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Calculations of greenhouse gas (GHG) emissions throughout the liquefied natural gas (LNG) chain —

Part 1: General

PROOF/ÉPREUVE

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 9, *Production, transport and storage facilities for cryogenic liquefied gases.*

A list of all parts in the ISO 6338 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Natural gas will play a key role in the energy transition (e.g. by replacing coal to produce electricity) and the use of liquefied natural gas (LNG) to transport natural gas is expected to increase. The process of liquefying natural gas is energy-intensive. Gas producers are increasingly accountable for their greenhouse gas (GHG) emissions and the ambition to reduce them. Furthermore, there is an emerging marketing demand for GHG data to enable commercial mechanisms such as offsetting to be utilized.

There is no standardized and auditable methodology to calculate the carbon footprint of the whole LNG chain (including but not limited to the well, upstream treatment, transportation, liquefaction, shipping, regasification and end user distribution). Various standards indicate possible approaches but are inconsistent in their results or not easily applicable.

The ISO 6338 series covers each part of the LNG chain, starting with liquefaction.

Attention should be paid to activities that can occur in different parts (e.g. gas treatment and distribution upstream of the liquefaction plant).

NOTE It is not possible to make like-for-like comparisons, or define a certification scheme, for one block only.

An example for e-methane is given in Annex C.

Calculations of greenhouse gas (GHG) emissions throughout the liquefied natural gas (LNG) chain —

Part 1: General

1 Scope

This document:

— provides the general part of the method to calculate the greenhouse gas (GHG) emissions throughout the liquefied natural gas (LNG) chain, a means to determine their carbon footprint;

— defines preferred units of measurement and necessary conversions;

— recommends instrumentation and estimation methods to monitor and report GHG emissions. Some emissions are measured; and some are estimated.

This document covers all facilities in the LNG chain. The facilities are considered "under operation", including emissions associated with initial start-up, maintenance, turnaround and restarts after maintenance or upset. The construction, commissioning, extension and decommissioning phases are excluded from this document but can be assessed separately.

This document covers all GHG emissions. These emissions spread across scope 1, scope 2 and scope 3 of the responsible organization. Scope 1, 2 and 3 are defined in this document. All emissions sources are covered including flaring, combustion, cold vents, process vents, fugitive leaks and emissions associated with imported energy.

This document describes the allocation of GHG emissions to LNG and other hydrocarbon products where other products are produced (e.g. LPG, domestic gas, condensates, sulfur).

This document does not cover specific requirements on natural gas production and transport to LNG plant, liquefaction, shipping and regasification.

This document is applicable to the LNG industry.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14044, *Environmental management — Life cycle assessment — Requirements and guidelines*

ISO 14064-1, *Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*

API *Consistent Methodology for Estimating Greenhouse Gas Emissions from Liquefied Natural Gas (LNG) Operations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14064-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
global warming potential
GWP
ratio of the time-integrated radiative forcing (warming effect) from the instantaneous release of 1 kg of the GHG relative to that from the release of 1 kg of CO_2

3.2
scope 1
direct greenhouse gas emissions
direct GHG emissions
emissions coming from sources that are owned or controlled by the facility

Note 1 to entry: This can be the emissions that are directly created by product fabrication or synthesis, for example, combustion fumes from a refinery.

3.3
scope 2
indirect greenhouse gas emissions from purchased and consumed energy
indirect GHG emissions from purchased and consumed energy
emissions from the generation of imported electricity, steam, and heating/cooling consumed by the facility

Note 1 to entry: These emissions physically occur at the facility where electricity, steam and cooling or heating are generated but as a user of the energy, the consuming party is still responsible for the greenhouse gas emissions that are being created.

3.4
scope 3
other indirect greenhouse gas emissions
other indirect GHG emissions
emissions from sources that are not owned and not directly controlled by the facility

Note 1 to entry: However, they are related to the company's activities. This is usually considered to be the supply chain of the company, so emissions caused by vendors within the supply chain, outsourced activities, and employee travel and commute. In many industries, these emissions account for the biggest amount of GHG emissions. This is due to the fact that in today's economy, many tasks are outsourced and few companies own the entire value chain of their products.

3.5
quality assurance
QA
planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process

3.6
quality control
QC
planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process

4 Principles

4.1 General

The application of the principles specified in 4.2 to 4.7 is fundamental to guaranteeing that GHG calculations are a true and fair account.

4.2 Relevance

Use data, methods, criteria, and assumptions that are appropriate for the intended use of reported information. The quantification and reporting of GHG emissions shall include only information that users – both internal and external to the plant – need for their decision-making. This information shall thus fit the intended purpose of the GHG project and meet the expectations or requirements of its users. Data, methods, criteria, and assumptions that are misleading or that do not conform to this document are not relevant and shall not be included.

4.3 Completeness

Consider all relevant information that can affect the accounting and quantification of GHG reductions, and complete all requirements. All relevant information shall be included in the quantification of GHG emissions. A GHG monitoring plan shall also specify how all data relevant to quantifying GHG reductions will be collected.

4.4 Consistency

Use data, methods, criteria, and assumptions that allow meaningful and valid comparisons. The credible quantification of GHG emissions requires that methods and procedures be always in the same manner, that the same criteria and assumptions be used to evaluate significance and relevance, and that any data collected and reported be compatible enough to allow meaningful comparisons over time.

4.5 Transparency

Provide clear and sufficient information for reviewers to assess the credibility and reliability of GHG emissions claims. Transparency is critical for quantifying and reporting GHG reductions, particularly given the flexibility and policy-relevance of many GHG accounting. GHG information shall be compiled, analysed, and documented clearly and coherently so that reviewers can evaluate its credibility. Information relating to the GHG assessment boundary and the estimation of baseline emissions should be sufficient to enable reviewers to understand how all conclusions were reached.

4.6 Accuracy

Uncertainties with respect to GHG measurements, estimates, or calculations should be reduced as much as is practical, and measurement and estimation methods shall avoid bias. Acceptable levels of uncertainty depend on the objectives for implementing a GHG project and the intended use of quantified GHG reductions. Where accuracy is sacrificed, data and estimates used to quantify GHG reductions shall be conservative.

4.7 Conservativeness

Where data and assumptions are uncertain and where the cost of measures to reduce uncertainty is not worth the increase in accuracy, best endeavours should be made to use the most probable data, with an analysis of the impact of likely uncertainty margins.

5 GHG inventory boundaries

Table 1 is a template for the reporting boundaries of the GHG report.

Table 1 — List of facilities

Relevant part of ISO 6338	In scope of the report	Out of scope of the report	Comment
Facility A	X		
Facility B		X	

The organization having financial and/or operational control over the facilities shall report all GHG emissions and removals within the reporting boundaries at least on an annual average basis.

6 Quantification of GHG emissions

6.1 Identification of GHG sources and quantification approach

6.1.1 General

The main emission sources to consider derive from fuel combustion, flaring, releases to atmosphere (including fugitive emissions) and emissions associated with imported energy or consumables. Tables 2 to 5 give an initial checklist of emission sources to consider, and an overview of typical quantification methods suitable for different emission sources.

The chosen method of quantification per emissions source differs from one facility to another. Different facilities have access to a varying number of flow meters, composition analysis equipment and level meters available.

Operators shall develop a GHG quantification plan to map out how all emission sources can best be identified in the facility, with a preference to obtain primary data for all major emission sources. The measurement plan shall also include an assessment of data accuracy and impact on the total GHG emissions calculation. This assessment allows the operator to assess if there is a need to further improve the amount or accuracy of instruments available for the total assessment. Guidance on this assessment is detailed in ISO 14064-1:2018, Annex C.

A list of activity data shall be defined based on reliability as primary and secondary data:

— primary data: quantified value of a process or an activity obtained from a direct measurement or a calculation based on direct measurements;

— secondary data: data obtained from sources other than primary data.

Primary data shall be used. Only in the absence of primary data, secondary data may be used, which can include estimated quantities and industry average emission factors.

Typically, primary data are recorded to enable GHG quantification contributing > 5 % of the site's total GHG emissions. For smaller individual sources a calculated approach is acceptable. CEN/TS 17874 defines material and non-material methane emissions.

6.1.2 to 6.1.5 describe sources to consider and typical quantification approach for the main emissions sources.

6.1.2 Emissions from fuel combustion

Table 2 is a template for describing the quantification approaches for emissions from fuel combustion.

Table 2 — Emissions from fuel combustion

Source	Examples	Quantification approach
Gas turbine drivers	Primary liquefaction drivers, power generation drivers, other refrigeration drivers (e.g. fractionation), CO_2 sequestration compressor drivers	Typically, primary data are recorded to enable GHG quantification. As a minimum, fuel gas consumption and composition are required. (Fuel composition at an LNG plant can vary widely depending on operating mode.)
Diesel drivers	Firewater pumps, power generation, boiler feed water pumps	Operator may report typical annual diesel consumption and include resulting annual emissions as a nominal allowance in the GHG calculation.
Boilers	Steam for turbine drivers, steam for process heating	Typically, primary data are recorded to enable GHG quantification for major fuel consumers (contributing >5 % of the total GHG emissions.) As a minimum, fuel gas consumption and composition shall be measured.
Fired heaters	Regeneration gas heater, heating medium heater, direct fired reboilers	If fuel measurements are available, operator should record total fuel gas consumption and composition. If direct fuel measurements are not available, a calculation based on operating duty and efficiency is acceptable.
Incinerators	Acid gas vent incinerator, thermal oxidizers, catalytic oxidizers, waste disposal	As above.
Unburned hydrocarbons shall be taken into account in all sections. If fuel measurements are available, operator should record total fuel gas consumption combined with combustion efficiency data for the fired equipment used. Ideally, combustion efficiency should be validated with measured emission data.		

6.1.3 Emissions from flaring and venting

Table 3 is a template for describing the quantification approaches for emissions from flaring and venting.