LNG adjuster calculation methodology

Reclaim Finance calculated adjusters for the 150 largest liquefied natural gas (LNG) terminal developers worldwide using the 2024 global oil and gas exit list (GOGEL) updated in March 2025.[1] This covers 89% of global LNG terminals capacity expansion plans, including 94% of LNG export terminals capacity expansion plans and 81% of LNG import terminals capacity expansion plans.

In order to calculate the financial support of LNG activity, we have multiplied each financing transaction by an adjuster which represents the proportion of the LNG segment activity in a company's overall business. For each LNG export and import terminal developer, segment adjusters have been calculated for the parent company for the last year available using the business segment reporting in annual reports to the fullest extent possible, complemented by further information from company publications and websites and estimations where necessary.

The following financial indicators have been used to calculate the adjusters in order of preference. Adjusters are calculated as a proportion of the financial indicator for the LNG segment over the financial indicator for the company as a whole:

- segment capital expenditures / additions to non-current assets,
- segment liabilities,
- segment assets,
- segment revenues,
- segment profit/loss.

This research was carried out by Profundo (www.profundo.nl).

Financial data methodology

Financial data from this report relies on:

[1] gogel.org

2021 to 2024 financial support accorded by 65 banks worldwide to the top 150 largest LNG developers[2], using the dataset of the 2025 "Banking On Climate Chaos" report. Financial flows include project and corporate financing, via corporate loans, revolving credit facilities and bond and equity issuances. As described in the previous section, financial flows have been adjusted to calculate the financing going to LNG expansion. Financial flows directly linked to green bonds have been removed. For more information, you can refer to the 2025 "Banking On Climate Chaos" report methodology.[3] Banks have been consulted to review this data as part of the engagement process for the 2025 "Banking On Climate Chaos" report. 2024 and 2025 specific project finance operations were extracted from the IJGlobal database. Banks have been consulted to review this data as part of the engagement process for the publication of this website.

Information regarding the insurance certificates:

Information on insurance certificates was collected through public records requests on twelve existing and proposed LNG export terminals located in the U.S. Rankings are based on the number active insurance certificates that companies are named on, as of October 2025. In the event of a tie, the rankings also take into account insurance certificates that have expired. Insurance certificates disclose differing levels of detail about insurance policies depending on jurisdictional applications of public records laws. This list should be seen as a sample view of important insurers of these projects, but not a complete picture.

The twelve operating and proposed US LNG export terminals reviewed are as follows: Calcasieu Pass LNG, Cameron LNG, Rio Grande LNG, Freeport LNG, Texas LNG, Gulf LNG, Sabine Pass LNG, Magnolia LNG, Woodside LNG, Lake Charles LNG, Southern LNG, and Tacoma LNG.

Policy data methodology

For both banks and insurers (the 30 biggest insurers based on the Insurance Scorecard, including Beazley and Hiscox, as they are two of the largest insurance companies operating within Lloyd's of London and which are not already listed), the rating of their policies will be

[2] LNG developers are companies that hold shares in LNG projects (companies specialized in midstream, integrated companies, utilities, industrial firms, and financial institutions such as private equity firms).

[3] Banking on Climate Chaos, Fossil Fuel Finance Report 2025 Research Methodology FAQ, 2025

based on data from the Oil and Gas Policy Tracker. Two aspects will be considered to assess the quality of the commitments:

- Restrictions on direct financing of LNG projects,
- Restrictions on financing companies developing LNG projects.

Initial proposal: table with four color levels and two columns (projects/companies) according to the robustness of commitments (inspiration: European Banks and Transition, p.17).

LNG Emission calculation methodology

The aim of this methodology is to calculate the greenhouse gas emissions associated with LNG import and export terminals between 2025 and 2030.

A first calculation is used to determine the LNG emissions factor, i.e. the emissions associated with the consumption of one kg of LNG by the end consumer, adding the emissions from methane leakages and energy consumption across the entire value chain.

In a second step, this factor is applied to import and export terminals in operation before 2030 and combined with the capacity of each terminal to calculate the emissions it will induce.

Calculation of the LNG emission factor

The methodology used to compute the LNG emission factor is based on the study by Robert Howarth in Energy Science & Engineering on October 3rd 2024 *The Greenhouse Gas Footprint of Liquefied Natural Gas (LNG) Exported from the United States*[4]. This paper is the reference for any numerical application of the methodology's results.

Methodology's principle

The general idea of the methodology is to start from 1 kg of LNG consumed by a customer, and to move up the value chain to account for emissions at each stage of the value chain (releases or energy consumption). Moving up the value chain from stage n+1 (downstream) to n (upstream) and calculating the emissions at stage n involves the following two operations:

- Calculate the mass of gas at the start of stage n+1 from the mass of gas at the start of stage n, as this is the mass of gas from which gas is released and energy losses occur. This is done using the formula:

$$Mass\_gas\_n + 1 \ = \ Mass\_gas\_n \ * \ (1 - loss\_factor\_n)$$

[4] Howarth RW. The greenhouse gas footprint of liquefied natural gas (LNG) exported from the United States. Energy Sci Eng. 2024;1-17.

where loss_factor_n is a factor between 0 and 1 that accounts for all losses of CO2 or CH4, from releases or energy consumption that happen during the n^{th} step of the value chain.
This formula can be inverted as follows:

$$Mass\_gas\_n \; = \; Mass\_gas\_n + 1 \; / \; (1 - loss\_factor\_n)$$

Hence, by performing a limited development of order 1 assuming loss_factor_n very small compared to 1 (an assumption justified by the orders of magnitude of the various loss_factor), the mass of gas at step n is:

$$Mass\_gas\_n \; = \; Mass\_gas\_n + 1 \; * \; (1 + loss\_factor\_n)$$

The latter formula calculates the gas mass at step n of the value chain from the gas mass at the previous step and the loss_factor at step n.

- Calculate the emissions for step n from the previous result. This is done using the formula:

$$Emissions\_n \; = \; loss\_factor\_n \; * \; Mass\_gas\_n$$

Only the dominant terms in the result of this calculation are retained (hence several terms are neglected) at each stage.

Example of the application of this methodology to the first stage of the value chain

As mentioned above, the methodology starts from 1 kg of LNG consumed by a customer. We aim to calculate the emissions induced at the stage in the value chain preceding the consumption stage, i.e. distribution. At this stage of the value chain, there is one source of methane release, which is leakage in the distribution network, characterized by the factor lf_d, and no methane loss through energy consumption. Applying the two operations above, the mass of gas at the distribution step is:

$$Mass\_gas\_d \; = \; Mass\_gas\_c \; * \; (1 + lf\_d)$$

With Mass_gas_d and Mass_gas_c the mass of gas respectively at the distribution and consumption stages of the value chain. As mentioned above, Mass_gas_c = 1 kg, hence:

$$Mass\_gas\_d \; = \; 1 \; + \; lf\_d$$

Thus:

$$Emission\_d \; = \; (1 \; + \; lf\_d) \; * \; lf\_d = \; lf\_d \; + \; lf\_d ** 2$$

And since lf_d**2 is very small compared to lf_d, the result is:

$$Emission\_d = lf\_d$$

Application to the entire value chain

Thus, the table below summarizes the total mass of gas, the emissions (without discriminating between CH_4 and CO_2 emissions) and the terms neglected at each stage of the value chain using the methodology detailed above:

Value chain stage	Total mass of gas	Emissions	Neglected terms
Distribution	(1+lf_d) * 1	lf_d * (1 + lf_d)	lf_d**2
Shipping	(1+lf_s) * (1+lf_d)	lf_s*(1+ lf_s) * (1+lf_d)	lf_d*lf_s directly when calculating the total mass of gas; (lf_s)**2 * lf_d + (lf_s)**2 + lf_s*lf_d
Liquefaction	(1+lf_l) * (1+lf_d+lf_s)	lf_l * (1+lf_l) * (1+lf_d+lf_s)	lf_l**2 * (1 + lf_d + lf_s)
Upstream-Midstream	(1+lf_um) * (1+lf_l) * (1+lf_d+lf_s)	lf_um * (1 + lf_um) * (1+lf_l) * (1+lf_d+lf_s)	-

With lf_d, lf_s, lf_l and lf_um the loss factors for the distribution, shipping, liquefaction and upstream-midstream stages respectively. These respectively account for the following:

- lf_d: accounts for downstream (distribution pipelines of the destination country) methane leakage.
- lf_s: accounts for carbon dioxide emitted from burning gas to fuel ships, as well as for the fraction of unburned methane emitted in the exhaust stream.
- lf_l: accounts for carbon dioxide emitted from burning gas to power liquefaction, produced from flaring, and that was in the natural gas before processing, as well as for the release of unburned methane during liquefaction and for regasification.
- lf_um: accounts for upstream and midstream (gas fields and pipelines of the production country) methane emissions.

The emissions of carbon dioxide from the combustion of natural gas by the consumer are added to cover all sources of LNG emissions across the entire value chain.

Once carbon dioxide and methane emissions have been calculated at each stage of the value chain, they are converted into CO_2e using the Global Warming Potential on a 20-year scale (GWP20) of methane. Finally, they are summed to obtain the emission factor, accounting for the greenhouse gas emissions induced by the consumption of one kg of LNG.

Calculation of LNG terminal emissions

Calculation of LNG emission factors for each export country

The following paragraphs give the calculation of methane and carbon dioxide emissions for each segment of value chain / lifecycle. The emissions are expressed in grams per kg of LNG burned for final consumption.

Upstream and midstream

The following equations are taken from Howarth et al. (2024) for methane and carbon dioxide emissions from up- and mid-stream activities (i.e. production, storage, transportation up to liquefaction facilities):

$$CH_{4\,um} = leakage\ rate_{um} \times (1 + leakage\ rate_{um}) \times 1{,}000\,\frac{gCH_4}{kg} \times LNG_{tot} + methane\ emission\ factor_{fuel\ oil\ production} \times Fuel\ oil$$

where the total mass of LNG burned or emitted over the entire lifecycle of LNG is defined as (normalized per kg of LNG burned for final consumption):

$$LNG_{tot} = 1\,\frac{kg}{kg\ LNG} + Downstream\ leaks + (LNG_{ship} + Vent.boil.off) + LNG_{liq}$$

The **rate of methane releases upstream and downstream is different in each country where the LNG is produced and must therefore be adjusted on a country-by-country basis**. For the USA, the leakage rate used by Howarth et al. (2024) has been adopted (2.8%). For other countries, this rate was calculated with the ratio between methane leakage and gas production in each country, using the Rystad Energy database.

Methane emission factor for fuel oil production is estimated at 3.9 gCH_4/kg (energy density of 39 MJ/kg and emission factor of 0.10 gCH_4/MJ).

$$CO_{2\,um} = carbon\ dioxide\ emission\ factor_{natural\ gas\ production} \times LNG_{tot} + carbon\ dioxide\ emission\ factor_{fuel\ oil\ production} \times Fuel\ oil$$

where emission factors are 612 and 616 gCO_2/kg respectively for natural gas and fuel oil (indirect emissions from energy used to explore and drill gas and oil wells, hydraulically fracture the wells, and process, store, and transport the fuels)

Liquefaction

The emissions during liquefaction process are estimated as follows:

$$CH_{4\,liq} = methane\ release\ rate_{\ liq} \times (1\,\frac{kg}{kg\ LNG} + Downstream\ leaks + LNG_{ship} + Vent.boil.off)$$

$$CO_{2\,liq} = (\alpha + \beta + \gamma) \times (1\,\frac{kg}{kg\ LNG} + Downstream\ leaks + LNG_{ship} + Vent.boil.off)$$

where:

- The rate of release of unburned methane is estimated at 3.5 gCH_4/kgLNG.
- α, β and γ are emission factors linked to gas burned to power liquefaction process, release of carbon dioxide embedded in natural gas before processing and flaring. These factors are estimated respectively at 270, 57 and 18 gCO_2/kgLNG.

At this stage can also be estimated the total mass of LNG consumed or emitted during liquefaction process (M being the molar mass):

$$LNG_{liq} = CH_{4\,liq} + \frac{M_{CH_4}}{M_{CO_2}} \times CO_{2\,liq}$$

Shipping

The emissions during shipping of LNG to import terminals are estimated as follows:

$$CH_{4\,ship} = methane\ slip\ rate_{ship} \times 1{,}000 \frac{gCH_4}{kg} \times LNG_{ship} + Vent.boil.off$$

$$CO_{2\,ship} = \frac{M_{CO_2}}{M_{CH_4}} \times 1{,}000 \frac{gCH_4}{kg} \times LNG_{ship} + energy\ emission\ factor \times energy\ density \times Fuel\ oil$$

where $LNG_{ship} = \frac{roundtrip\ days \times LNG\ daily\ consumption}{ship\ capacity}$ and $Fuel\ oil = \frac{roundtrip\ days \times LNG\ daily\ consumption}{ship\ capacity}$

Howarth et al. (2024) considers four types of tankers (steam-turbine powered by LNG, four-stroke engine tanker powered by LNG, two-stroke engine powered by LNG and diesel-powered tankers). For the sake of simplification, as the calculation includes LNG terminals in various countries, the **following average hypotheses are considered**:

- Tanker fleet is only composed of modern two-stroke engine tankers, which are only powered by LNG (hence $Fuel\ oil = 0$ in all the equations above [conservative])
- Boil-off is fully used to fuel the tankers and / or excess is fully reliquefied and there is no venting (hence $Vent.boil.off = 0$ in all the equations above [conservative])
- LNG daily consumption rate is 108 tLNG/d (hypothesis from Howarth et al. (2024) for ships powered by modern two-cycle engines [conservative])
- Slip rate is 3.8% (hypothesis from Howarth et al. (2024) for ships powered by modern two-cycle engines [conservative])
- Average roundtrip duration is 38 days (average hypothesis from Howarth et al. (2024), considering LNG shipping globally)
- Average ship capacity is 60,800 t

Downstream

Finally, downstream emissions are calculated as follows. Methane emissions originate from leaks in transmission pipelines in the destination country and carbon dioxide from the combustion of natural gas in power plant (**which is deemed to be the only end-use** [conservative]).

$$CH_{4\,downstream} = Downstream\ leaks$$

$$CO_{2\,downstream} = Emission\ factor_{combustion}$$

where:

- Downstream leaks (methane emissions from transmission pipelines and storage in the destination country; no slippage from power plant) are assessed at 0.32% of final gas consumption (i.e. 3.2 gCH_4/kgLNG), and
- Carbon dioxide emission factor is calculated at 2,750 gCO_2/kgLNG, given an energy density for natural gas of 55 MJ/kg (and carbon intensity ~50 gCO_2/MJ).

Total lifecycle emissions

Total LNG lifecycle emission factors (per kg of LNG burned for final consumption) are then computed by converting methane and carbon dioxide emission factors using a Global Warming Potential factor for methane on a 20-year period (GWP_{20}=82.5) and adding up all factors along the value chain.

A different lifecycle emission factor is calculated for each export country.

List of LNG terminals

The **list of terminals** considered in this analysis results from the concatenation of **terminals in operation for at least one year between 2025 and 2030**, based on:

(i) the reference databases *Global Oil and Gas Exit List* (*GOGEL*) for under construction and planned terminals and
(ii) *Enerdata* for operational.

These databases also provide the capacity and commissioning date of each terminal.

Calculation of LNG terminal emission factor

The emission factor for a given terminal is determined as follows:

- The **emission factor** of an **export terminal** is the **emission factor of the country** in which the terminal is located.
- For each LNG-importing country, a list of the countries from which this LNG originates and the share it represents in the total energy volume of LNG imported by this country is extracted from the *Enerdata* database. The **emission factor** of an **import terminal** is therefore the **weighted sum of the emission factors** of the **countries exporting** the LNG **to the country** in which the terminal is located.

Calculation and accounting for LNG terminal emissions

The emissions associated with a terminal are calculated by multiplying its emission factor by its capacity:

$$Yearly\ emissions\ =\ Emission\ factor\ \times\ Capacity$$

These are accounted for every year of terminal operation, i.e. for every year from and including the year the terminal is commissioned.

Cautionary statement on emissions figures

The estimation of emissions induced by LNG terminals is based on a peer-reviewed study by an internationally recognized researcher.

However, while Howarth et al. (2024) studies the case of American natural gas, here the geographical scope includes all export and import terminals existing or planned to be operational in the next five years.

Consequently, average assumptions are taken on most segments of the value chain to calculate lifecycle emissions, with estimates on upstream / midstream leakage rates calculated for each export country.

It should therefore be noted that the calculated emissions figures cannot in any case constitute precise projections and are only intended to show orders of magnitude of the climate impact of these infrastructures.

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