroleum products. Many countries rely on revaporised imported LNG for power generation on gas-fired turbines. The war in Ukraine has also highlighted the value of LNG as a flexible energy vector: LNG tankers can be re-routed to those most in need, and terminal inventories can act as a buffer in long supply chains.

As a result of the Ukraine war and the resulting sanctions against Russia, supplies of LNG derived from shale gas in the US and from conventional natural gas from Africa and the Middle East will substitute Russian pipeline gas in Central Europe. With increased demand for LNG in Europe and continued strong demand in Asia, shipped LNG cargoes are likely to increase through this decade and 'peak-LNG' may be as late as the mid-2040s.

Despite the array of clean energy challengers such as green hydrogen, the construction of additional hydrogen-ready gas-fired power stations, LNG terminals and regasification facilities will be inevitable. And in the short-term, floating regasification units or floating power plants will also be used until additional shore-side infrastructure has been built.

LNG: comparatively low-carbon, but high greenhouse gas impact

Per MW of power generation, electricity from natural gas yields less than half the carbon dioxide (CO_2) emissions than a coal-fired power plant. Compared to coal or heavy fuel oil, LNG can also support a reduction in harmful atmospheric pollutants such as sulfur dioxide and particulate matter.

Germany and Poland have traditionally used hard coal and lignite for power generation and both countries are planning additional LNG import terminals to enable a transition from coal to gas. However, the use of LNG is not without concern. Methane, which is the main constituent of natural gas, is a potent greenhouse gas (GHG). On a 100-year timescale, one tonne of methane released to the atmosphere has the same negative impact on climate change as 28 tonnes of CO_2. As an example, in the US natural gas leaks during extraction, storage, and transport are estimated to be in the order of nine million tonnes per year.

Amidst Net Zero ambitions, the role of LNG as a 'bridge' to renewable energy is now seen as essential. Since LNG will be with us for the coming decades, there must be a relentless focus on eliminating methane emissions from upstream, midstream, and downstream operations.

The impact of switching supply routes on greenhouse gas emissions

In central Europe, more than 40% of natural gas has been supplied from Russia via pipelines during recent years. The balance has mainly been pipeline natural gas from the Netherlands and Norway. A small percentage has been through LNG imports, principally from Norway and Qatar.

The total GHG emissions from the LNG supply chain are generally expressed as equivalent tonnes of CO_2 (CO_2e). Taking Germany as an example, supply of Russian pipeline natural gas results in more than 10kg CO_2e per GJ of energy. For the Norwegian and Netherlands pipeline natural gas, this number reduces to 2.8 and 3.5kg CO_2e per GJ, respectively. The reduction is due to the shorter pipeline distances and fewer re-compression stations required.

LNG imports from the US and Qatar have slightly less CO_2e greenhouse gas emissions than Russian pipeline gas. Circa 50% of these emissions are related to liquefaction of the natural gas to LNG. Another major portion (circa 40%) is emitted during LNG shipping and transfers between shore terminals and the tanker. The balance of circa 10% is due to pipeline emissions in the producing country as natural gas flows from wells to liquefaction facilities.

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As Russian gas supplies to central Europe reduce and LNG imports increase, the overall climate impact is likely to remain the same. However, there is still the need to reduce methane emissions in these LNG supply chains.

Alternative internationally-traded energy vectors, such as green ammonia, e-methanol or liquid hydrogen may emerge to challenge the dominance of LNG. However, at present they lack the scale of LNG operations. They also have lower volumetric energy densities than LNG, meaning that tankers and storage terminals will need to be larger.

Methane emissions in the European refining sector have been falling

In Europe, the Industrial Emissions Directive (IED) and the associated best practice reference (BREF) notes for the refining of mineral oil and gas regulate methane emissions. Methane falls within the broad definition of volatile organic compounds (VOCs).

The IED suite of legislation was introduced in 2010 and BREF notes for various industry sectors followed. Each sector was given a period of grace to retroactively implement the regulations on existing facilities. According to the European Pollutant Release and Transfer Register (E-PRTR), refineries in Europe that reported data emitted 4,200 tonnes of methane in

2020. This is a tremendous reduction since the peak of 28,400 tonnes that were emitted in 2013 and indicates that the IED and its associated best practices led to significant reductions in methane emissions.

Best Available Technology (BAT) 6 of the refining BREF note refers to 'sniffing' and optical gas imaging methods as being suitable for VOC leak detection. Also in the US, under the US EPA (Environmental Protection Agency) regulations, these methods are acceptable for methane detection.

For rapid scanning of a gas processing facility, a hand-held optical gas imaging (OGI) device can be ideal as part of a holistic leak detection and reduction programme. Some of these devices use a point and shoot type tuneable diode laser (TDL) spectroscope which has been configured to identify methane.

Another option is to use a similar instrument which relies on infrared detection to identify methane. Most devices in this category display a visual map on a monitor to help locate leaks. These methane hot spots can then be repaired or further investigated using sniffers to quantify the leak.

Portable analysers appropriate for methane sniffing employ flame ionisation or photo ionisation detectors. Advanced units combine both techniques. The benefit of using a sniffer is that the methane concentration can be measured to prioritise maintenance.

Data from US oil and gas operations reported by the US Department of Energy showed that 41% of methane leaks in 2017 were related to methane compression[1]. This category is the largest source of methane emissions. The same report confirms that the second most significant source, responsible for 35% of methane emissions from the sector, were related to pneumatic controllers at oil and gas processing locations. Focus in these two areas alone will target more than three quarters of methane emissions from within the sector. Static leak detection equipment used around the equipment most prone to leak can help to identify issues that require maintenance and leak reduction.

Methane emissions pose safety risks

Methane is also highly flammable. A natural gas pipeline explosion on the 9th September 2010 in San Bruno, a suburb of San Francisco, resulted in a fireball 300m high. The fire raged for hours, and 200 firefighters were called to tackle the blaze. Sadly, eight people lost their lives, and 35 houses were destroyed. An incident of this kind can be caused by a methane leak followed by an ignition, for example from a naked flame.

The crater left by the blast was the size of two tennis courts placed end to end. This hole in the ground was mirrored by a similar hole in the stock market valuation of the gas transmission company that owned and operated the pipeline. Its share price fell 8% on the day after the explosion, leaving the company worth $1.5bn less on the US stock exchange.

Gas analysers are used extensively on gas pipelines to ensure pipeline integrity. Oxygen sensors are permanently looking for air ingress, which is characteristic of a gas pipeline leak. Flow and pressure measurement are also essential to monitor for leaks. Emergency shut-off valves can be installed in the pipeline to minimise emissions in the event of a catastrophic pipeline failure.

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Further emissions reduction required

E-PRTR data for 2020 reports methane emissions from thermal power stations and other combustion installations at 99,300 tonnes. That is 23 times more than the emissions reported from refineries. Furthermore, the E-PRTR data reveals that landfill sites emitted more than 483,000 tonnes of methane in 2020: that's 115 times more than the European refining sector.

The energy sector has some work to do, and other sectors must also make significant changes to reduce their GHG emissions. Fortunately, highly reliable and sensitive methane gas detection and gas analysis instrumentation exists to provide visibility of the problems to address. gw

REFERENCE

1. Natural Gas Flaring and Venting: State and Federal Regulatory Overview, Trends, and Impacts June 2019, US DOE