Carbon-Neutral LNG

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Over the past two years, the global pandemic has decimated economies and industries around the world and has led to considerable volatility in energy prices. Demand has contracted and expanded as economies have faced setbacks and then made progress, with unprecedented volatility in the liquefied natural gas ("**LNG**") market having been compounded recently by a series of supply-side disruptions and economic recovery. There has also been high seasonal demand for LNG – especially in China, which increased LNG imports by approximately 18% in 2021 and has now surpassed Japan as the top importer of LNG.[1]

The price of spot LNG in Asia Pacific has seen significant price swings, with the Platts JKM benchmark recording an all-time low of U.S.$1.825/MMBtu on 28 April 2020 and then sky-rocketing to a then-record high of U.S.$56.326/MMBtu on 6 October 2021, at the time its highest level since the inception of the benchmark in 2009.[2] The current JKM monthly average is U.S.$24.815/MMBtu for March 2022 deliveries. Spot transactions are estimated to account for approximately 30-35% of all LNG trades globally, with most trades conducted under short, medium and long term contracts.

As well as surging prices, there has also been a surge in 'carbon-neutral' LNG transactions since the first trade in 2019, with over 30 carbon-neutral LNG cargoes having been traded to date. Against this backdrop, and the gathering momentum for the energy transition and the recent 2021 United Nations Climate Change Conference ("**COP26**"), we analyse carbon-neutral LNG transactions and consider the measurement of carbon emissions and carbon-neutral LNG transaction reporting, with a view to establishing whether carbon-neutral LNG trades are the beginning of a new paradigm that the LNG industry will need to adopt in order to address the requirements of governments, customers and industry stakeholders.

WHAT IS CARBON-NEUTRAL LNG?

LNG contains hydrocarbons. In order for an LNG cargo to become carbon-neutral or carbon-offset, the counterparties involved must take actions to offset the greenhouse gas ("**GHG**") emissions from all or part of the LNG value chain in the production, transportation and use of a cargo of LNG. This is achieved by the acquisition and retirement of carbon credits.

LNG EMISSIONS

The first step in a carbon-neutral LNG transaction is to calculate the emissions from the LNG value chain, which are typically measured in carbon dioxide equivalent ("**CO_2e**") to account for the emission of GHGs other than CO_2.[3] Measurement of certain of these emissions is challenging – downstream combustion emissions

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can be measured based on the amount of GHGs produced when regasified LNG is burned, whereas measuring well-to-tank ("**WTT**") emissions is more complex. Downstream power generation emissions from LNG are estimated to account for approximately 70% of the lifecycle GHG footprint of LNG.[4]

Historically, there has not been an industry-wide accepted methodology for measuring emissions from each stage of the value chain, which has required parties to carbon-neutral LNG transactions to use proprietary methodologies to calculate the emissions to be offset. Recently, however, a number of organisations have released standardised methodologies, with the aim of making GHG offsetting more objective and transparent.

The International Group of Liquefied Natural Gas Importers ("**GIIGNL**") recently published a Monitoring, Reporting and Verification and GHG Neutral LNG Framework[5] (the "**GIIGNL Framework**") that aims to "*promote a consistent definition of 'GHG Neutral' LNG as well as disclosure of verified emissions based on sound GHG accounting criteria and definitions*" and is designed to be used by any entity responsible for reporting the GHG footprint of an LNG cargo or making a claim regarding GHG emission reductions, offsetting or carbon neutrality. The steering committee of companies who were involved in the development of the GIIGNL Framework included Cheniere Energy, CNOOC, Engie, JERA, Shell, Tokyo Gas, TotalEnergies and Pavilion Energy, all of which have been active in the nascent carbon-neutral LNG market. The GIIGNL Framework contains a set of guidelines on the monitoring, reporting, reduction, offsetting and verification of GHG emissions from the LNG value chain. In brief, the GIIGNL Framework sets out five "*declaration pathways*" which parties may adopt, depending on the extent to which GHG emissions are mitigated from different "*LNG life cycle stages*" including drilling, production, gathering and processing, transportation, liquefaction, storage and loading, shipping, unloading, reloading and regasification, and then downstream activities including gas transmission, storage, distribution and end use.

Under the GIIGNL Framework, GHG-neutral LNG requires:

1. reference standards for quantifying GHG emissions (e.g. PAS 2060:2014, an international standard for determining carbon neutrality);
2. a set scope and basis of reporting GHG emissions;
3. documentation and implementation of a method of calculating the GHG footprint, which should be reviewed annually;
4. identification of any "*low GHG features*" (any passive advantages already associated with a supply source, e.g. flare and venting elimination, and carbon capture and storage technology);
5. development of a GHG emissions reduction plan;
6. establishment of an offset strategy which sets out the criteria for the selection of projects and the standard used, selection of verified carbon credits, maintenance of evidence that the carbon credits are transparently retired on a third-party registry and disclosure of the carbon credits in a statement of the LNG cargo (including the number of carbon credits acquired from each project);
7. preparation of the cargo statement, which may use the GIIGNL template; and
8. verification from an independent third party as to the details of the relevant cargo or cargoes and the claims regarding emissions, reductions and offsetting.

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An alternative methodology for measuring and reporting GHG emissions from certain stages of the LNG value chain, the 'Statement of Greenhouse Gas Emissions' or SGE methodology, published jointly by Pavilion Energy, QatarEnergy and Chevron on 17 November 2021, can also now be used. It "*aims to create a common standard for the measurement, reporting and verification of the GHG emissions associated with producing and delivering an LNG cargo to drive greater transparency and enable stronger action on GHG reduction measures*" and has been reviewed by independent academic experts, commercial institutions and verification bodies.[6] It has been applied to LNG sale and purchase agreements between Pavilion Energy and the two suppliers and may be used by other LNG suppliers. The GIIGNL Framework and the SGE methodology are intended to account for CO_2, methane and nitrous oxide, although the SGE methodology excludes emissions from regasification, distribution and end use.

Data compiled by S&P Global Platts suggests that market practice has trended towards offsetting emissions from the entire LNG value chain but, ultimately, parties have to decide whether to offset full lifecycle emissions, or only to offset emissions from specific parts of the LNG value chain (e.g. well-to-flange or combustion only). The GIIGNL Framework and the SGE methodology will contribute to greater transparency in publicly announced carbon-neutral LNG transactions in the coming years.

CARBON CREDITS

Having established the emissions to be offset, parties must determine the carbon credits required to offset those emissions and from where the carbon credits will be sourced. Each carbon credit represents one tonne of GHGs on a CO_2e basis. For context, according to GIIGNL, approximately 5,970 LNG cargoes were delivered in 2020 (an almost 10% increase from 2019, 2021 data from GIIGNL is not yet available). Assuming that each LNG cargo had full lifecycle emissions of approximately 250,000 metric tonnes of CO_2e[7] (although, of course, this will vary widely), the emissions from LNG cargoes delivered in 2020 could have amounted to approximately 1.5 billion metric tonnes of CO_2e.

Carbon offset registries (such as the one run by the non-profit organisation, Verra) assess offset projects and programs and issue carbon credits where there are measurable and verifiable emission reductions which satisfy an agreed standard. A serial number is assigned to each carbon credit and the owner of the credit is recorded in the registry, allowing credits to be transparently sold and transferred.

Where carbon credits are labelled by carbon crediting programs, participants selling or transferring the credits rely on the standards that the program has in place to ensure the legitimacy of the credits. According to Verra, only projects certified against the 'Verified Carbon Standard' ("**VCS**")[8] are issued tradable carbon credits (which Verra calls 'Verified Carbon Units' ("**VCUs**")). These projects are subject to desk and field audits by independent third parties and by Verra staff in order to ensure that the projects are compliant with the VCS. Verra's registry contains information on certified projects and on issued and retired VCUs, enabling participants in transactions to verify that the VCUs have been properly issued and can be retired. Once a company which is seeking to offset its emissions retires a credit for this purpose, the credit can no longer be traded.

Carbon credits may be transferred between account holders with a specific registry and may also be traded on carbon exchanges, which allow participants to buy and sell carbon credits or tokens representing carbon credits. In the voluntary carbon markets, government regulation is typically not present and

parties can voluntarily purchase carbon credits to offset their carbon footprint for their own purposes. As well as existing carbon exchanges, there are alternative carbon markets in the pipeline such as the proposed London Stock Exchange voluntary carbon market which plans to increase access to capital for GHG mitigation projects by allowing funds to list and to issue carbon credits generated by projects held in their vehicles as dividends.

There are a number of types of carbon offset projects, including forestry, renewable energy, waste-to-energy, energy efficiency, alternative fuel and GHG abatement. According to Kenneth Foo, Managing Editor of S&P Global Platts' Asia LNG pricing team, participants in carbon-neutral LNG transactions have typically acquired carbon credits linked to nature-based (often forestry) projects either from third party registries or from the portfolio of the LNG supplier.

Nature-based projects aim to protect, transform or restore land and enable nature to add oxygen to, and absorb CO_2 emissions from, the atmosphere, through activities such as forestry restoration and afforestation. Carbon credits may also be issued to other types of projects, such as technology-based projects that reduce or capture GHG emissions.

However, concerns have been raised with respect to the use of older carbon credits because offset projects may not be monitored after the issuance of the carbon credits. Where projects are not maintained, the quality and effectiveness of the carbon credits may not be as initially envisaged. Nevertheless, there is no effect on calculations when they are used to offset emissions, which can lead to older (or stale) carbon credits being more attractive to buyers because they are cheaper and have the same accounting value.[9] In order to ensure that carbon credits are effective, offset projects need to be monitored on an ongoing basis to ensure that they are still mitigating emissions as anticipated.

PRICING

The pricing of carbon credits depends on numerous factors, including the source of the carbon credit and the nature of the underlying project, and pricing can vary significantly. S&P Global Platts' 'CNC' daily price assessment, which reflects the spot market for nature-based carbon credits, has risen significantly, from U.S.$4.70/metric tonne CO_2e at the launch of the assessment on 14 June 2021 to U.S.$11.30/metric tonne CO_2e on 8 March 2022, due largely to increased demand in order to satisfy environmental targets and investor concerns and an insufficiency of newer credits, as well as increased interest in trading carbon credits as investments.[10]

However, some reports have suggested that these prices are still too low to encourage a switch from coal to gas in Asia and that a carbon price of U.S.$20 to U.S.$50 per ton would bring gas and coal to cost equivalence, but that a much higher carbon

price of U.S.$125 per ton would be required to keep global temperature rises in line with the Paris Agreement's long term temperature goal.[11]

Fluctuating prices mean that the cost associated with making an LNG cargo carbon-neutral is variable. As between the parties to a carbon-neutral LNG transaction, allocation of the cost is a matter for negotiation. Foo notes that, in carbon-neutral LNG transactions where full lifecycle emissions are offset, buyers could be willing to cover the cost of carbon credits in respect of downstream and combustion emissions, while sellers could be willing to cover a large portion of the cost of carbon credits in respect of WTT emissions. For downstream gas purchasers, this may ultimately be reflected in higher prices given the additional costs incurred for a carbon-neutral LNG cargo.

To aid understanding of the pricing of carbon-neutral LNG, S&P Global Platts has launched the 'CNL' suite of carbon-neutral LNG daily price assessments that includes the cost of nature-based carbon credits purchased and retired to offset the carbon emissions from a 3.4TBtu LNG cargo shipped from Australia to Japan, Korea, Taiwan and China ("**JKTC**"), based on the U.S. Environmental Protection Agency's GHG equivalencies calculator of CO_2 emissions of natural gas at 53kg/MMBtu. The assessments are summarised in the table below:

Assessment	Description	Price on 8 March 2022
CNL WTT JKTC differential	Cost to offset CO_2e emissions on a WTT basis, taking into consideration emissions associated with production, including an estimate for fugitive emissions, liquefaction, freight (including ballast leg) and regasification. S&P Global Platts uses an estimate of the CO_2e emissions from production and liquefaction at every LNG production site in Australia, including an estimate of fugitive emissions, and weights these emission levels by their 2021 LNG production volume to determine the upstream segment of emissions. S&P Global Platts uses an estimate of CO_2e emissions stemming from a round-trip (laden and ballast legs) of a tri-fuel diesel electric (TFDE) LNG carrier on the Australia-JKTC route as well as regasification in JKTC terminals to arrive at the total WTT emissions value.	U.S.$0.168/MMBtu
CNL WTW JKTC differential	Cost to offset CO_2e emissions for the full lifecycle of an LNG cargo delivered to JKTC from Australia (also known as well-to-wheel or well-to-wire).	U.S.$0.767/MMBtu
CNL DES JKTC differential	Well-to-flange DES assessment of cost to offset CO_2e emissions of an LNG shipment from Australia delivered ex-ship to JKTC at the flanges of the discharge port.	U.S.$0.162/MMBtu
CNL Combustion JKTC	Cost to offset the combustion leg of a CNL trade in North Asia, being CO_2e emissions associated with internal pipeline transport and combustion of regasified LNG in the JKTC region.	U.S.$0.600/MMBtu

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While the CNL assessments represent a useful market price reference based on estimated or modelled data, each carbon-neutral LNG trade could be priced differently as the emissions profile of each cargo could vary. As always, more targeted data would allow for more specific calculations and, as the carbon-neutral LNG market grows, new pricing solutions are likely to develop. Jeffrey Moore, Manager of S&P Global Platts' Asian LNG Analytics team, anticipates that "*we may be able to look at individual projects and come up with a specific price that is customised for that project, and even obtain measured emissions per ship. We want to be able to say, 'if you are loading gas onto this vessel for this journey and unloading it at this destination, you will emit x amount of CO_2e'.*"

Greater transparency and publication of data in carbon-neutral LNG transactions is likely to lead to the development of various carbon-neutral LNG price assessments based on actual data, capable of providing more accurate or specific reference points for market participants.

OUTLOOK FOR CARBON-NEUTRAL LNG

While carbon-neutral LNG shipments currently make up only a small part of global LNG trade (less than 1%), S&P Global Platts projects that the segment will grow rapidly and estimates that most LNG trading companies will want at least half of their LNG trades to be carbon-neutral in the next decade.

A summary of announced carbon-neutral LNG trades to date is shown below, and it is notable that a number of key LNG market participants in Asia Pacific are represented:

Date	Supplier	Buyer	Volume	Markets	Emissions Covered	Registry and Credit
18/6/2019	Shell	Tokyo Gas	1 cargo	Japan	Full lifecycle	VCS
18/6/2019	Shell	GS Energy	1 cargo	Korea	Full lifecycle	VCS
27/6/2019	JERA	Unstated	1 cargo	India	End-use only	CDM
4/3/2020	Shell	CPC	1 cargo	Taiwan	Full lifecycle	VCS
22/6/2020	Shell	CNOOC	2 cargoes	Mainland China	Full lifecycle	VCS
9/9/2020	QP Trading	CNOOC	1 cargo	Mainland China	Full lifecycle	VCS
29/9/2020	TotalEnergies	CNOOC	1 cargo	Mainland China	Full lifecycle	VCS
18/11/2020	Shell	CPC	1 cargo	Taiwan	Full lifecycle	VCS
1/3/2021	Mitsui	Hokkaido Gas	1 cargo	Mainland China	Full lifecycle	Unstated
1/3/2021	Gazprom	Shell	1 cargo	UK	Full lifecycle	VCS
1/3/2021	RWE	POSCO	1 cargo	Korea	WTT only	VCS
9/4/2021	Mitsubishi/DGI	Toho Gas	1 cargo	Japan	Unstated	Unstated
16/4/2021	Unstated	Pavilion Energy	1 cargo	Singapore	WTT only	VCS and CCB
5/5/2021	Cheniere Energy	Shell	1 cargo	Europe	Full lifecycle	Unstated
1/6/2021	Oman LNG	Shell	1 cargo	Middle East/South Asia	Full lifecycle	Unstated
11/6/2021	Shell	Astomos	1 cargo	Japan	Full lifecycle	Unstated
20/6/2021	TotalEnergies	CNOOC	1 cargo	Mainland China	Full lifecycle	VCS
6/7/2021	Shell	Osaka Gas	1 cargo	Japan	Full lifecycle	Unstated nature based
10/7/2021	INPEX	Own terminal	1 cargo	Japan	Full lifecycle	Unstated
12/7/2021	Shell	PetroChina	5 year term supply	Mainland China	Full lifecycle	Unstated nature based
16/7/2021	Sempra and BP	IEnova	1 cargo	Mexico	WTT only	Nature based (afforestation)
22/7/2021	Unstated	AES	1 cargo	Dominican Republic	WTT only	Unstated renewable
6/8/2021	ENI	CPC	1 cargo	Taiwan	Full lifecycle (PAS 2060)	VCS, nature based (REDD+)
17/8/2021	PETRONAS	Shikoku Electric	1 cargo	Japan	Unstated	VCS, renewable
6/9/2021	BP	CPC	1 cargo	Taiwan	WTT only	Unstated
13/9/2021	INPEX	Toho Gas	1 cargo	Japan	Full lifecycle	VCS, unstated
13/9/2021	PETRONAS	Shenergy	3 cargoes	China	Unstated	Unstated
28/9/2021	Sakhalin	Toho Gas	1 cargo	Japan	Unstated	VCS, unstated
8/10/2021	DGI	JAPEX	1 cargo	Japan	Unstated	Unstated
20/12/2021	CNOOC	CNOOC	1 cargo	Hong Kong	Full lifecycle	Unstated
10/1/2022	PETRONAS	Hiroshima Gas	1 cargo	Japan	Unstated	Unstated

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While approximately 88% of global emissions are currently covered by country net zero ambitions,[12] the use of coal as an energy source is still widespread in Asia, with more than 200 coal-fired power plants planned or under construction in the region (almost half of which are in China).[13] China announced in September 2021 that it would not build new coal-fired power projects abroad (estimated to remove approximately 56 coal-fired power projects from the pipeline) and over 40 countries (including Indonesia and South Korea) agreed at COP26 to phase down coal-fired power by 2050.

In its LNG Outlook 2022, Shell noted that *"LNG has a key role to play as a reliable and lower-emission energy source, particularly in Asia, replacing declining domestic gas production, enabling coal-to-gas switching and supporting economic growth."*[14] Encouraging the use of LNG as a bridge fuel remains a popular solution in Asia Pacific as the carbon intensity of LNG is much lower than that of coal, which could help countries meet growing demand for power with a lower environmental impact. According to the U.S. Energy Information Administration, the combustion of natural gas emits approximately 50% less CO_2 compared to the combustion of coal (approximately 228.60 pounds of CO_2 per MMBtu for certain coal and approximately 116.65 pounds of CO_2 per MMBtu for natural gas).[15] With a smaller carbon footprint, LNG will continue to play an important part in a lower carbon economy and, in combination with the offsetting mechanism used in carbon-neutral LNG transactions, can help host governments and market participants meet their climate change targets.

Further, although there are concerns that carbon-neutral LNG trades might be 'one-offs' designed to fulfil corporate ESG (environmental, social and governance) objectives, Japanese and South Korean utilities in particular are keen to purchase carbon-neutral or carbon-offset LNG, due in part to downstream commitments to supply carbon-neutral gas to customers and government commitments to net zero targets,[16] and it is likely that buyer requirements will continue to drive the development of the carbon-neutral LNG market. In Japan, the world's second-largest LNG importer,[17] this is particularly evident from the establishment of the 'Carbon Neutral LNG Buyers Alliance' in March 2021, with its fifteen member companies agreeing to *"work to increase the recognition of CNL [carbon-neutral LNG] in society and carry out initiatives to improve its evaluation by investment institutions and establish its position within the various systems in Japan with the aim of contributing toward Japan's achievement of a carbon neutral society by 2050"*.[18] Other drivers will include government requirements, through the regulatory permitting process for projects, and providers of finance, who are increasingly requiring more stringent ESG standards for projects and corporate clients. Lenders who provide financing for new LNG projects or expansions of existing projects may introduce their own requirements for carbon neutrality or offsetting as a condition to financing, including potentially requiring carbon capture, use and storage (CCUS). Many lenders are increasingly under pressure from investors and concerned about public perception of their activities, which is likely to exacerbate this issue and lead to increased environmental due diligence, although there is still support for projects and lenders are themselves embracing major energy transition themes and leveraging their green financing and ESG expertise to create a competitive edge. According to a senior energy banker in Southeast Asia, "*There is no doubt that the bar is being set higher and higher, and not every financial institution sees a long term future in development of hydrocarbon resources. But there is an increasing acceptance that regional energy markets are developing at different speeds and with different trajectories. I believe we will continue to see significant volumes of financing raised for LNG projects, both for new projects and expansions, at least for the next decade. Continued growth on the demand side makes this almost certain, in my view.*"

If parties to LNG transactions can find economic ways to continue trading carbon-neutral LNG, then it will become more prevalent. To date (aside from the Pavilion Energy, QatarEnergy and Chevron plan) we are only aware of one term LNG sale and purchase agreement having been executed for carbon-neutral LNG (between Shell and PetroChina – announced in July 2021, a five-year agreement using carbon credits from Shell's global portfolio), which could be due in part to the volatility of carbon pricing. Once there are more developed and international markets suitable for LNG market participants to trade carbon credits and to have greater visibility on price outlook, together with suitable financial instruments on international

exchanges allowing them to hedge the price of carbon credits, it is likely that we will see further carbon-neutral LNG SPAs and potentially the amendment of existing LNG SPAs to be carbon-neutral. Our view is that, while carbon-neutral LNG trades are nascent today, we are witnessing the emergence of a new paradigm that will become a feature of the entire LNG industry in the next five to ten years.

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Endnotes

1. Shell plc, 'Shell LNG Outlook 2022' (February 2022) accessed 22 February 2022.
2. The JKM benchmark recently spiked to a new high of U.S.$84.762/MMBtu on 7 March 2022 (for April physical deliveries), before settling to U.S.$54.281/MMBtu on 8 March 2022, due in part to uncertainty and concerns over shortage of supply caused by the Russian invasion of Ukraine.
3. Erin Blanton and Samer Mosis, 'The Carbon-Neutral LNG market: Creating a Framework for Real Emissions Reductions' (2021) Columbia School of International and Public Affairs, Centre on Global Energy Policy. CO_2e captures the combined effect of all anthropogenic GHG emissions in a single metric based on each gas's warming potential over a given period of time, a metric known as a substance's global warming potential (GWP).
4. GIIGNL, 'GIIGNL MRV and GHG Neutral LNG Framework' (2021).
5. See endnote 4.
6. Chevron, 'Pavilion Energy, QatarEnergy And Chevron Launch GHG Reporting Methodology For Delivered LNG Cargoes' (17 November 2021) accessed 15 February 2022. The methodology is available at: https://www.chevron.com/-/media/chevron/sustainability/documents/SGE-methodology.pdf.
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9. Kenji Asada, Aiko Munakata and Mari Ishibashi, 'Opaque carbon credit market undermines fight against climate change' Nikkei Asia (11 February 2022) accessed 15 February 2022.
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