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ENERGY SUSTAINABILITY

Why closer attention is now being paid to LNG emissions

The issue of emissions along the LNG value chain is now weighing more heavily on companies strategic decision-making processes. While challenges persist, there have been improvements in methane leakage management, carbon capture and storage, carbon offsetting, and fuel switching in the LNG industry



Methane leakage and emissions from parts of the LNG value chain are a topic of concern

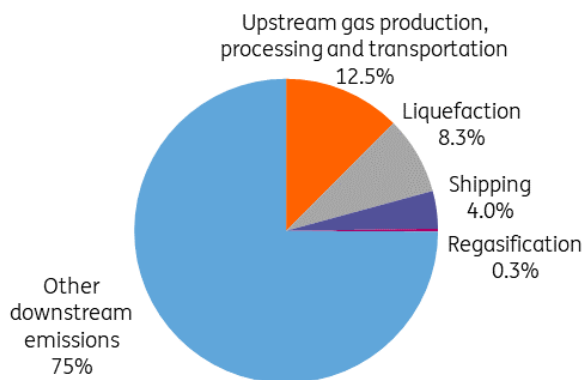
The increasing role of LNG in meeting global energy demand since the Russia-Ukraine war, combined with rapidly growing pressures to decarbonise energy-intensive economic activities, has led to heightened attention on greenhouse gas (GHG) emissions from the LNG value chain.

Emissions from the LNG value chain mainly come from three parts:

- **Upstream**, where natural gas is extracted, produced, transported, and liquified into LNG
- **Midstream**, which includes shipping LNG from the production location to the destination
- **Downstream**, where LNG is regasified into natural gas and combusted

Here's a breakdown of emissions along the value chain...

Share of life-cycle LNG emissions



Source: Center on Global Energy Policy at Columbia University

Methane leakages pose great challenge to LNG emissions measurement

While these are general estimates, it remains difficult to calculate the actual emissions volumes. And even today, there has not been a widely established formula. **The main reason behind the difficulty is the challenges in calculating methane's contribution to LNG life-cycle emissions.** In producing and transporting LNG, gaseous methane can be leaked into the atmosphere. Methane is a much more potent greenhouse gas than carbon dioxide (CO₂), as it can trap as much as **80 times** the amount of heat as CO₂ does during the first 20 years of its existence. But methane is also more short living (i.e., it dies out after 10 years), so under a 100-year timeframe, it becomes **28 times** more powerful as CO₂. Today, the norm is to calculate the global warming impact of methane over 100 years, but still, it remains challenging to precisely compare methane with CO₂.

Moreover, there is not yet a consensus on the average rate of methane leakages from LNG production. Studies from NGOs (e.g., the Environment Defense Fund), universities (e.g., Cornell and Carnegie Mellon), and governmental agencies (e.g., the Department of Energy, or the DOE) show the average methane leakage rates ranging from 0.7% to 3.3% – and that number can become a lot larger depending on production location and well productivity. Given the powerful nature of methane in causing global warming, even a small change in the leakage rate assumption can lead to substantially different results of emissions from LNG.

Organisations from both the public and the private sectors have been trying to compare the life-cycle emissions of methane from LNG imports in a region to the emissions from alternative options (such as coal or pipeline gas) that are available to that region.

While we think this is an important approach, we also acknowledge that the discrepancies in methane leakage assumptions can yield different conclusions. Mainstream research analysis

(from the US DOE) shows that LNG exported from the US to Asia can result in a 54% to 2% emissions reduction compared to local coal combustion over a 20-year timeframe, and emissions from LNG exported from the US to Europe can be 56% less to 1% more than using coal. As for comparing US exported LNG to Russia pipeline natural gas to Europe, results indeed vary based on methane leakage assumptions, with some scholars concerned about mega leakages from Russia pipelines. It is also true that with the Russia-Ukraine war ongoing, imports of natural gas from Russia have dropped significantly regardless of emissions considerations.

As the awareness of and technologies for measuring methane emissions develop, the issue of methane leakage and emissions from the other parts of the LNG value chain have become a topic of concern from businesses, investors, and governments. And because LNG is still a fossil fuel, there has been increasing debate on how much more of LNG the world will realistically produce to achieve an increasingly noticeable balance between energy security, especially for Europe and Asia, economic development, notably in developing countries, and climate mitigation.

How industry players are reducing emissions

One thing, at least, is clear: the current and any potential future LNG value chains need emissions reduction. Several pathways are being developed by the industry:

- **Methane monitoring and prevention of leakage**

Reducing methane emissions from LNG starts with monitoring the leakages. And this is already a challenge. Today, technologies such as optical gas imaging cameras, satellites, aircraft, drones, regional sensors, and point sensors are available to detect methane leakages from gas operations – but these technologies cannot yet track methane emissions systematically and accurately. Point sensors can track small leakages but it would require an army of those sensors to cover large natural gas projects or extended pipelines. Satellites can cover larger areas, but they are unable to detect small leakages. This means that current methane leakages are likely to be underestimated, and as technologies develop, we may see increases in those numbers.

The natural gas industry needs real innovation to improve methane monitoring. Luckily, there are efforts aimed at driving change. Smart sensors are being explored to better track pipeline methane emissions. Other sensor technologies for production sites are also becoming more advanced. LongPath Technologies in Colorado, for example, recently received funding from the US Department of Energy to develop its mobile dual-frequency comb laser spectrometer. Still, more policy support is needed to incentivise R&D from gas companies to innovate and deploy new technology. The industry would also benefit from having guided standards on how to best measure methane emissions.

As for methane emissions prevention, effective practices are already available. These include replacing components that emit methane during operations, installing emissions control equipment, and installing leak detection and repair (LDAR) devices. As methane that is prevented from leaking can be sold to the market, the additional revenue can in many cases exceed the cost of installation. In fact, analysis from the International Energy Agency shows that about half of all existing technology for methane emissions reduction can be implemented at no additional cost.

- **Carbon capture and storage (CCS)**

Besides using carbon offsets essentially paying for others to reduce emissions on one's behalf, companies are also exploring options to use CCS technology to reduce the actual emissions from LNG production. Qatargas' Qatar LNG CCS project is reported to have become operational since 2019, and the project is undergoing development to capture 4.3 million tonnes per annum (mmtpa) of CO₂ from Qatargas' 10 trains by 2024. In addition, Venture Global LNG in the US, BP Tangguh LNG in Indonesia, NextDecade Rio Grande LNG in the US, Hoegh LNG Stella Maris (location undecided), Novatek Yamal LNG in Russia, and Total Energies Papua LNG in Papua New Guinea are going through various stages of project development or early evaluation, with expected operation years ranging from 2024 to 2027. Despite a higher interest rate environment in many advanced economies, policy support across jurisdictions such as tax credits and carbon pricing continue to fuel the deployment of CCS technology. We see CCS as a key mitigation method for the LNG industry in the future.

- **Carbon offsetting**

Purchasing voluntary carbon credits to offset emissions is becoming more and more common practice among LNG companies in the pursuit to reduce GHG emissions. And if the amount of purchased carbon credits is equal to the estimate of life-cycle LNG emissions, then an LNG cargo can be deemed 'emissions-neutral'. In fact, several dozens of LNG cargoes have claimed themselves as emissions neutral since 2021.

This is a viable mechanism, but there needs to be more transparency, standardisation and scrutiny to make the system more effective. First, a good portion of the purchased carbon offsets have no disclosure of where the credits come from. This makes it hard to verify the credibility of those carbon offsets. Second, carbon offsets should not be the main way for LNG companies to pay and 'write off' their emissions. Companies should still prioritise reducing emissions. Finally – and this is not limited to the LNG industry – voluntary carbon credit platforms such as Verra should take on a stricter approach when verifying offset generating projects before offering the credits to buyers.

Various frameworks have been established to address the first two challenges. One which is widely used is from the International Group of Liquefied Natural Gas Importers (GIIGNL). Companies adhering to this framework need to (among other things) report the origin of their

purchased carbon offsets, emissions reduction plans, and the LNG emissions standards they have applied.

- **Shipping fuel switch**

Finally, as the shipping industry races to switch from using fossil fuels to biofuels or even LNG to power their cargoes, we can expect the emissions from transporting LNG to decrease over time.

Conclusion

All in all, the issue of emissions along the value chain is now holds more weight in LNG companies' strategic decision-making processes. There is still a long way to go toward methane detection improvement, measurement standardisation, and so on – but because of the nature of methane, even a small achievement can have a huge positive impact. While the exact future role of LNG in energy transition and energy security is still up for debate, there is no doubt that any existing or upcoming LNG projects need deep emissions reduction.

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