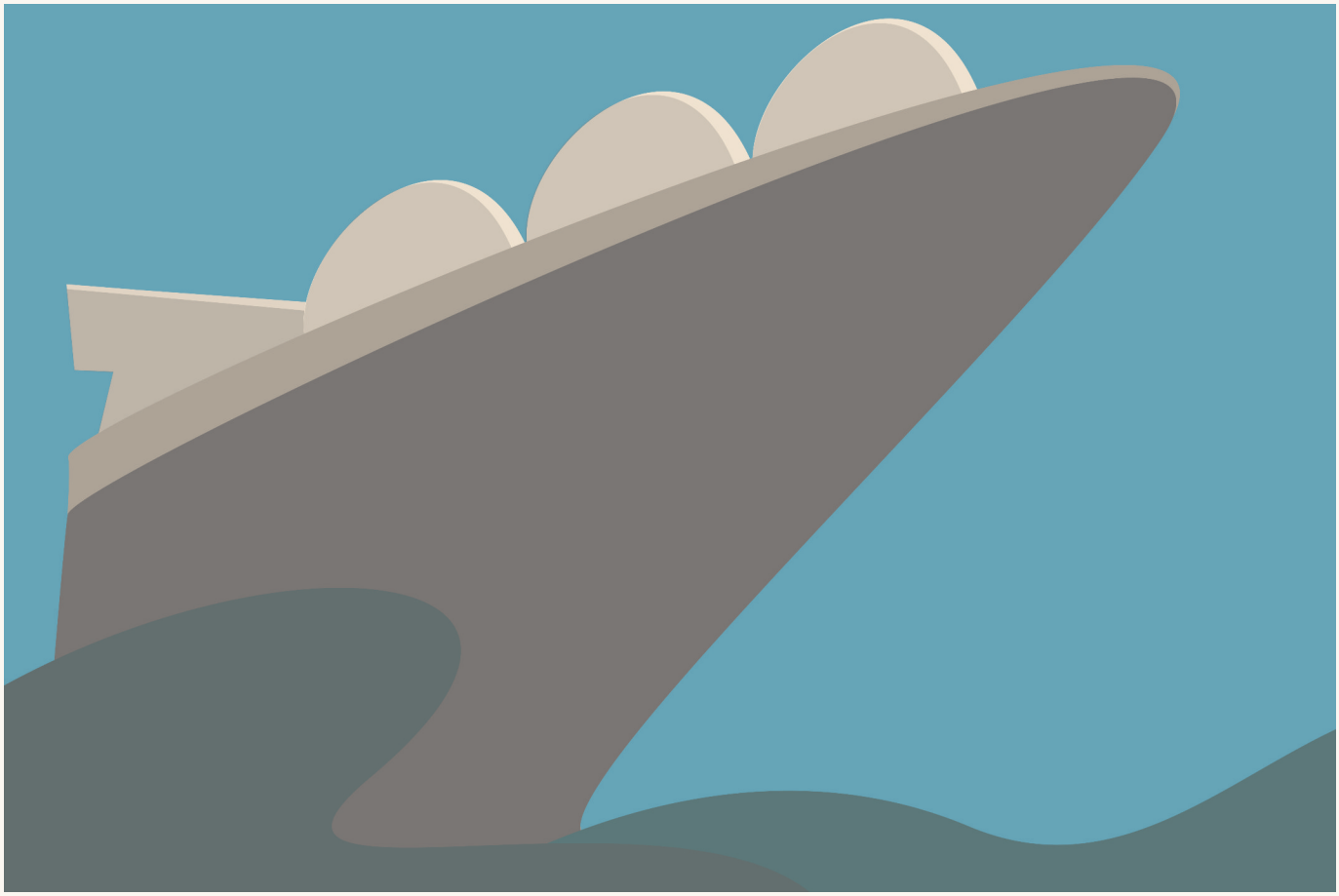
Viewfinder

ESG issues in critical focus

DISCERN sustainability

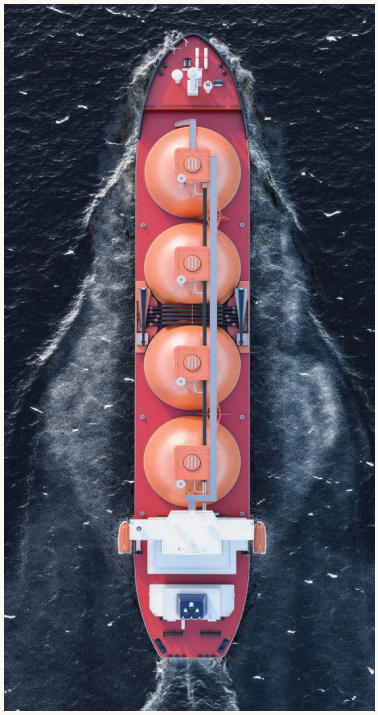
All aboard?



What to ask oil and gas companies about LNG

KEY TAKEAWAYS

- LNG is poised for huge expansion, promoted as low-pollution, lower carbon
- LNG's emissions profile still does well against coal but will get worse in relative terms to pipeline gas as more low-quality assets become un-stranded
- A list of questions investors can ask LNG producers on emissions and scenario planning
- For < 2°C warming, natural gas is not the answer. It's not even an answer.



ENERGY ECONOMICS

Simple is better

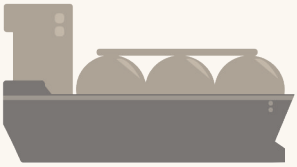
There is a faithful principle to keep handy when assessing which fuel source is more emissions-intensive than another; obvious enough to be overlooked, inconvenient enough to be ignored. The more 'work' you have to perform in order to get it in a fit state for consumption, the more absolute CO_2e it will emit over its lifecycle. Consequently, the lower quality and greater complexity of your starting material, the more work it requires.

When you further encumber treatment with elaborate transport methods to reach the point of end-use, the emissions profile (and a lot else) can get ugly. Exhibit A, for the operation of this principle is tar sands, the oil-soaked bitumen exhumed from beneath forests, washed, pummelled, upgraded and refined to a quality that is passable to put in your engine.

What requires more 'work' to make unfit into fit is also more expensive. It is for this reason that exotic sources have been the marginal source of supply. They add the extra when high prices support them. Under a theoretical global government, to the extent we needed oil and gas at all it would be logical and responsible to first exhaust the light, sweet oil and gas that gushes forth so obligingly in the Arabian Peninsula until the last well there ran dry.

Un-stranding

Those conditions not prevailing, the relentless drive of technology has progressively allowed physically stranded assets to become un-stranded. What was once unconventional has become conventional through the facilitation of ingenious technology and its aggressive propagator: falling prices. This is what enabled economic exploitation of the tar sands, mined only artisanally since the 19th century, on an industrial scale. The same dynamics underly the dramatic growth of Liquified Natural Gas (LNG).



PRIMER ON LNG: SIMPLIFIED LIFECYCLE

Natural gas resources that are too far away to build a pipeline to customers are tapped at source

The raw feedstock, which can contain various proportions of methane, sulphur, carbon dioxide, mercury, benzine and hydrates undergoes separation

At the nearest purpose-built port facility, an LNG 'train' further separates, purifies and chills to -161°C using heat exchangers so it can be safely liquified: compressed to 1/600th of its gaseous density and stored (now at least 90% methane)

The gas is transferred to specially built tankers that keep the LNG liquid under transport and shipped

On arrival, the LNG is unloaded at its destination and or re-exported at special facilities where it is re-gasified using vapourisers and then injected into the local grid or trucked to its point of combustion

Recent innovations have created stationary and even floating (FLNG) combined gas platforms/LNG trains at sea. Tankers can collect and go straight to destination. Ships too can be fuelled by LNG (bunker LNG) and get a boost from shipping regulations cutting sulphur and carbon content from traditional vessels

For greenhouse gases (GHG) management, there is the need to distinguish between; cleaned up molecules of CH4/methane, which are the valuable molecules companies want to capture as much as is economic; fugitive methane emissions (those that are lost in the chain); Scope 1 CO_2 that is vented deliberately for want of economic incentive and; Scope 2 CO_2 generated indirectly through energy use in the project, itself.

Why is LNG growing? Economics and Environment

LNG surged in the first decade of the century, led by companies such as BG, subsequently bought by Shell. According to the International Gas Union's (IGU) 2018 World LNG Report, in 2017 trade in LNG grew 12%. China and South Korea lead demand. Qatar and Australia occupy number one and two supply positions. The US continues to open new port facilities to export and retain its dominant hydrocarbon position, based on the shale and tight oil and gas revolution. Malaysia, Indonesia, Russia and Cameroon are also joining the fray.

The International Energy Agency in its New Policies Scenario (NPS) assumes the commitments given under the Paris Accord are largely implemented but not improved upon. In NPS, it expects "trade in LNG more than doubles [by 2040] in response to rising demand from developing economies."

The obvious driver is greater energy demand led by emerging markets and the low cost of input gas at under $5/MMBtu (driven down by fracking). At its back however, natural gas has definite environmental advantages over the traditional incumbent: coal. Substituting LNG for coal in power generation typically results in huge cuts in local pollutants like SOx, NOx, mercury and Particulate Matter. The same is true for heavy vehicles using LNG compared to diesel. As we will see, depending on the origin of the gas, there is also a significant reduction in CO_2 compared to coal. This is taken for granted in moderate climate policies and promoted vigorously by the oil and gas companies as the flexible partner for renewables.

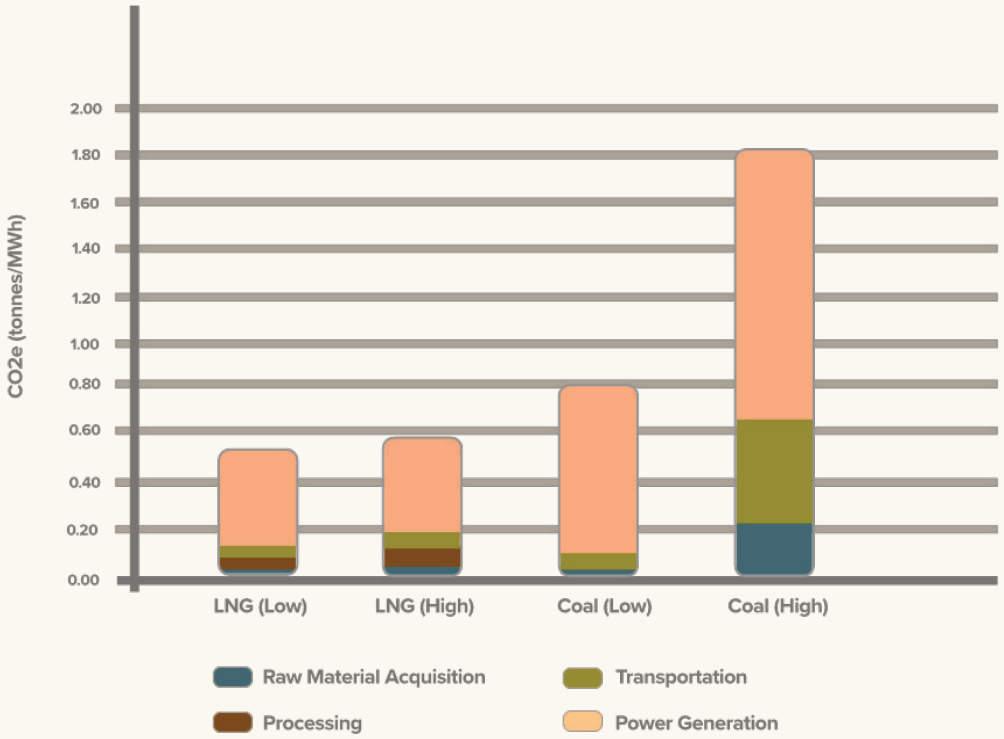
Just how good are LNG's stated greenhouse gas credentials?

Data are surprisingly few. A 2015 paper by the IGU in preparation for the UN Paris negotiations contains the following table.

Comparison of LCA Results for Primary Energy Production and Delivery (Coal and LNG) from the CLNG Study

	Low GHG Case		High GHG Case	
LNG LCA	**CO_{2e} (tonnes/MWh)**	**% of Total**	**CO_{2e} (tonnes/MWh)**	**% of Total**
Raw Material Acquisition	0.017	3.4%	0.021	3.7%
Processing	0.064	12.9%	0.104	18.4%
Transportation	0.051	10.3%	0.074	13.1%
Power Generation	0.365	73.4%	0.365	64.7%
Total:	**0.497**	**100.0%**	**0.564**	**100.0%**

	Installed Power Plant (Range, All countries)	New-Build Power Plant (Range, All countries)
Coal LCA	**CO_{2e} (tonnes/MWh)**	**CO_{2e} (tonnes/MWh)**
Raw Material Acquisition	0.018-0.232	0.017-0.191
Processing	------	------
Transportation	0.036-0.424	0.036-0.352
Power Generation	0.909-1.166	0.748-0.884
Total:	**1.071-1.499**	**0.870-1.158**

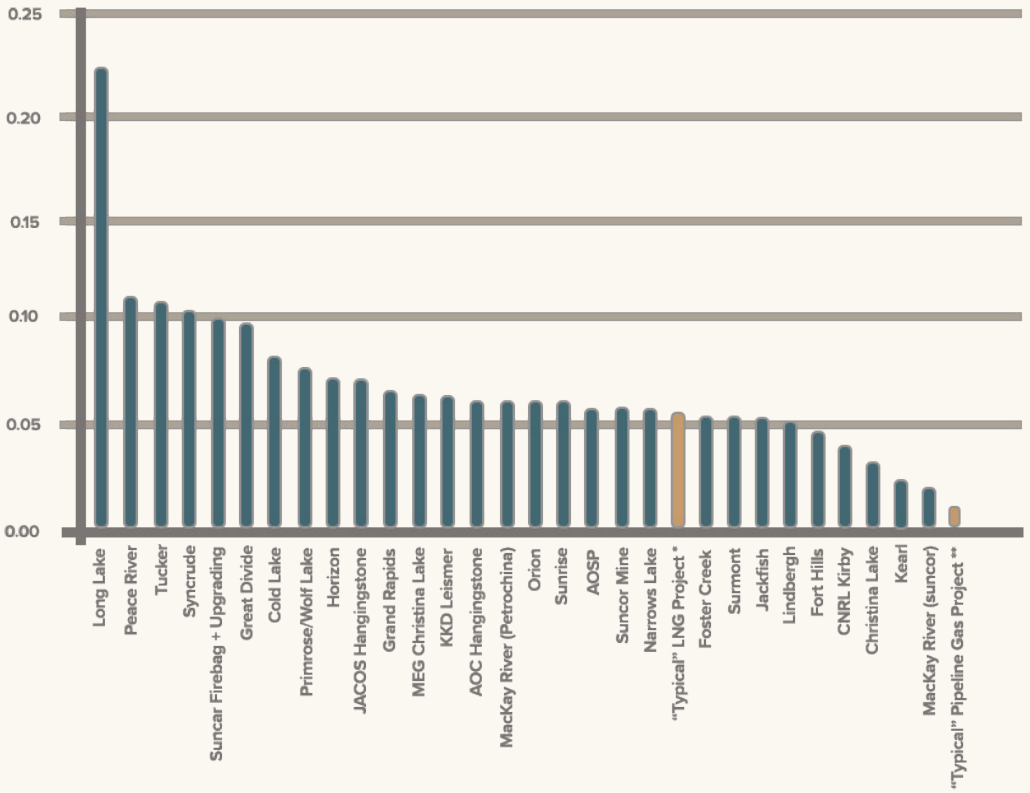


International Gas Union: LNG versus Coal

The IGU graph says LNG can deliver major cuts in CO_2e compared to typical coal. The results are consistent with a paper produced in 2014 by the US Energy Department. While not peer reviewed, it appears well designed and controlled to reflect real-life conditions and variables. It compared the lifecycle emissions analysis (LCA) of natural gas derived from the Marcellus Shale region of the US (mostly fracking) and shipped as LNG to Europe or Asia to the incumbent gas sources. The paper found that 100-year Global Warming Potential emissions intensity were similar. It found no penalty for US LNG compared to the largest existing source for Europe, with similar results to LNG via Algeria to Europe.

But the Marcellus may not be representative of LNG's future sources of growth. In 2017, to its credit, the favourite consultancy of the oil and gas industry, Wood Mackenzie put out a report, cautioning that not all gas projects are created equal, in terms of emissions. It contained the following striking graphic.

Emissions intensities of 'typical' natural gas projects in comparison with selected Canadian oil sands projects

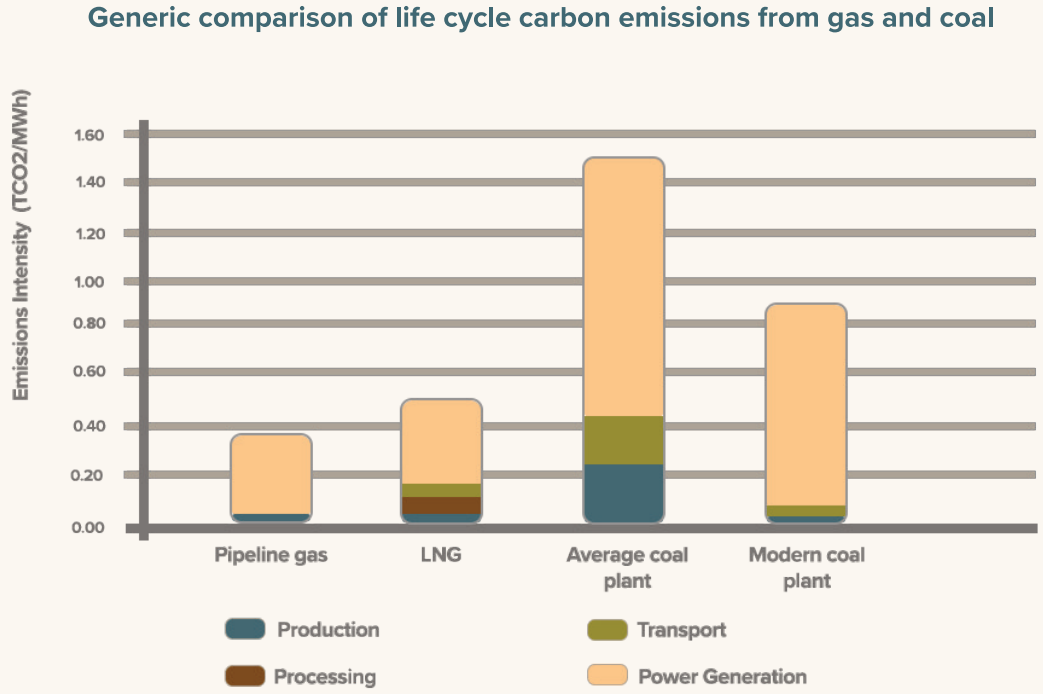


*Typical LNG Project includes 5% CO_2 which is separated and vented prior to liquefaction (includes upstream and liquefaction emissions)
** Typical Pipeline Gas Project assumes no CO_2 is vented as part of the upstream development
NB Gas projects do not include GWP of methane fugitive emissions

Source: Wood Mackenzie

This upstream analysis, based on asset-by-asset granular assessment, found that the typical LNG project is scarcely any better on CO_2e per barrel of oil equivalent than typical mature tar sands mines like AOSP and the Suncor Mine-and about six times worse than pipeline gas!

It must be stressed that we are only talking about upstream emissions here, where the minority of total emissions over the lifecycle occur (the majority occurring at combustion). The fact remains that the average LNG-derived gas, though somewhat worse than pipeline gas for lifecycle emissions, still offers significant cuts on lifecycle emissions from modern coal plant. Nevertheless, few would have expected that the best oil sands project is better than the worst LNG project, even for upstream emissions.

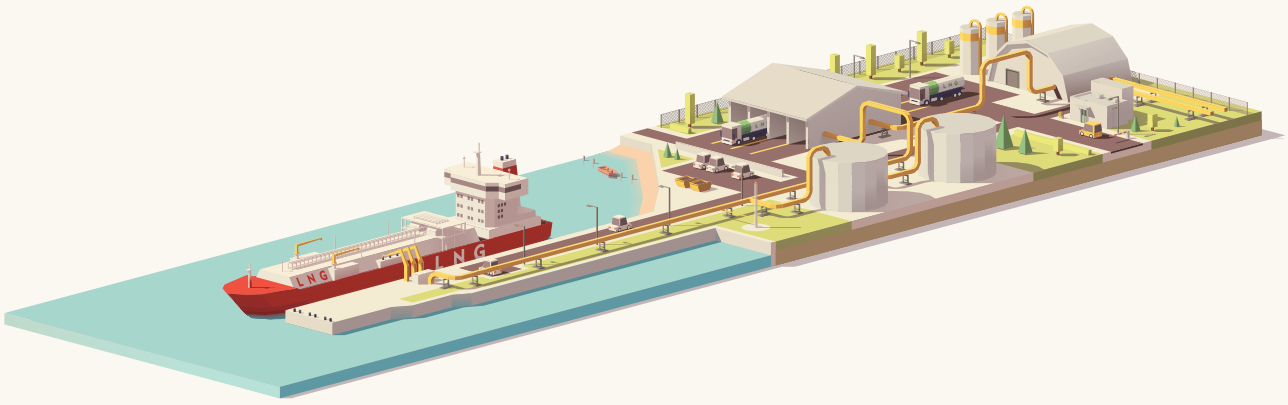


Source: Wood Mackenzie

What spikes LNG upstream emissions

There are four factors to look at that are distinctive or influential relative to conventional, piped gas that account for this emissions intensity:

1. The quality and purity of the raw source material
2. The preparation of the source material for liquification
3. Marine transportation
4. Re-gasification



As noted, publicly available data for LCAs of Liquified Natural Gas are thin.The American Petroleum Institute has published a protocol and inventory and, in it, the table that is most consistent with indications from other industry sources in terms of the intensity hotspot is below. Note that value given for flared GHGs for sour is, in each case, about twice that of sweet in developed countries. Clearly, it is the quality of the feedstock and energy intensity of the liquification process that account for the greatest CO_2e penalty.

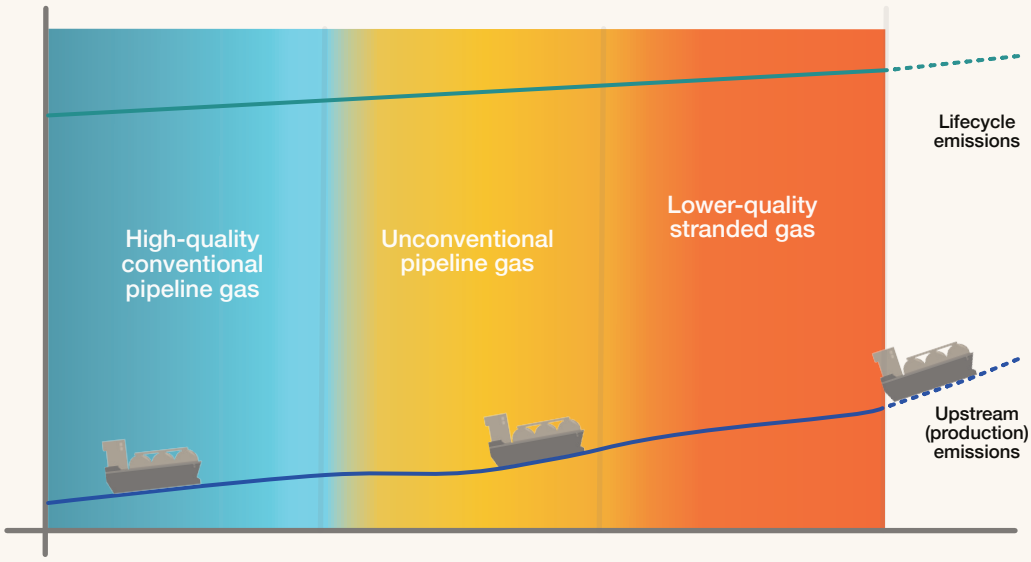
GHG Emission Factors for Gas Flares in Gas Processing and Liquefaction [a]

Flare Source	Units [b]	CO_2	CH_4	N_2O
Developed Countries				
Sweet Gas Processing (H_2S < 4ppm)	$Gg/10^6m^3$ (raw gas feed)	$1.8*10^{-3}$	$1.2*10^{-6}$	$2.5*10^{-8}$
	$tonnes/10^6 scf$ (raw gas feed)	$5.1*10^{-2}$	$3.4*10^{-5}$	$7.1*10^{-7}$
Sour Gas Processing (H_2S > 4ppm)	$Gg/10^6m^3$ (raw gas feed)	$3.6*10^{-3}$	$2.4*10^{-6}$	$5.4*10^{-8}$
	$tonnes/10^6 scf$ (raw gas feed)	0.10	$6.8*10^{-5}$	$1.5*10^{-6}$
Other Countries				
Sweet Gas Processing (H_2S < 4ppm)	$Gg/10^6m^3$ (raw gas feed)	$1.8*10^{-3}$ - $2.5*10^{-3}$	$1.2*10^{-6}$ - $1.6*10^{-6}$	$2.5*10^{-8}$- $3.4*10^{-8}$
	$tonnes/10^6 scf$ (raw gas feed)	$5.1*10^{-2}$ - $7.1*10^{-2}$	$3.4*10^{-5}$ - $4.5*10^{-5}$	$7.1*10^{-7}$- $9.6*10^{-7}$
Sour Gas Processing (H_2S > 4ppm)	$Gg/10^6m^3$ (raw gas feed)	$3.6*10^{-3}$ - $4.9*10^{-3}$	$2.4*10^{-6}$ - $3.3*10^{-6}$	$5.4*10^{-8}$- $7.4*10^{-8}$
	$tonnes/10^6 scf$ (raw gas feed)	0.10 – 0.14	$6.8*10^{-5}$ – $9.3*10^{-5}$	$1.5*10^{-6}$ – $2.1*10^{-6}$

(a) IPCC, 2006 IPCC Guidelines
(b) Extracted from Tables 14-11 and 14-12 of the 2009 API Compendium which converted the metric units presented by the IPCC to English tables
(c) Per IPCC designation this refers to developing countries with economies in transition

Source: American Petroleum Institute

The naturally occurring, Scope 1 CO_2 that is mixed in with the valuable methane is, absent strong carbon prices, cheaper to flare than to sequester. WoodMac says a few of the dirtiest, poorest quality source material; sour, acid and wet gas with high sulphur and associated CO_2 are skewing the average for LNG.



ACTIONS FOR INVESTORS

To know what the dirtiest LNG projects are and if you hold them, you could buy WoodMac's or a competitor's dataset. You could also ask your LNG-heavy producers the following questions, using the Taskforce for Climate-related Financial Disclosures (TCFD) framework.

Governance

- Can you show how the emissions lifecycle differentials within your hydrocarbon portfolio are factored into your TCFD scenario planning? Do LNG or certain LNG projects inhibit achievement of company policy GHG reduction goals e.g. production emissions?
- How does your internal price of carbon affect the merit order for Final Investment Decisions (FID)? Is LNG carbon price sensitive?

Strategy

- Is the portfolio tilting toward acid/sour gas and condensate and how is this affecting the emissions profile?
- Do you expect to make use of Floating LNG facilities to un-strand assets and will these be used to access only high-quality/sweet reserves?

Risk Management

- What operational measures are you taking to flatten the emissions intensity of LNG projects compared to pipeline gas and are any step-changes on the horizon?
- Taking Chevron's Gorgon project as an example, what scope is there, geologically and economically, for Carbon Capture and Storage for your assets?

Metrics & Targets

- Can you outline the LCA and boundaries for your existing and planned LNG projects?
- How does the CO_2e footprint of your LNG compare to your pipeline gas assets; are there any outliers, and why?

Liquid dreams: what are the companies saying?

Exxon Mobil and Chevron describe LNG as 'cleaner burning'. Those words are chosen advisedly. At the point of combustion, the local and global pollution benefits hold when compared to coal for power and diesel for engines. BP and Shell are more ebullient, asserting that LNG and their respective carbon policy goals as compatible.

However, this confidence does not sit easily with WoodMac's projections, here. LNG is estimated to become the second-largest absolute source of upstream emissions from all oil and gas sources, after conventional onshore oil (the current main source) and the third-worst for upstream CO_2 intensity. Tar sands is in worst place and heavy oil in second-worst.

This puts LNG in the bottom quartile of the oil and gas peer group for production emissions. That goes for both absolute (projected share of market) and intensity measures. The oil and gas companies will say this is focussing excessively on production emissions when they account only for a minority of lifecycle emissions. They have a point. Indeed, even under the Agency's recent and most ambitious Sustainable Development Scenario that aimed to keep us < 2° C of global warming, natural gas grows its share of a fossils market - a market that peaks early and then shrinks.

Chevron's Gorgon LNG project will use Carbon Capture and Storage to deal with associated CO_2
(Photo courtesy of Chevron)

But it is not much of an argument to sanction exotic 30-plus year investments amid a climate emergency with the defence that is OK to go for dirtier forms of gas, because, well, the incumbent, coal, which is already being phased and competed out in many countries, is dirtier still. Global emissions have resumed their upward trend. As widely reported, the door is closing on 2°C, if not already shut. This through-the-looking-glass incrementalism is the opposite of what we need.

The Task Force on Climate Related Financial Disclosures

CONCLUSIONS

For as long as natural gas must be in the mix, circumspection and a forensic approach are needed to understand its role in companies' portfolios.

Climate discipline should be explicit in all FIDs to avoiding making policy goals harder to achieve. As an investor, if you have a fund climate strategy that allows what you deem progressive hydrocarbon companies, you have an obligation to be sharp on the detail. Do not accept a superficial 'gas is good' narrative. After all, this 'running to stay somewhat less behind' approach on environmental impact was a significant contributor to two of the aforementioned supermajors getting out of tar sands. We are convinced they will not be the last.

Speaking of policy goals, there are much bigger questions that will eclipse the LNG versus pipeline gas differential. How much more gas can we, as a planet, burn without frying? The perils of ensconcing gas as a false friend, difficult to evict after its initial charms have worn off have been widely discussed. As we have seen, stranding is actually not a new phenomenon. Many companies now accept the principle of environmental stranding.

Do your companies still assume that, for reasons known only to them, it will always be their resources that will receive grace and favour, in the event of a correction? If so, we suggest you ask them to justify that.

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