The Quest for Cleaner Natural Gas: Engaging the Global Ecosystem

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Highlights

- **Natural gas producers are increasingly focused on reducing upstream emissions, but other players in the global gas trade are far less engaged on the issue.** Opportunities for investor engagement exist throughout the global gas system – including with midstream operators, LNG exporters, buyers, banks and insurers.

- **Gas buyers have influence over the supply chains they procure from – but have yet to use this to drive emission reductions.** Natural gas deal terms still center on price, volume, and delivery terms. Expanding gas supply contract parameters to include emissions intensity could broaden engagement and accelerate progress on emissions reduction.

- **Finance providers can help raise ambition on methane.** Equity and credit investors, commercial banks, export credit agencies, and trade insurance companies all play a role in gas project finance and ongoing lending to gas players. By introducing methane into the conversation, these players can create incentives for operators to do more.

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This brief is an adaptation of, and includes the analysis and excerpts from, a series of reports by the Center for Strategic and International Studies (CSIS), supported by Environmental Defense Fund (EDF). Graphics and language borrowed from these reports are used with the permission of CSIS. Graphics produced by CSIS are noted as such. Section 2 contains solely the opinions of EDF and was not authored by CSIS. CSIS is an independent bipartisan and nonprofit policy research institution.

For the full CSIS reports, see "How Market Factors Could Shape Demand for Cleaner Gas" (November 2021), "Methane Emissions and the Gas Ecosystem: Buyers, Sellers, and Banks" (Dec 2021), and "Reducing Methane Emissions from Global Gas: Policy, Markets, and Ecosystems" (May 2022).

Introduction

Reducing methane emissions is one of the greatest opportunities to slow the pace of global warming. Methane is a potent greenhouse gas, with more than 80 times the warming potential of carbon dioxide in its first 20 years after release into the atmosphere. Because methane is a short-lived climate pollutant, cutting emissions can have a nearly immediate impact. Methane is firmly on the international climate agenda, and more than 100 countries have adopted the Global Methane Pledge, a collective agreement to cut methane emissions by at least 30 percent below 2020 levels by 2030. The energy sector — including oil, natural gas, coal, and bioenergy—accounts for about 40 percent of anthropogenic (human-caused) methane emissions. The oil and gas sector presents some of opportunities to cut methane pollution.

Investors can engage the global gas system to reduce methane emissions. Investors should recognize the complexities of the global gas system and identify ways to influence market development and shape incentives for various players. Relevant factors include market position; ownership structure; mandates; ESG sensitivities; and influence of actors in different markets. Across the board, pressure from investors could influence decisions on gas procurement and investment.

This brief incorporates insights and language from three reports published by the Center for Strategic and International Studies[1] (CSIS) that were supported by Environmental Defense Fund. In this synopsis for investors we highlight key features of the global gas market; identify the main gas market players; summarize what they are saying about reducing methane emissions; and suggest ways investors can encourage different members of the global supply chain to reduce methane emissions.

1 "How Market Factors Could Shape Demand for Cleaner Gas" (Nikos Tsafos, November 2021) outlines features of the global gas industry. "Methane Emissions and the Gas Ecosystem: Buyers, Sellers, and Banks" (Ben Cahill, Nikos Tsafos and Ian Barlow, December 2021) defines the different players in global gas. "Reducing Methane Emissions from Global Gas: Policy, Markets, and Ecosystems" (Ben Cahill, May 2022) describes the views expressed by key players on methane emissions and ways to reduce them.

How investors can engage the global gas ecosystem to encourage methane reductions

Investors looking to encourage faster action on methane emissions reduction can engage a range of players in the global gas system, as described in the sections that follow. Below are some examples of questions to ask when raising methane emissions as a critical abatement opportunity.[2]

When engaging with	Questions investors can ask
Upstream (producers) and midstream (gas pipelines)	• What actions are you taking to reduce the methane intensity of your gas? • Share details of your methane monitoring, reporting and verification (MRV) and leak detection and repair (LDAR) programs. • Are you a member of the Oil & Gas Methane Partnership 2.0 (OGMP) or other initiatives to improve methane emission data quality and transparency? • Are you involved in differentiated gas or related products? How do you verify the robustness of this scheme and the underlying emissions data?
LNG exporters	• How do you assess the lifecycle methane intensity of LNG that you deliver to customers? • What is the lifecycle intensity of your gas delivered to different locations? • How do you engage with upstream suppliers to assess and reduce methane intensity? • Are you a member of the Oil & Gas Methane Partnership 2.0 (OGMP) or other initiatives to improve methane emission data quality and transparency? • Are you involved in differentiated gas or related products? How do you verify the robustness of this scheme and the underlying emissions data?

2 For more context on the issues referenced above, see "An Investor's Guide to the Oil and Gas Methane Partnership 2.0", EDF and UN Environment Programme, Sept 2021.

When engaging with	Questions investors can ask
Gas and power utilities	• Do you assess the methane intensity of the gas you procure? • How do you engage with upstream suppliers to assess and reduce methane intensity? • Do your contracts for procuring natural gas have terms incentivizing operational emission reductions? • Are you involved in differentiated gas or related products? How do you ensure the robustness of this scheme and the underlying emissions data?
Banks and insurers	• Do you consider methane emissions intensity when providing financing or insurance to gas supply or gas infrastructure? • Do you provide incentives to encourage lower emissions intensity of supplied gas?

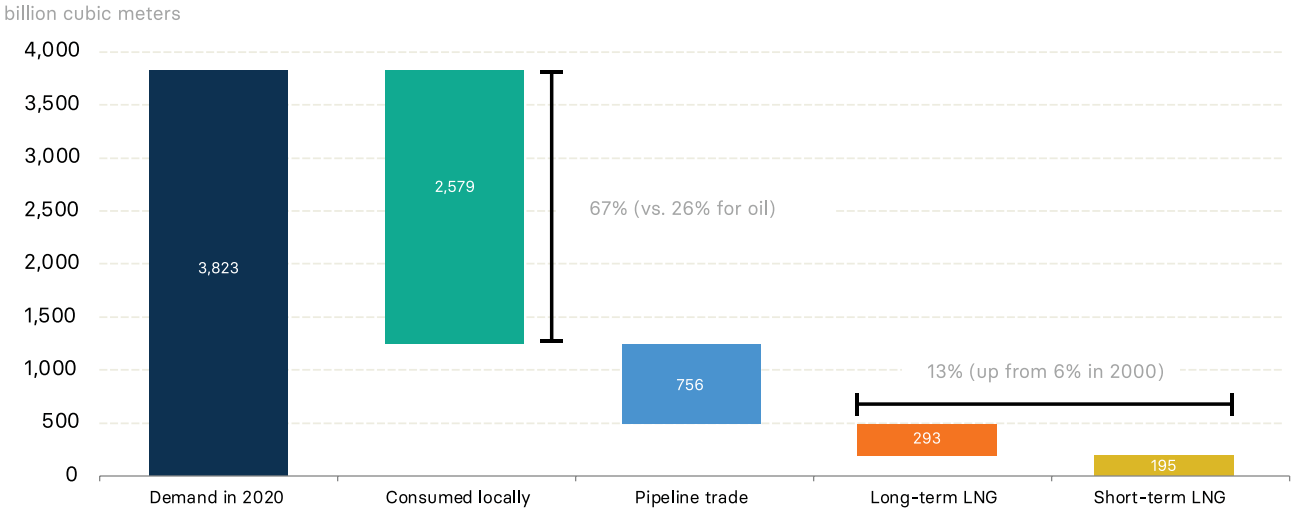
Fundamentals of global gas markets

The structure of the global gas market has important implications that affect how investors can engage to affect methane emissions:

1.

Most gas never crosses a border. In 2020, two-thirds of the world's gas was consumed in the country where it was produced. The remaining one third crossed a border by pipeline or on a ship, transported as LNG. Of the international gas trade, most takes place by pipeline, which accounted for 756 billion cubic meters (bcm) in 2020, versus 488 bcm for LNG. However, growth in the LNG market has been faster: LNG's share of total gas consumption has more than doubled over the past decade, to 13% in 2020. Strategies that leverage international trade to reduce emissions are essential, however stringent domestic regulation that limits methane pollution from the oil and gas industry are critical to address gas that does not cross a border.

Figure 1: Most Natural Gas Never Crosses a Border



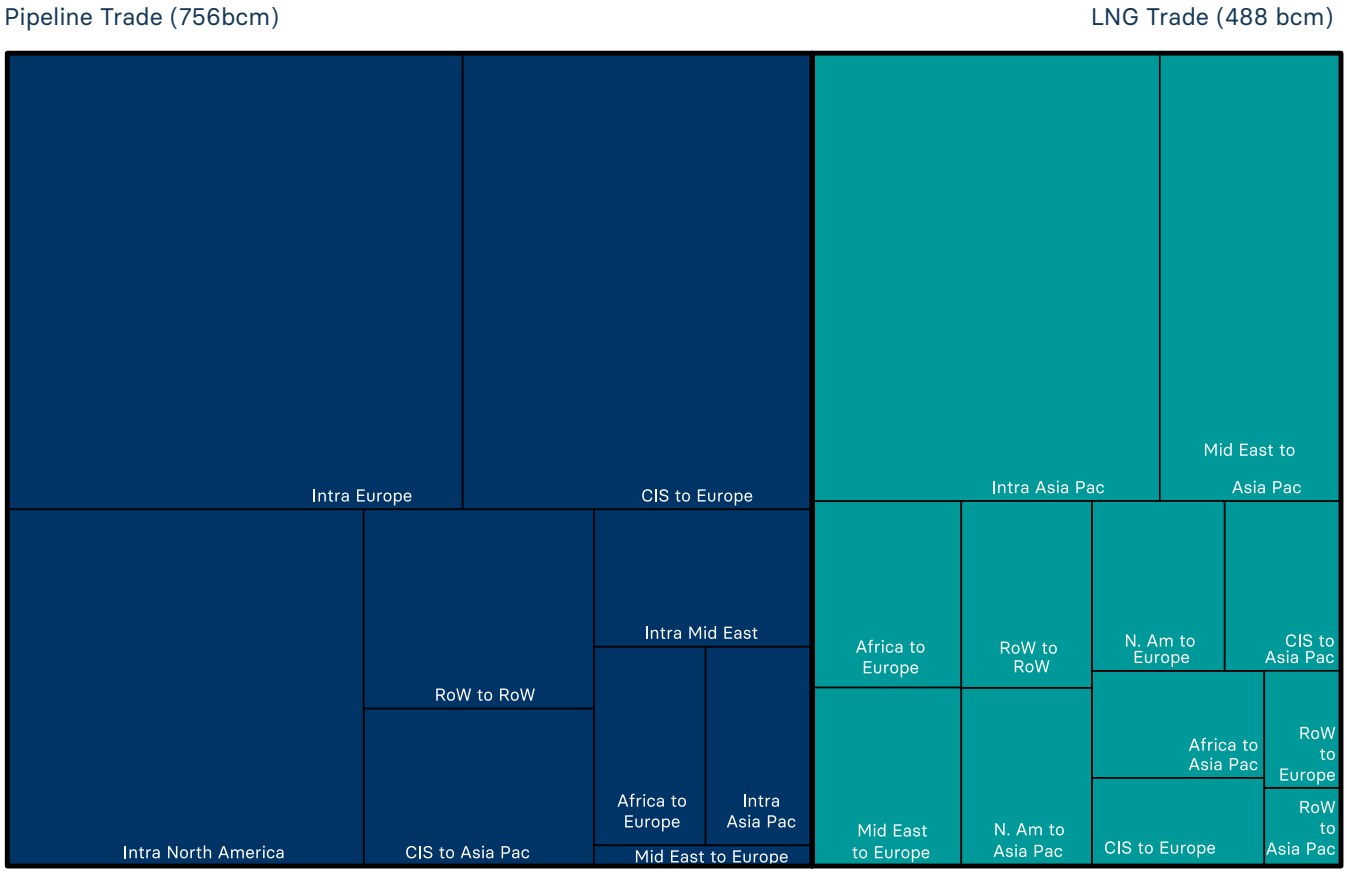
Note: Data for pipeline and LNG trade are taken from the bp Statistical Review; the split between long-term contracts (typically 10 to 25 years) and short-term contracts (less than 3 years) is from the International Group of Liquified Natural Gas Importers (GIIGNL); there is minimal trade based on medium-term contracts. The estimate for gas consumed locally is inferred as the difference between total consumption and international trade.

2.

A few trade corridors are key. Most pipeline trade revolves around Europe or takes place within North America. Most LNG ends up in Asia, either from the Asia-Pacific region or from the Middle East. This structure means that significant strides can be made by focusing attention on a few key markets.

The global gas trade comprises five net-exporting regions: the Commonwealth of Independent States (CIS), the Middle East, North America, Africa, and South America, and two net-importing regions: Asia-Pacific and Europe. Most trade corridors exist to connect one of these surplus regions to one of these deficit regions. Countries and large gas-buying entities within the two major importing regions could reduce global methane pollution by adopting ambitious policies and leveraging their purchasing power to influence methane emission reductions from imported gas supply chains.

Figure 2: Natural Gas Cross-Border Trade in 2022 (via pipeline and LNG)



Source: bp Statistical Review of World Energy 2021.

3.

The share of gas in an economy affects its market and policy positions. The importance of gas to different countries varies. A gas buyer that is heavily reliant on natural gas might have fewer developed alternatives and thus could be more risk-averse to any policies that might disrupt energy supply.

So does industry structure. The numbers of actors and consumers involved in a country's gas market also varies. Regulation might also be easier or harder to pass and enforce in a market depending on its size and complexity. With greater exposure to global capital markets comes greater influence for equity investors and creditors to demand gas market participants take voluntary action to control methane pollution.

4.

In 2020, almost a quarter of the world's energy came from natural gas, a share that has risen steadily over the past half century.[3] The regions that depend most on gas are the Commonwealth of Independent States (CIS) and the Middle East, where gas accounted for over half of primary energy in 2020. At the other extreme, in the Asia-Pacific region, gas made up just 12 percent of the energy mix in 2020. In between these extremes are, in descending order, North America (34 percent), Africa (30 percent), Europe (25 percent), and South America (20 percent). Because of the share of natural gas within the global energy mix, it is critical that investors take the emissions footprint of this fuel into account.

Figure 3: Share of Primary Energy Met by Natural Gas

percent of primary energy

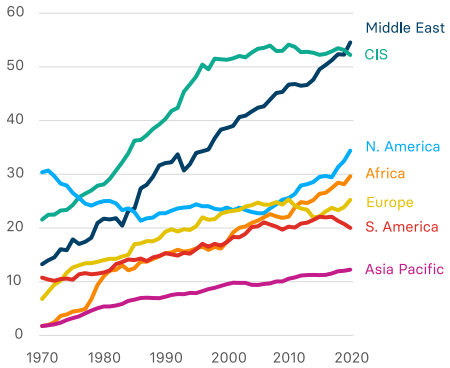
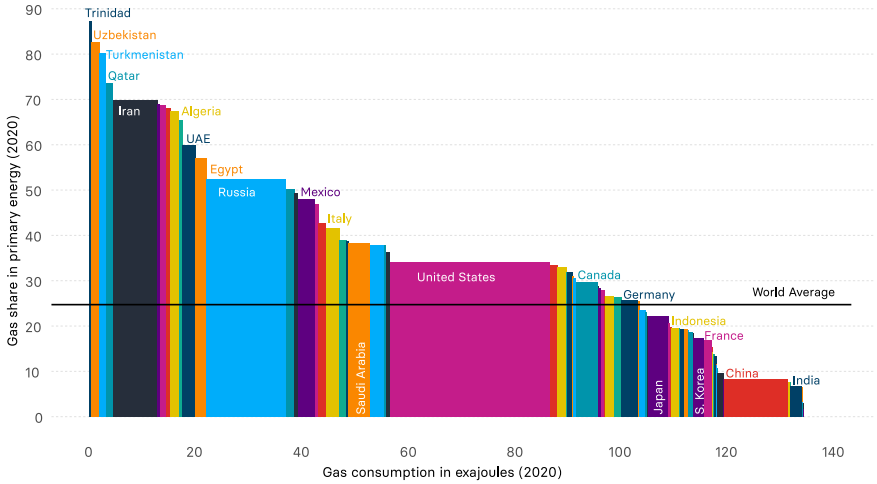


Figure 4: Natural Gas Consumption and Market Share by Country



Source: Bp, Statistical Review of World Energy 2021.

5.

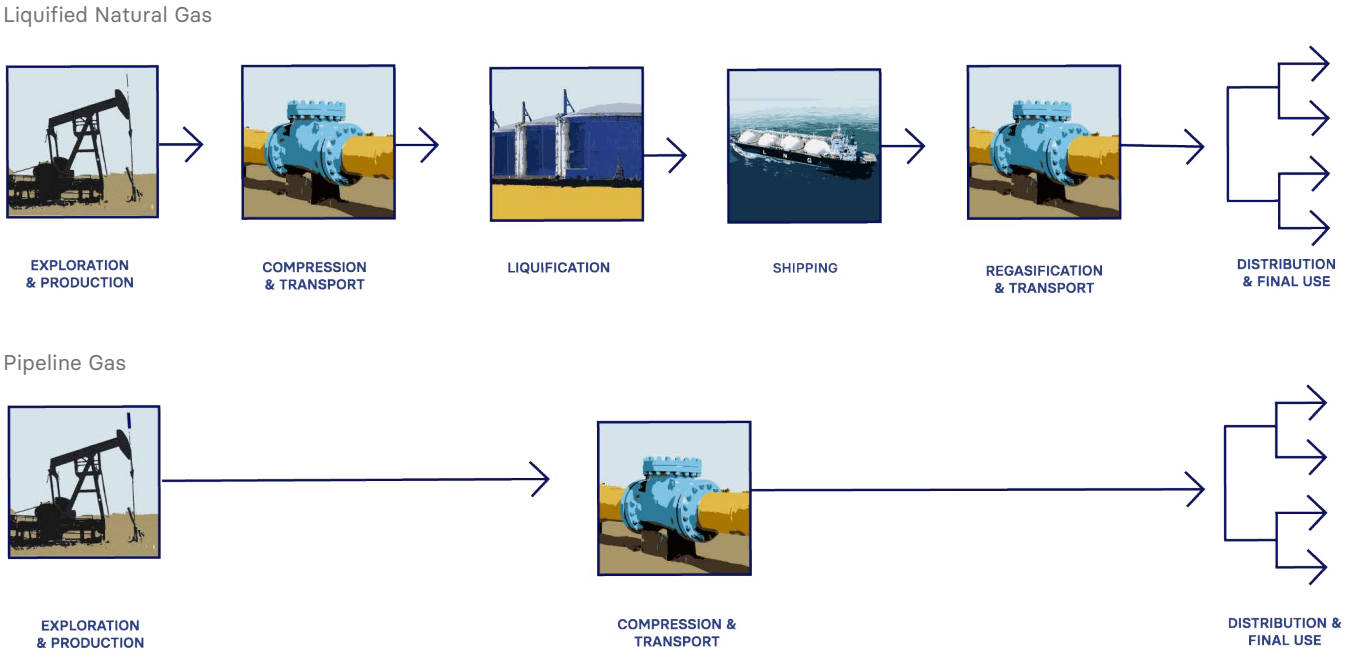
Transparency surrounding emissions within gas markets has been lacking, however a paradigm shift in methane emissions data quality and transparency is on the horizon. Methane emissions data reporting has been patchy, and the quality of reported data is often poor – systematically under-counting emissions. This is set to change over the next few years. On the one hand, energy company data reporting is poised to become more robust: companies representing over a third of oil and gas production have joined the Oil and Gas Methane Partnership, a comprehensive, measurement-based reporting framework for methane emissions focused on data quality and transparency. There is a growing consensus in industry that data quality needs to improve to gain stakeholder confidence, and many companies are responding accordingly.

A second factor driving industry data transparency is a profusion of methane emissions monitoring satellites that are currently in orbit or launching soon. For example EDF's MethaneSAT, due to launch in 2023, will provide public access to industry emissions data with broad coverage and high resolution and sensitivity. The upcoming surge in satellite data will provide stakeholders, including gas buyers and investors, with unprecedented insight into methane emissions from natural gas supply chains.

Key players in the gas ecosystem

A brief typology of global gas players can shed light on how companies are responding to the imperative of reducing methane emissions and reveal opportunities for investors to engage with influential actors. Some global gas players — utilities, NOCs, supermajors, LNG exporters, and trading houses — have robust targets to cut methane emissions, but others have no discernible plans. Stakeholder pressure matters and in the absence of a regulatory framework it can promote voluntary efforts that mobilize gas players to proactively cut methane emissions.

Figure 5: Natural Gas Supply Chain



- The supermajors face strong pressure to act on methane emissions, given the scale of their production and the investor scrutiny they face in multiple jurisdictions. These companies have issued targets and shown various levels of support for industry associations that advocate better emissions measurement and abatement, such as the Oil and Gas Methane Partnership. Generally, the majors are more supportive of tougher methane regulations than smaller oil and gas companies that face less investor scrutiny on methane. Investor pressure continues to be a powerful incentive for these companies to increase the quality of their emissions data, the comprehensiveness of their reporting, and focus on emission reductions.

- National oil companies are ultimately accountable to governments, whether they are wholly state-owned or partly listed, so government priorities matter a great deal. Gas-exporting NOCs cannot ignore the potential for tougher methane regulations. Some NOCs, such as Qatar Energies, are making concerted efforts to decarbonize their gas production, viewing this as a competitive differentiator. Many NOCs have exposure to international capital markets – particularly credit markets — and international investors can challenge them to adopt more ambitious climate goals.

- Some LNG exporters and gas producers are marketing low-emission-intensity gas, or "differentiated" gas. Certain U.S. exporters appear to be positioning themselves for a more carbon-constrained market by attempting to track the emissions intensity of gas from the wellhead through transportation, liquefaction and shipping. Cheniere, for example, published a life cycle analysis of GHG emissions specific to its supply chain and has offered "emissions tags" for certain cargoes. The scope and rigor of emissions tracking remains an open question, especially in light of the near-universal lack of measurement-based methane emissions data.

- Trading houses such as Vitol, Trafigura, Mercuria, and Gunvor have become significant players in global LNG trade, buying and selling cargoes around the world. But some commodity traders such as Vitol are privately held, and their views and operations are sometimes hard to piece together. Their public commitments on methane emissions are scarce.

- Gas and power utilities in gas-importing countries typically set the terms of long-term natural gas contracts and invest in producing-country LNG projects that present levers for engagement on emissions. They also typically operate a range of domestic infrastructure such as regasification facilities, pipelines and power plants that are emissions sources. Jera and KOGAS (Japanese and South Korean utilities, respectively) are the world's largest LNG buyers and hold equity stakes in numerous overseas projects, including liquefaction terminals. To date, gas and power utilities have generally not shared much information on their methane intensity goals. It will likely require pressure from their government stakeholders and investors to shift their priorities.

Top concerns of large gas customers

Buyers and sellers of gas conduct extensive due diligence before entering a long-term agreement that entails major new infrastructure investment. Buyers considering where to source natural gas consider several risk factors and methane intensity could be adopted as one of the terms. Key considerations today include:

- Will the supply of gas be predictable and reliable? This can be affected by: 1) geology (the size and quality of the resource base underpinning the transaction and the technical factors that might affect production); 2) geography (some LNG crosses the Suez or Panama Canals, exposing delivery to bottlenecks; the IEA has noted that over 50 percent of the world's LNG plants in 2020 were "heavily exposed to risks from violent storm surges"; 3) politics (several LNG exporters have experienced civil strife, interrupting LNG flows).

- What is the commitment level and track record of the project sponsors? Buyers weigh the credibility, track record, and commitment of the sellers.

- Do the various project stakeholders support the project? Buyers look closely at the various stakeholders: the host government, local communities, workers, non-governmental organizations, and so on. Alignment between these parties is key.

- Is the broader ecosystem favorable to project development? The ecosystem in which a project will be constructed — including the regulatory structure, availability of labor, and suitability of the environment — is essential. Buyers ask questions such as: Can the state review, negotiate, and execute contracts? Is the environment safe? To what extent is new infrastructure needed, and how easy might it be to construct that infrastructure?

- Will the project make money? Commercial viability is a relative term. What is commercially challenging one day might be attractive the next. But buyers try to understand whether the relative allocation of risks and rewards makes sense and whether the state is projected to make a sufficient return for its resource.

The buyers in long-term transactions weigh many factors in deciding what gas to buy and on what terms, and methane intensity must compete for attention with these other issues. Investors can ensure that methane emissions are on the agenda in their engagement with companies as they negotiate long-term contracts or make infrastructure investment decisions.

What global gas players say about methane

To better understand how companies are grappling with concerns over methane emissions CSIS interviewed select global gas players, who expressed a wide variety of views. In general, they found that companies are aware of the methane challenge and are contemplating the potential impact on their business. Most utilities, NOCs, and trading houses see methane emissions as an important issue and anticipate more scrutiny from stakeholders such as shareholders, banks, and government agencies on their emissions intensity goals. At the same time there is a great diversity of perspectives on this issue, and it is not consistently included among the list of top priorities.

KEY THEMES AROUND METHANE FROM CONVERSATIONS WITH GAS INDUSTRY PLAYERS

1.

Oil & gas companies are more focused on reducing emissions. Many operators have set emissions targets and introduced transition plans that include strategies to reduce methane intensity – such as improved leak detection and repair (LDAR) programs and reduction of gas flaring. This is partly in response to investor pressure, which has focused on companies with assets in multiple jurisdictions such as European majors or U.S. independents with international portfolios. The perception among companies is that external scrutiny over their methane intensity has grown significantly in a short period of time. Several companies also suggested that to maintain access to capital, they must now present viable plans to lower their carbon intensity.

2.

Cleaner gas can be a strategic advantage for some suppliers. Several U.S. LNG exporters suggested that over the long term, greater scrutiny of oil and gas methane emissions could be a boon for U.S. LNG. One LNG exporter suggested that if the global gas system evolves in a way that lowers methane emissions, the impetus will largely come from suppliers, not buyers. The same company suggested that the likelihood of a supply push for differentiated gas is much higher in the United States, due to a convergence of interests from investors, upstream operators competing for capital, regulators, and data providers. These comments highlight one important aspect of global LNG: this is a competitive industry, and most sellers are vying for the same buyers. If more markets become carbon-constrained and begin to feature higher carbon prices, sellers with lower emissions intensity will have an important advantage. This is the principal reason why some LNG sellers have begun experimenting with life cycle analysis of emissions specific to their supply chain or suggesting ways to uniformly assess greenhouse gas emissions associated with each LNG cargo.

3.

Emissions intensity is not yet a common factor in LNG trade terms. Both LNG sellers and buyers suggested that whatever the future may bring, as of today greenhouse gas emissions intensity pales in comparison to other factors. Price, volume, and delivery terms are the critical elements in LNG deals—both spot and long- term transactions. Likewise, commercial banks, export credit agencies, and trade insurance companies that are key players in LNG project finance are not yet attuned to methane intensity issues. There is no evidence at present that methane intensity is a critical factor in the way any of these entities assess project risks and rewards for gas projects.

4.

Many believe switching from coal to gas is already a climate win, limiting their focus on methane emissions associated with gas. Several companies expressed a view that it is already challenging for countries like the Philippines, Thailand, and Indonesia to switch from coal to natural gas in power generation. Imported LNG competes with cheap, abundant coal in several of these markets, so opting for natural gas is already seen as a victory for climate policy. In this context, LNG exporters suggested that governments in the region have limited incentives to look too deeply at the emissions profile of gas.

5.

Better data and methane detection technology will be key. New data and benchmarks are beginning to assess the carbon intensity of both natural gas and crude oil, as well as the price of carbon offsets needed for individual LNG cargoes. There is good reason to believe that market demand for such assessments will grow as more countries introduce carbon prices and incentivize companies to scrutinize the emissions intensity of the fuels they buy. Several companies noted an awareness that ground-based detection, aerial surveys, and satellite data are becoming more widely available. Many upstream and midstream operators have committed to work toward measurement-based reporting covering all their operated and non-operated assets. As methane quantification methods improve and more data becomes available on basin- and asset-level emissions, data providers will have a key role to play in building market confidence and demand.

Conclusion

Over the past decade, stakeholders in the oil and gas industry have increasingly recognized the need for energy companies to reduce methane emissions quickly and sharply in order to limit global temperature rise. Best practices and frameworks to measure and reduce methane leaks, like the Oil and Gas Methane Partnership, have been established. Engagement by investors has played an important role in spurring companies to adopt methane targets and will continue to drive progress in measuring progress and achieving real emissions reductions.

Certain segments of the global gas industry, notably gas buyers and importers, are far less engaged on energy methane emissions. Investor engagement with these segments presents an opportunity to influence the market toward lower-emissions gas. By understanding the complexities of the global gas system and the varied market structures and incentives that different stakeholders face, investors can effectively apply pressure that rewards better performance and drives down portfolio emissions.

Appendix 1: Select global gas players.

The table below includes a cross-section of participants in global gas markets including supermajors, US LNG exporters, Asian NOCs, utilities, trading houses, and commodity traders. The selection is not exhaustive but reflects a range of geographies, company types, and roles in the global gas system.

Table 1: Global Gas Players

Player	Typology	Selected Liquefaction Projects	Scale of Gas Trade and Market Position	Climate and Methane Commitments
Jera Japan	Gas and power utility	Freeport LNG, Wheatstone LNG, Darwin LNG, Gorgon LNG, Ichthys LNG	Jera reported LNG transaction volumes of 40 million tons (mmt) in FY 2020 (April 1, 2020, to March 31, 2021). It is the dominant gas and electricity provider in certain regions and has a broad footprint in fuel procurement, receiving, storage, power generation, and domestic sales.	Jera is targeting a 20 percent cut in CO2 emissions intensity by 2030 and net-zero emissions by 2050. It plans to rely on co-firing with ammonia and hydrogen to meet this target but "the use of CO2- free LNG is also being considered." a Japan has signed the Global Methane Pledge.
KOGAS South Korea	State gas utility	Mozambique Area 4, LNG Canada, Gladstone LNG, Prelude FLNG, Donggi-Senoro LNG	KOGAS is the world's second largest LNG-importing company after Jera and imported about 35 mmt of LNG in 2020. It has monopoly status in South Korea's wholesale gas sector (other gas companies import about 10 percent of South Korea's LNG). It operates five regasification terminals and a gas pipeline system of nearly 5,000 km.	KOGAS is targeting a 20 percent reduction in CO2 emissions by 2030 and net-zero status by 2045. Korea has signed the Global Methane Pledge and has a 2050 net-zero target.

Table 1: Global Gas Players Continued

Player	Typology	Selected Liquefaction Projects	Scale of Gas Trade and Market Position	Climate and Methane Commitments
CNPC China	National oil company	Yamal LNG, Arctic LNG 2, LNG Canada	CNPC produced 160 bcm in natural gas in 2020. CNPC is China's largest upstream oil and gas producer, is one of three dominant NOCs, and has extensive upstream and midstream assets in China. It also operates 19.3 mmt in regasification capacity.and a gas pipeline system of nearly 5,000 km.	CNPC's goal is to limit CO2 emissions after 2025 and reach "near zero" net emissions by 2050. It aims to reduce average methane emissions intensity by 50 percent by 2025 (over 2019 volumes). As part of a U.S. -China statement during COP26, China aims to "develop a comprehensive and ambitious National Action Plan on methane, aiming to achieve a significant effect on methane emissions control and reductions in the 2020s."
Qatar Energy Qatar	National oil company	Qatargas and RasGas LNG trains at Ras Laffan, North Field East expansion, Golden Pass LNG	Qatar Energy exported 77.1 mmt of LNG in 2020. The company has an extensive fleet of LNG vessels, has regasification capacity in several countries in Europe and elsewhere, has upstream oil and gas assets in numerous countries, and is a joint venture partner with ExxonMobil at the Golden Pass LNG project in the United States.	In November 2021 Qatar Energy, Pavilion Energy, and Chevron issued a new methodology to standardize measurement, reporting, and verification of GHG emissions for specific LNG cargoes. The SGE methodology "recognizes the importance of methane emissions in the transition to a low-carbon economy and is fully aligned with the complete and transparent reporting of methane emissions." Qatar Energy has joined the Oil and Gas Methane Partnership and has committed to direct measurement-based methane emissions accounting for their operated and non-operated assets.

Table 1: Global Gas Players Continued

Player	Typology	Selected Liquefaction Projects	Scale of Gas Trade and Market Position	Climate and Methane Commitments
Gazprom Russia	National oil company	Sakhalin -2, Ust- Luga. Pipeline assets include an extensive network to Europe and the Power of Siberia pipeline.	Gazprom is the world's largest gas producer by volume and operates the world's largest gas transmission system. In 2020 it produced 454 bcm, and it exported 175 bcm to Europe (including Turkey but excluding former Soviet Union countries). The majority state-owned company accounted for 66 percent of Russia's domestic gas production last year.	In 2020, Gazprom's reported methane emissions stood at 25.5 million tons of CO2 equivalent, or about 25 percent of its total GHG emissions, although most independent measurements suggest these self-reported numbers are a serious underestimation. Gazprom reports that it reduced methane emissions by 22 percent last year, compared to 2019. Gazprom aims to reduce methane emissions according to best practices from the Methane Guiding Principles but has not stated any specific quantitative targets.
Petronas Malaysia	National oil company	Petronas LNG (Bintulu T1 -9), PFLNG 1 and 2, Gladstone LNG, Egyptian LNG, LNG Canada	Petronas's LNG sales volume in 2021 was 33.1 mmt. The company is Malaysia's key producer, licensing body for domestic oil and gas, and equity partner in all domestic oil and gas fields. A partly listed subsidiary manages domestic gas distribution.	In 2020, Petronas quantified methane emissions from its LNG facilities and its domestic gas subsidiary, Petronas Gas Berhad, but has not yet disclosed detailed data. In 2021, it planned to quantify methane emissions throughout the upstream sector. Malaysia has signed the Global Methane Pledge.

Table 1: Global Gas Players Continued

Player	Typology	Selected Liquefaction Projects	Scale of Gas Trade and Market Position	Climate and Methane Commitments
Shell Netherlands / UK	Supermajor	Qatargas 4, LNG Canada, Gorgon LNG, North West Shelf, Queensland Curtis, NLNG, Oman LNG, Atlantic LNG, Brunei LNG, ELNG (Idku)	Globally, Shell's LNG sales volume in 2020 was 69.7 mmt. It holds the largest LNG portfolio among the supermajors. It is optimistic about long-term gas and LNG demand, viewing gas as an energy source that can partner with renewables and appeal to a range of customers in a decarbonizing world. Shell suggests that the LNG industry will have to offer cleaner energy supplies to help customers meet net-zero targets.	Shell's reported methane emissions in 2020 stood at 67,000 tons, compared with 91,000 tons in 2019, with 60 percent coming from flaring and venting. Shell aims to keep methane emissions intensity levels below 0.2 percent for its operated assets by 2025 (backed by empirically measured data in line with Shell's participation in OGMP 2.0). Shell shared recommendations with the European Commission on forthcoming methane regulations, and it supports EPA regulations of methane from the U.S. oil and gas sector under the Clean Air Act.
Cheniere United States	LNG exporter	Sabine Pass LNG, Corpus Christi LNG	Cheniere exported 25.6 mmt in LNG volumes in 2020. When Sabine Pass Train 6 is completed, it will have 45 mmtpa in liquefaction capacity at Sabine Pass and Corpus Christi.	In August 2021 Cheniere published a detailed life cycle analysis of GHG emissions specific to its supply chain from wellhead to delivery point. The company is offering "cargo emissions tags" to estimate GHG emissions associated with each particular LNG cargo. Cheniere published a peer- reviewed study showing its calculations. It aims to satisfy future market needs and establish a potential competitive advantage by offering this type of detailed emissions accounting to customers.

Table 1: Global Gas Players Continued

Player	Typology	Selected Liquefaction Projects	Scale of Gas Trade and Market Position	Climate and Methane Commitments
Vitol Switzerland	Commodity trader	Vitol is a large LNG buyer and trader but does not hold equity stakes in liquefaction projects.	Vitol traded 10 mmt in LNG cargoes in 2020. Vitol is a privately held commodity trading house, competing with other traders and portfolio players.	Vitol provides a "Green LNG" offering for customers to mitigate emissions, relying on market solutions such as offsets and renewable energy credits. It aims to provide "carbon neutral solutions for individual LNG cargoes or for the whole supply chain from wellhead to customer."
Mitsui Japan	Trading house	North West Shelf, ADNOC LNG, Qatargas 1-3, Sakhalin -2, Oman LNG, Cameron LNG, Mozambique LNG, Arctic LNG 2	The start -up of Cameron LNG Train 3 was expected to raise Mitsui's equity LNG volumes to about 8 mmt. Mitsui is one of Japan's largest trading houses.	Mitsui has set a 2050 net-zero emissions target and aims to cut emissions in half by 2030 from 2020 volumes.

Source: CSIS research based on company reports, investor presentations, and media reports.

Appendix 2: Select LNG Projects

The table below includes a sampling of LNG projects that includes a range of geographies, equity investors, lenders and trade insurance companies.

Table 2: Selected LNG Projects

Project	Capacity mmtpa*	Equity Stakeholders	Cost $ billion**	Selected Lenders and Insurers $ billion***	
Yamal LNG Russia	17.4 (Trains 1 -4)	Novatek, TotalEnergies, CNPC, Silk Road Fund	$27 billion (Trains 1-3)	• China Ex-Im Bank • China Development Bank • National Welfare Fund of Russia • Japan Bank for International Cooperation (JBIC)	$10.6 $1.5 $2.3 $0.21
Mozambique LNG Mozambique	13.1 (Trains 1-2)	TotalEnergies, ENH (Mozambique), Mitsui, ONGC, ONGC/Oil India, Bharat Petroleum, PTTEP	$20 billion	• U.S. Ex -Im Bank • JBIC • Nippon Export and Investment Insurance (NEXI) • SACE (Italy) • African Development Bank	$4.7 $3.0 $2.0 $0.95 $0.4
Sabine Pass United States	30 (Trains 1-6)	Cheniere, Blackstone Infrastructure, Brookfield Infrastructure	$20 billion	• T1-4: Bank consortium • T 1-4: Korea Eximbank (KEXIM), Korea Trade Insurance Corporation (K -SURE) • T5: Syndicated bank loans • T5: KEXIM • T5: K-SURE • T6: Bank consortium, including MUFG	$4.4 $1.5 $2.85 $1.0 $0.75 $1.5

Table 2: Selected LNG Projects Continued

Project	Capacity mmtpa*	Equity Stakeholders	Cost $ billion**	Selected Lenders and Insurers $ billion***
Cameron LNG United States	13.5 (Trains 1-3)	Sempra, TotalEnergies, Mitsubishi/NYK, Mitsui	$10 billion	• Project bonds $3.0 • Commercial banks, insured by NEXI $2.0 • JBIC $2.5
Freeport LNG United States	15 (Trains 1-3)	Freeport, Jera, Osaka Gas, Zachry Hastings, DOW Chemical, Buckeye Partners	$12.5 billion	• T1: Bank consortium $3.0 including $2.5 billion from JBIC • T2: Bank consortium $2.0 • T3: Bank consortium $2.5
LNG Canada Canada	14 (Trains 1-2)	Shell, Petronas, PetroChina, Mitsubishi, KOGAS	$31 billion	• Bank consortium $1.0 • JBIC $0.85

Source: CSIS research based on company reports and investor presentations as well as media reports.

*Million tons per annum.
**Some figures cited are for full costs, while some are liquefaction costs only.
***Includes loans, loan guarantees by ECAs, and trade insurance cover by insurance companies.

Appendix 3: Further reading

The Burning Question: How to Fix Flaring

A review of the flaring performance of 20 major oil and gas companies and presents recommendations for investors and other stakeholders to reduce the associated environmental, social and financial risks.

OGMP Investor Guide

Guidance from EDF and UNEP on the Oil and Gas Methane Partnership (OGMP), a first-of-its-kind reporting framework designed to improve the clarity and credibility of oil and gas industry methane emissions data.

Emission Omission

Shareholder engagement guidance from EDF and Rockefeller Asset Management highlighting investment risks from a vast portfolio of oil and gas production assets, which have largely been excluded from ESG oversight because they are operated by third parties.

Private Equity Methane Solutions Site

EDF's landing page for private equity and operators offering tools, resources, and readings on methane management.

Methane Action at National Oil Companies

Research from Carbon Limits examining the essential role of NOCs to accelerate global methane reductions.