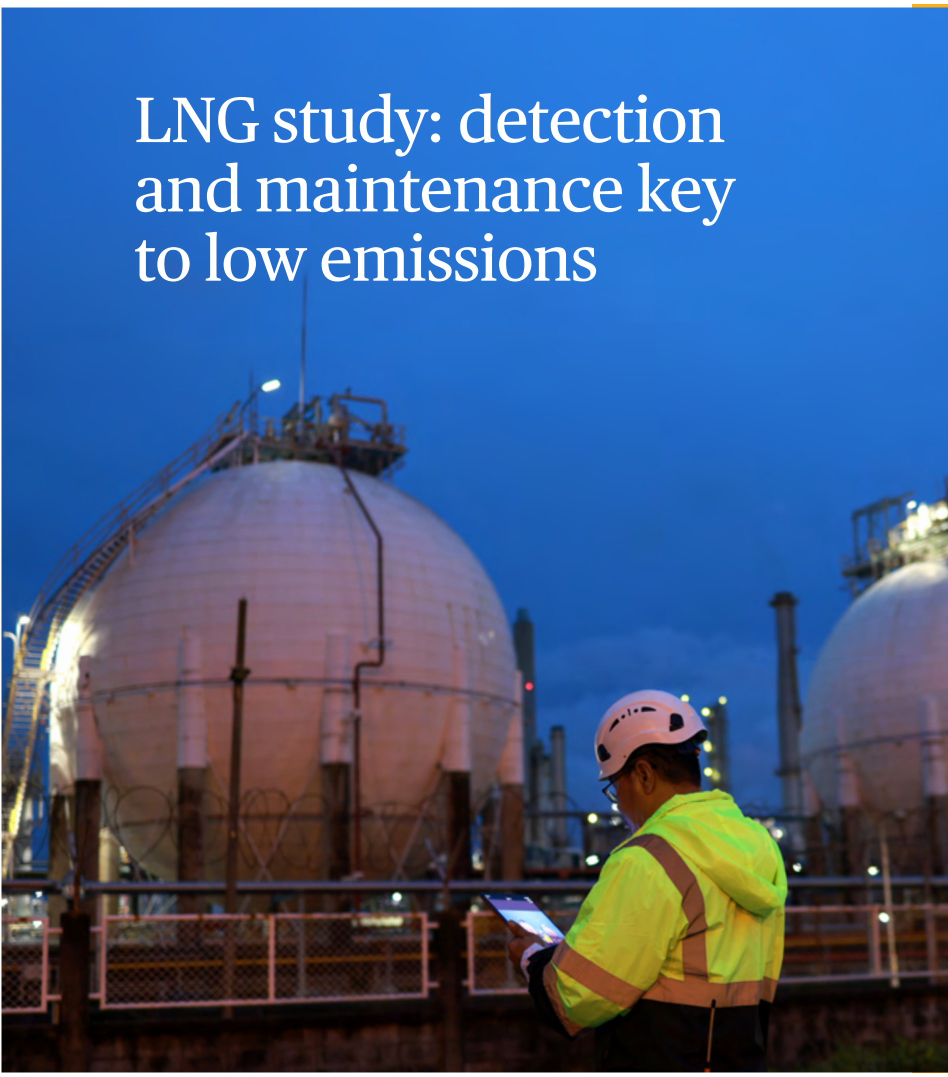
LNG study: detection and maintenance key to low emissions



Global demand for liquified natural gas (LNG) continues to rise, reflected by the fact that U.S. gross exports of LNG are projected to increase by 19% in 2025 and increase again by 15% in 2026. At various points along its supply chain, natural gas production has the potential to release methane – a greenhouse gas (GHG) 86 times more potent than carbon dioxide (CO_2) over the first 20 years of its entry into the atmosphere. Reducing these methane emissions is seen as crucial to maintaining the climate benefit of natural gas over coal.

In the U.S., new technologies have been successfully deployed to calculate methane emissions in upstream facilities, but direct measurements taken at U.S. liquefaction terminals have been lacking. Calculating emissions intensity at these terminals has been complicated by the fact that the facilities are often so large and complex that many sources of methane emission are inaccessible to technicians. As a result, direct measurements from these terminals are not publicly available, representing a major gap in our development of accurate, measurement-informed LNG supply chain emissions inventories.

Now a recently published study in the journal *Environmental Science & Technology Letters* has provided groundbreaking new insights into just how much methane these facilities are, in fact, emitting – and its findings may help us close the aforementioned knowledge gap. The study, which was conducted over the course of 16 months at two of the largest LNG export terminals in the country, affirms that methane emissions at these crucial links in the natural gas supply chain, while they have never been thought to be a major source, are even lower than previously estimated.

Using a combination of aerial and ground-based technologies, researchers intermittently measured the methane emissions coming from a pair of Cheniere Energy facilities located in Corpus Christi, TX, and Sabine Pass, LA. These two facilities alone accounted for 51% of U.S. LNG exports in 2023, making them representative of the liquefaction and export subsector as a whole. The study found that methane emissions intensity in both terminals varied between 0.007% and 0.045%, meaning that the variances in methane emissions from these facilities were not significantly contributing to the facilities' larger GHG emissions profiles.

The researchers believe that these same percentages likely apply to all LNG facilities in the country. The findings could have important implications for the way we think about the environmental impact of LNG; they furthermore illustrate just how important effective detection methods and regular maintenance are to keeping methane levels low at these facilities.

TOOLS AND METHODOLOGIES

The findings illustrate just how important effective detection methods and regular maintenance are to keeping methane levels low at these facilities.

In order to obtain the most accurate measurements possible, the researchers adopted a multiscale approach that utilized different technologies in three separate phases. The first was a baseline phase intended to develop an initial "snapshot" estimate of whole-site methane and CO_2 emissions, the latter of which result mainly from the energy-intensive process of liquefaction itself along with the fuel combustion required to power the facility. The second was an enhanced monitoring phase involving a series of periodic measurements taken over a period of six to ten months at each liquefaction facility. Finally, the researchers checked all their measurements during an end-of-project verification phase.

Three different means were employed to measure emissions at the facilities. One was a LIDAR plume identification system developed by Bridger Photonics that employs aerial mass balance technology to measure methane. Another was an aerial mass balance system using cavity ring-down spectroscopy developed by ChampionX for measuring methane. The third was a ground-based OGI camera survey of methane emissions.

The researchers relied on two different bottom-up emissions inventories for their estimates at the facilities. In the first of them, the facility's operator calculated the emissions intensity at the site for the duration of each measurement that included both methane and CO_2 emissions, as well as data from stack tests, ground-based leak detection and repair records, and other sources of information. In the second, the operator provided the previous year's emissions inventory as submitted to the U.S. Environmental Protection Agency as part of the agency's greenhouse gas reporting program.

The final measurement-informed inventory was based on whole-site emissions estimates incorporating the aerial survey data. The time-averaged measurement-informed inventory for methane represented the average at each survey through all three project phases. (The time-averaged measurement-informed inventory for CO_2 represented the average at only the baseline and end-of-project phases, as the enhanced monitoring phase did not include CO_2 measurements.) Results were reported in three ways: as methane emissions intensity, as CO_2 emissions intensity and as GHG emissions intensity, using both 20- and 100-year global warming potential values.

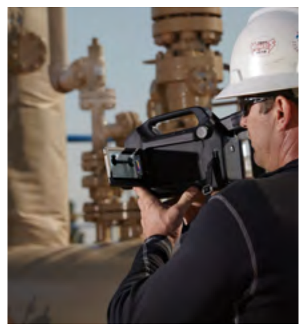
RESULTS AND CONCLUSIONS

Aerial surveys have made the task of measuring methane from oil and gas facilities much easier, and made data collection much more reliable.

The study's authors emphasize the role of maintenance in lowering methane emissions, noting that "we observe[d] significant reduction in methane emission from each source after corresponding maintenance activities at both sites." But their findings also revealed something else: Aerial surveys have made the task of measuring methane from these and other oil and gas facilities much easier, and made data collection much more reliable.

Correspondingly, the study may have exposed the limitations of the OGI cameras that have often been used to detect emissions at LNG facilities up to this point. Because OGI crews cannot reach all of the potential emission sources found within LNG facilities, they are simply not as thorough as aerial surveys are at estimating whole-site emissions. At one of the facilities, for instance, more than 58% of the Bridger-identified emissions detected across the entire site couldn't be accessed by the OGI crew.

As the oil and gas sector continues to take steps to reduce methane emissions from its operations, LNG operators have an opportunity to step out in front and show how instituting robust maintenance programs and deploying the most up-to-date detection and measurement technologies available can make a tremendous difference.



KEY TAKEAWAYS:

- A new study published in *Environmental Science & Technology Letters* analyzes first-of-its-kind measurement-informed data from U.S. LNG facilities to conclude that methane emissions from these facilities are lower than past estimates would indicate.
- The researchers highlight the relative advantages of using aerial technologies over ground-based ones for identifying and measuring methane emissions at these facilities.
- They furthermore note that robust maintenance programs are important for reducing methane emissions from LNG terminals.

ADDITIONAL INFORMATION:

The study may have exposed the limitations of the OGI cameras that have often been used to detect emissions at LNG facilities up to this point.

- The study, which was conducted over the course of 16 months, took place at two Cheniere LNG facilities (in Corpus Christi, TX, and Sabine Pass, LA) which, taken together, accounted for 51% of LNG exports in the U.S. in 2023.
- It provides the first measurement-informed GHG emissions intensity estimates at U.S. liquefaction terminals using multiscale measurement technologies.
- Three technologies were utilized: Bridger Photonics and Champion X were used for aerial plume identification of methane, along with ground-based OGI inspections.
- Utilization of aerial based technologies to identify plumes, followed up by ground-based inspections, is considered most effective.

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