

## Lower-Carbon, Carbon-Neutral, and “Green” LNG

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This Practice Note discusses the use of lower-carbon and carbon-neutral liquefied natural gas (LNG) to lower the carbon intensity of LNG and reduce the carbon footprint of LNG projects. It also discusses how this lower-carbon and carbon-neutral LNG can be produced, verified, and priced.

Natural gas has long been viewed by many as a bridge fuel to enable the oil & gas industry and other stakeholders to transition from carbon-intensive energy sources to renewable forms of energy. This is because natural gas is cleaner than other forms of hydrocarbon, most notably coal. However, some now view natural gas as not being clean enough, and liquefied natural gas (LNG) sellers and producers are coming under pressure to reduce the life cycle greenhouse gas (GHG) emissions associated with their LNG. Lifecycle emissions refers to all emissions that are released along the LNG value chain, including from:

- The extraction and production of natural gas.
- The delivery of natural gas to the liquefaction plant.
- Gas processing and liquefaction.
- The shipment of LNG to its final destination.

For more information on each of these steps, see [Practice Note, Understanding the US LNG Value Chain](#).

The first sales of carbon-neutral LNG were announced in June 2019. These were spot sales of a single cargo of LNG. Since then, there have been more announcements of lower-carbon and carbon-neutral LNG sales, both on a spot sale and on “term sale” (a firm commitment to purchase an agreed quantity of LNG over an agreed term) basis. While these sales currently represent a small fraction of the global LNG market, this is an area of the LNG industry that is expected by many to continue to grow as countries around the world seek to transition towards a lower-carbon future.

This Practice Note:

- Explains what is meant by lower-carbon and carbon-neutral LNG.

- Discusses what is driving the development of this new trade in lower-carbon and carbon-neutral LNG.
- Analyzes how to structure transactions for lower-carbon and carbon-neutral LNG.

### Defining Lower-Carbon, Carbon-Neutral, and “Green” LNG

There is currently no globally accepted or industry standard definition of “lower-carbon LNG”, “carbon-neutral LNG,” or “green LNG”. These terms are often used interchangeably to refer to many different concepts. However, all of these terms refer to LNG that has a lower carbon footprint than would otherwise be the case. This lower carbon footprint can be achieved by either or both of the following approaches:

- Directly reducing the GHG emissions associated with producing, transporting, and using LNG.
- Using carbon credits to offset all or part of the GHG emissions associated with producing, transporting, and using LNG.

### Carbon-Neutral LNG

Carbon-neutral LNG refers to LNG that has a net zero carbon footprint. This does not mean that GHG is not emitted in connection with the LNG cargo. Rather, it means that the total reduction in GHG emissions (whether by direct reductions of these emissions in the LNG value chain or the use of carbon credits) is *greater than or equal* to the carbon footprint of the relevant quantity of LNG.

Using currently available technology, carbon neutrality can only be achieved with the use of carbon offset credits (see Carbon Offsets). It is not possible to directly reduce all

of the emissions associated with a cargo of LNG given the potential GHG emissions at each stage of the LNG value chain. This is the case even if carbon capture technology is used in connection with the production and end-use of the LNG. An LNG cargo, therefore, always results in some GHG emissions being released into the atmosphere, and these emissions must be offset if the LNG cargo is to be carbon-neutral.

### Lower-Carbon LNG

In the case of “lower-carbon LNG”, the carbon footprint is reduced but does not reach net zero. This could be because the buyer and seller elect to only reduce and/or offset emissions associated with that cargo before delivery. For example, the seller may elect to reduce and/or offset GHG emissions from either:

- The production and transportation of the LNG, but not from its end use (for example, its combustion in a power plant after it has been regasified).
- Combustion or other end use. This refers to the actual consumption of the LNG/natural gas, but not from its production and transportation to the delivery point.

With a cargo of lower-carbon LNG, it should be made clear what the “lower” is by reference to, as it may refer to either:

- What the GHG emissions would be from that supply source had the relevant direct reductions not been made and/or had carbon offset credits not been used.
- A market average carbon footprint for LNG.

There is currently no globally accepted or industry standard definition of lower-carbon LNG. As a result, the requirements will be subject to negotiation and agreement between the buyer and seller of the relevant cargo. The requirements must also comply with any applicable laws or regulations governing what constitutes “lower-carbon” in the relevant jurisdiction.

This Note does not use the term “green LNG.” While this term is sometimes used to refer to lower-carbon or carbon-neutral LNG, the terms “lower-carbon LNG” and “carbon-neutral LNG” are more precise and are used where each is appropriate.

### Drivers of the Development of Lower-Carbon and Carbon-Neutral LNG

There are many factors driving the development of lower-carbon and carbon-neutral LNG, including:

- **Legal and regulatory developments.** Many countries have adopted decarbonization road-maps or have committed to decarbonization goals under international treaties (for example, the Kyoto Protocol and Paris Agreement) (see [Practice Note, UNFCCC, the Kyoto Protocol and the Paris Agreement](#)) and as a result have enacted:
  - emissions control and trading regimes;
  - carbon taxes; and
  - other climate change and decarbonization-related legislation.
- **Voluntary commitments and mandates.** Many companies have adopted corporate sustainability policies and decarbonization commitments (sometimes referred to as environmental, social, and governance (ESG) policies), in response to pressure to reduce GHG emissions or achieve net zero from investors, lenders, and other stakeholders (for example, customers and end-users). For more information on these commitments and updates, see [Practice Notes, ESG Disclosure & Sustainability Reporting Frameworks](#) and [Key Developments in ESG and Climate Disclosure: 2021 Tracker](#).

### Quantifying GHG Emissions

To offer lower-carbon or carbon-neutral LNG, an LNG seller must first quantify the GHG emissions associated with the relevant cargo of LNG. While carbon dioxide (CO<sub>2</sub>) is the most prevalent of the anthropogenic (human-caused) GHG emissions, it is not the only GHG that is considered by governments, regulators, and other stakeholders. The Kyoto Protocol also provides targets for:

- Methane.
- Nitrous oxide.
- Hydrofluorocarbons (HFCs).
- Perfluorocarbons (PFCs).
- Sulfur hexafluoride.

GHG emissions are measured in tonnes of CO<sub>2</sub> equivalent (CO<sub>2</sub>e), with any non-CO<sub>2</sub> GHGs being converted to an equivalent quantity of CO<sub>2</sub> by reference to their global warming potential.

### Standards Used to Quantity GHG Emissions

Many different standards exist to quantify GHG emissions. These standards can be used to quantify the GHG emissions associated with a given company, project, or even product. The product standard is likely to be the most

appropriate for quantifying the GHG emissions associated with a cargo of lower-carbon or carbon-neutral LNG.

There is currently no uniformly accepted industry standard for quantifying the GHG emissions associated with a cargo of LNG, but the most widely used standards are:

- The [Product Life Cycle Accounting and Reporting Standard](#) developed by the Greenhouse Gas Protocol (GHG Protocol). This is a partnership convened by the World Resources Institute and the World Business Council for Sustainable Development.
- [ISO 14067](#) developed by the International Organization for Standardization (ISO), which specifies principles, requirements, and guidelines for quantifying and reporting the carbon footprint of a product, in a manner consistent with International Standards on life cycle assessment (ISO 14040 and ISO 14044).
- [Publicly Available Specification \(PAS\) 2050](#) developed by the British Standards Institution (BSI) to provide a consistent method for assessing the life cycle GHG emissions of goods and services.

These standards all seek to quantify the GHG emissions associated with the relevant product on a life-cycle assessment (LCA) or “cradle to grave” basis.

The appropriate standards and methodology for quantifying emissions vary from company to company, and even from transaction to transaction. Relevant factors include:

- The legal and regulatory regimes applicable to the LNG seller.
- The LNG seller’s internal environmental or carbon accounting policies (including how it is quantifying GHG emissions in its wider business).
- The legal and regulatory regimes applicable to the LNG buyer and/or the end-user of the LNG.

### Factors that Affect LNG’s GHG Emissions

According to The International Group of Liquefied Natural Gas Importers (GIIGNL), the average lifecycle emissions from one LNG cargo is estimated to be around 250,000 tonnes of CO<sub>2</sub>e. This amount varies depending on several factors, including:

- The source of the LNG. LNG produced in jurisdictions where flaring or venting of natural gas is extensive will have higher GHG emissions.
- The strength and scope of laws and regulations to limit methane leaks in the relevant jurisdiction and the technology used to limit methane leaks.

- The liquefaction technology used. A seller may seek to reduce GHG emissions from this stage of the LNG value chain by using:
  - more efficient liquefaction technology; or
  - carbon capture, utilization and storage (CCUS) technology to capture and/or store GHG emissions produced during the liquefaction process.
- The type of vessel used to transport the LNG cargo to the relevant jurisdiction. LNG vessels have varying fuel efficiency and rates of methane slip.
- The distance between the LNG seller and the LNG cargo’s destination point.
- The procedures used to regasify the LNG at its destination point.
- The downstream use of the LNG. The majority (about 75%) of the GHG emissions from an LNG cargo are incurred when the LNG is used (for example, once it is burned after it has been converted to natural gas for use in a power plant). The nature of this end use (whether to produce petrochemicals or consumed in a power plant), and the emissions associated with this end use, are therefore a critical factor in the lifecycle GHG emissions from each LNG cargo.

### Reducing GHG emissions

To offer lower-carbon or carbon-neutral LNG, an LNG seller may seek to reduce GHG emissions resulting from all or some of the following parts of the LNG value chain:

- Production of natural gas. The seller can reduce flaring, venting, and other fugitive emissions of GHGs (including by committing to the World Bank Zero Routine Flaring by 2030 Initiative).
- Transportation of natural gas. The seller can reduce GHG emissions associated with pipeline transportation by:
  - monitoring and replacing equipment to reduce methane leaks in pipeline facilities;
  - electrifying compressors and valves; and/or
  - using renewable power or renewable fuels (in place of natural gas) for pipeline operations.
- Liquefaction of natural gas. GHG emissions can be reduced during liquefaction by using:
  - CCUS technology to capture GHG emissions produced during liquefaction; and/or
  - renewable power for generation or using renewable natural gas as feedstock. Renewable natural gas,

also referred to as biogas, is natural gas derived from organic waste material (for example, food waste, garden and lawn clippings, and animal and plant-based material) or degradable carbon sources like paper, cardboard, and wood.

- Shipping of LNG. Sellers can use lower-carbon marine fuel (for example, hydrogen or ammonia), or improved technology to reduce the release of methane (or “methane slip” as it is known) in the LNG tanker’s engines.

For more information on these steps in the LNG value chain, see [Practice Note, Understanding the US LNG Value and Process Chain](#) and [Liquefied Natural Gas \(LNG\) Value and Process Chain](#).

The decision as to where to reduce GHG emissions depends on:

- The LNG seller.
- The LNG seller’s position in the LNG value chain.
- The operations over which the LNG seller has control.

For example, an LNG seller may own and operate the relevant LNG liquefaction facility but purchase natural gas from third parties and use third party pipelines to transport natural gas to the liquefaction facility. This is the case for many US LNG projects. In these cases, the LNG seller would have limited ability to reduce emissions from the production and transportation of natural gas, unless it could secure binding emission reduction commitments from its natural gas suppliers and transporters.

### Carbon Offsets

A lower-carbon or carbon-neutral LNG cargo may not involve any direct reductions of GHG emissions in the LNG value chain. The reduction to the cargo’s carbon footprint may instead be achieved solely using carbon offset credits. A carbon offset credit is a credit that can be sold or purchased by a company or individual to compensate for all or part of that company’s or individual’s GHG emissions. Each credit represents one tonne of GHG emissions (in CO<sub>2</sub>e) that has either been avoided or removed from the atmosphere. The credits are generated by companies that develop carbon reduction projects (for example, renewable energy projects or reforestation or afforestation projects).

There are many different domestic and international programmes under which a company can generate or acquire carbon offset credits. The key distinction for these programmes is between the compliance market and the voluntary market.

### Compliance Market

These are credits that can be used to comply with, and must typically be expressly vetted and approved by, an emissions reduction regime (for example, the Kyoto Protocol, the Paris Agreement, the European Union’s Emissions Trading System (EU ETS) or other country-specific emissions trading schemes).

One of most widely traded compliance credits are those generated under the United Nations’ Clean Development Mechanism (CDM). The CDM is a project-based mechanism that enables the generation and issuing of certified emission reductions from eligible CDM project activities. Under this mechanism, credits produced in developing countries can be used to offset emissions in developed countries. For more information on compliance markets and the CDM, see [Practice Notes, CDM and JI: Clean Development Mechanism and Joint Implementation projects](#) and [Emissions trading schemes: overview: International Emissions Trading under the Kyoto Protocol](#).

### Voluntary Market

These are credits that are purchased for purely voluntary reasons (for example, because of consumer or stakeholder concerns). The voluntary market is not regulated in the same way as the compliance market, but several domestic and international programmes, methodologies, and standards have been developed to verify and certify carbon reduction projects. These include:

- The [Gold Standard Verified Emissions Standard](#).
- The [Verified Carbon Standard \(VCS\)](#).
- The [Climate, Community & Biodiversity \(CCB\) Standards](#).
- The [American Carbon Registry \(ACR\)](#).
- The [Climate Action Reserve](#).

Certified carbon reduction projects are recorded on the central registry of the relevant program, along with the credits that these projects generate. If credits are sold or transferred to a third party, then the third party is registered as the holder of those credits in the registry. When the holder of a credit wants to use that credit to offset its emissions, the credit is retired and may no longer be transferred or used.

Not all voluntary credits are verified or certified, however and there is a wide range in terms of the quality and value of voluntary credits.

### Structuring Lower-Carbon and Carbon-Neutral LNG Transactions

The structure of a lower-carbon or carbon-neutral LNG transaction depends on a several factors, including:

- How the carbon footprint of the LNG is reduced. The relevant terms of the LNG sale agreement will vary depending on whether the GHG emissions are:
  - reduced along any part of the LNG value chain; and/or
  - offset using carbon offset credits.
- The type of transaction (whether it is a spot sale or a term sale).

### Monitoring, Reporting, and Verification of GHG Emissions

Monitoring, reporting, and verification of GHG emissions (MRV) is the cornerstone for any lower-carbon or carbon-neutral LNG transaction. This is the case regardless of how GHG emissions are reduced. Whether by actual direct GHG emissions reductions or carbon offset credits, the LNG seller must be able to accurately quantify the GHG emissions associated with each cargo of LNG under the transaction.

For any transaction that involves:

- Actual reductions in GHG emissions, the seller will need to use MRV to demonstrate to the LNG buyer that these reductions have been achieved. This is especially important if the buyer is paying a premium for the relevant quantity of lower-carbon or carbon-neutral LNG (see *Payment of a Premium for Lower-Carbon or Carbon-Neutral LNG*).
- The use of carbon offset credits (and therefore any quantity of carbon-neutral LNG), the seller will need to use MRV to calculate:
  - the carbon footprint of the relevant quantity of LNG; and
  - the quantity of carbon offset credits that must, therefore, be transferred by the LNG seller to the LNG buyer together with the LNG to offset all or part of the GHG emissions associated with that quantity of LNG (see *Transfer of Carbon Offset Credits*).

There is no uniformly accepted industry approach to MRV. The rights and obligations of the parties with respect to MRV under the transaction are subject to negotiation and agreement between the parties, including any relevant standards (for example, the GHG Protocol) that will apply for the MRV provisions (see *Standards Used to Quantify GHG Emissions*).

In some simple transactions (for example a spot sale for a single cargo of LNG), the parties might not actually include any MRV provisions in the relevant sale agreement. The parties may instead agree to a deemed quantity of GHG emissions that are associated with the relevant cargo. The LNG buyer may request to see supporting information before agreeing to this deemed quantity, but the buyer may not otherwise have rights to verify the GHG emissions associated with the relevant LNG cargo.

In longer-term transactions, for example a 20-year LNG sale and purchase agreement, the LNG buyer may seek more certainty about the exact quantity of GHG emissions associated with each cargo of LNG. The buyer may, therefore, require the LNG seller to notify the buyer of the GHG emissions associated with each cargo of LNG delivered under the agreement. Additional provisions may apply, including:

- Detailed MRV provisions.
- The GHG emissions data supplied by the LNG seller may be supported by warranties from the seller for its accuracy.
- A requirement for independent certification of the GHG emissions or rights for the buyer, or an independent third party, to audit the LNG seller and its records to verify the GHG emissions reported by the seller.

If the LNG buyer requires the seller to provide this GHG information in advance for the cargoes to be delivered over the long-term agreement, then the buyer may be limiting the pool of potential sellers who could supply the cargoes. While sellers with a dedicated supply source can commit to delivering from that source, and therefore can provide the buyer with the GHG emissions data related to that source, traders and other participants in the secondary market may not be in a position to commit to a specific source for the entire quantity in advance, and they also may not want to reveal their trading strategies.

### Actual Reductions in GHG Emissions

If the carbon footprint of the LNG to be supplied under the transaction is to be reduced or capped as a result of actual reductions in emissions in the LNG value chain (whether by using renewable natural gas as feedstock, CCUS technology at the liquefaction facilities, or otherwise) then the relevant LNG sale and purchase agreement should expressly address these reductions or caps. The LNG buyer will likely require warranties, covenants, and other undertakings from the LNG seller for these reductions or caps. These provisions are especially important where

the buyer is paying a premium for the relevant quantity of lower-carbon or carbon-neutral LNG (see Payment of a Premium for Lower-Carbon or Carbon-Neutral LNG).

A key issue that should be addressed under the relevant LNG sale and purchase agreement are the rights and remedies that the LNG buyer has if the required GHG emissions reductions are not achieved (meaning the actual carbon footprint of the LNG exceeds the agreed footprint). The agreement should make clear whether the LNG buyer:

- Is permitted to refuse to accept delivery of the LNG (if it becomes aware before delivery).
- Can only claim damages from the seller for breach of the applicable warranties, covenants, and undertakings under the agreement.

If the LNG buyer is limited to a damages claim regarding the breach, then the parties should consider whether the buyer will incur any actual losses because of the delivery by the seller of the non-compliant LNG. If it will not (for example, because the lower-carbon or carbon-neutral LNG is being purchased for purely voluntary reasons without direct financial benefit for the buyer) or if the damages are speculative or unknown, then the LNG sale and purchase agreement may need to include a liquidated damages regime.

### Transfer of Carbon Offset Credits

If carbon offset credits will be supplied alongside the relevant cargo of lower-carbon or carbon-neutral LNG, then the parties will need to provide for the transfer or retirement of the agreed quantity of credits on delivery of the cargo. Applicable legal regimes may regulate the resale of carbon credits and other “environmental commodities.”

The terms for the transfer of the carbon offset credits may be included in the LNG sale and purchase agreement itself, or alternatively may be addressed in a separate agreement entered into between the parties at the same time as the LNG sale and purchase agreement. Several standard form agreements exist that could, with appropriate amendments, be used to transfer carbon offset credits, including from:

- The [International Emissions Trading Association \(IETA\)](#)
- The [International Swaps and Derivatives Association \(ISDA\)](#).
- The [European Federation of Energy Traders \(EFET\)](#).

The parties will need to agree, however, whether the transfer of the carbon credits should be effective if the

LNG seller fails to deliver all or part of the relevant cargo of LNG and the LNG seller is not otherwise excused from performance. In this case, the LNG buyer may be obliged to procure replacement LNG or natural gas from third parties, but the buyer may not be able to acquire rights to carbon offset credits alongside such replacement LNG or natural gas. The buyer may, therefore, require that the seller transfers such rights to the buyer, or purchases in the market and delivers to the buyer equivalent rights to carbon offset credits, notwithstanding the seller’s failure to deliver the relevant cargo.

### Payment of a Premium for Lower-Carbon or Carbon-Neutral LNG

An LNG seller may incur additional costs in connection with the sale of a cargo of lower-carbon or carbon-neutral LNG. These include:

- **The cost of purchasing carbon offset credits.** The LNG seller may have incurred costs in connection with the generation or purchase of the credits that it needs to supply alongside the relevant cargo.
- **Natural gas purchase costs.** If the LNG seller is purchasing lower-carbon natural gas, (for example, renewable natural gas or natural gas from a supplier that has taken active steps to reduce the GHG emissions associated with its natural gas (including blending the natural gas with hydrogen or renewable natural gas)), then the LNG seller may be obliged to pay a premium for that natural gas above the market price for natural gas.
- **Capital costs.** If the LNG seller has taken steps to reduce the GHG emissions associated with the production of LNG at its facilities (for example, using CCUS technology), then the seller may have incurred additional capital costs in connection with the development of those facilities.
- **Operating costs.** The LNG seller may incur additional operating costs in connection with any MRV requirements, and if the LNG seller has taken steps to reduce the GHG emissions associated with the production of LNG at its facilities (for example, using renewable power or renewable fuels), this may result in increased operating costs.

For an LNG buyer, the purchase of lower-carbon or carbon-neutral LNG may bring economic advantages. These include:

- Reduced financial obligations or liabilities under the applicable emissions trading scheme or carbon tax regime to which it is subject.

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- Being able to sell lower-carbon or carbon-neutral LNG or natural gas at a premium in the relevant delivery market.
- Indirect benefits such as:
  - improving the reputation or public perception of the buyer;
  - ensuring that the buyer continues to be able to sell natural gas or otherwise operate in certain jurisdictions;
  - ensuring that the buyer is not in breach of its obligations under any of its financing arrangements (which may restrict the purchase of GHG emissions intensive fuels); and
  - ensuring that it can still access capital from certain sources.

The question is therefore what premium, if any, is payable for a cargo of lower-carbon or carbon-neutral LNG? This is subject to negotiation between the parties to the transaction, and depends on the exact circumstances of the transaction, including:

- The specific additional costs the LNG seller incurred in connection with the provision of lower-carbon or carbon-neutral LNG.
- The economic or other benefits the buyer gains from the purchase of lower-carbon or carbon-neutral LNG.
- The seller and buyer’s respective bargaining positions.

In addition, if carbon offset credits are to be provided alongside the cargo, the parties will need to agree on

how these carbon offset credits are to be valued for those purposes, taking into account that:

- There may not be an established market price for those credits.
- The costs for carbon offset credits can vary greatly from project to project.

The parties will also need to agree whether these credits are to be supplied by the LNG seller at cost, at reduced cost, or at a premium.

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