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# **Greenhouse Gas Index for Products in 39 Industrial Sectors: Liquefied Natural Gas (LNG)**

NAICS CODE 488999

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## Important Note

This module is not a stand-alone document. Readers should refer to the introduction for a more detailed overview and discussion of the Framework and procedures to determine the GGI and, especially, to the ***Note on Common References, Default Values, Acronyms and Abbreviations used in the Modules***. Common information includes default values for CO<sub>2</sub> emissions from electricity and thermal energy derived from coal, oil and natural gas; a list of acronyms and abbreviations; guidance on using the sources cited for US exports, imports, and production by sector, and CO<sub>2</sub> emissions from electricity produced in nations that export to the United States.

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# 1. Introduction

This module provides estimates for initial export rebates and import charges for liquified natural gas (i.e., LNG, which is included in NAICS Code 488999, All Other Support Articles for Transportation) if there is an upstream greenhouse gas (GHG) tax and the tax law provides for such rebates and import charges. The United States imports far less quantities of LNG than it exports. Product shipments of LNG from the United States in 2019 were about \$6 billion. US exports of LNG in 2018 were about 1.1 trillion cubic feet and such imports to the United States were about 53 billion cubic feet.<sup>1</sup> In 2019, imports came primarily from Trinidad and Tobago. As described in a recent media report, the United States became the leading global LNG exporter in December 2021—and is expected to have that role throughout 2022 and for several years beyond.<sup>2</sup> Under the Framework we've proposed, export rebates and import charges would be based on an upstream US GHG tax and the greenhouse gas indices (GGIs) for the imported and exported products.<sup>3</sup>

In this module, we determine indicative, representative GGIs—which track GHG process emissions and the contribution of the carbon content of products derived from fossil resources along the production and supply chain in a manner analogous to that used for value-added taxes—for LNG. When a product's GGI is multiplied by the GHG tax, the result is the relevant export rebate or import charge. A minimum GGI of 0.50 tonnes CO<sub>2</sub>e/tonne product is required for an export rebate or the imposition of an import charge. We refer to products that meet this threshold as GHG-intensive products. As described below, our indicative estimate for the GGI of LNG is 3.39 tonnes CO<sub>2</sub>e/tonne LNG.

LNG is natural gas that has been cooled to a liquid state (at about -260°F) for shipping and storage. The volume of natural gas in its liquid state is about 600 times smaller than its volume in its gaseous state. The liquification process makes it possible to transport natural gas to places where pipelines do not reach. In 2019, on an annual basis, the United States became the **world's third-largest LNG exporter**—only Qatar and Australia exported more LNG.

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<sup>1</sup> US exports of LNG are much larger in 2022 [at the time of publishing]. For reports on LNG exports, imports, and prices see:

<https://www.energy.gov/sites/default/files/2020/11/f80/LNG%20Annual%20Report%20-%202019.pdf>; <https://www.eia.gov/todayinenergy/detail.php?id=48876>;  
<https://www.eia.gov/dnav/ng/hist/n9133us3m.htm>

<sup>2</sup> See: <https://www.cnn.com/2022/01/05/energy/us-lng-exports/index.html>

<sup>3</sup> Flannery, Brian, Jennifer A. Hillman, Jan Mares, and Brian C. Porterfield. 2020. Framework Proposal for a US Upstream GHG Tax with WTO-Compliant Border Adjustments: 2020 Update. Washington, DC: Resources for the Future.

<https://www.rff.org/publications/reports/framework-proposal-us-upstream-ghg-tax-wto-compliant-border-adjustments-2020-update/>

As described in the Framework, and summarized in the introduction to these modules, there are two major steps involved in determining GGI values for LNG. The first is to evaluate the total input of taxed sources of GHG emissions—CO<sub>2</sub>e(TOT) used to produce LNG. The second is to allocate this total to the entire slate of covered products created by the manufacturer in the same process. Since LNG is the sole product:  $GGI = CO_2e(TOT)/M(LNG)$ , where M(LNG) is the total mass of produced LNG.

This module provides a means for the Regulator to estimate, based on public information, initial export rebates and import charges for LNG if there were an upstream GHG tax of \$20 per tonne of CO<sub>2</sub>. This information would be useful to the Regulator in evaluating the information provided by exporters to indicate their requested export rebate.

The major contributors to the GGI of LNG occur from GHG-intensive input products—namely, natural gas and electricity. The module describes procedures based on publicly available information that could be used for imports from manufacturers in nations that may not have detailed reporting obligations for manufacturers. Below we estimate these contributions using existing generic information. Final values of GGIs for LNG must account for the loss of natural gas (approximately 10 percent)<sup>4</sup> that is consumed during production for compression and liquefaction. Procedures for determining the GGI automatically account for such losses since the mass of LNG products will be smaller (by about 10 percent) than the mass of input natural gas. Note that estimates for rebates must account for the GHG-intensive inputs and processes used in specific production facilities. For example, these could change significantly if electricity rather than natural gas was used to power more of the conversion.

The major participants in the US LNG industry are already obligated annually to determine and report to the US Environmental Protection Agency (EPA) GHG emissions from their operations if they are over 25,000 tonnes per year. Firms will also know the amounts of LNG they produce, and, under the Framework in the United States, suppliers would be obligated to inform customers (and the Regulator) of the GGI values of GHG-intensive products that they sell. Therefore, manufacturers would have the information needed to determine the GGI values for the LNG that they create. More accurate and timely information to determine rebates and import charges could undoubtedly be obtained by the Regulator from either industry associations or firms (e.g., S&P Global, which has a business of obtaining and marketing information about the GHG aspects of various corporate actions).

Firms that seek rebates for LNG exports will be required to provide the GGI of their product to the Regulator. That information will provide the Regulator with the basis for confirming the GGI and determining the export rebate.

**An important note:** We emphasize that the estimates in this module are meant only to provide indicative, representative values for GGIs of LNG. Actual values will depend on

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<sup>4</sup> See: <https://www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php>

the determination of the GGI for LNG produced at a specific facility. Some of the public data on which the calculations rely date back and probably are not representative of industry performance today. Since companies, associations, and commercial firms that collect and market information about the energy and emissions profiles of a product can provide more accurate information than was used here, the Regulator should seek such information when determining potential import charges or evaluating requests for export rebates. The estimates here do not account for all GHG-intensive chemicals or other materials that may contribute to the GGI. Subject to the administrative costs to evaluate all such inputs and be consistent for both export rebates and import charges, the Regulator should strive to accept all verifiable raw material inputs for the GGI for specific products.

## 2. LNG

Multiple sources indicate that about 10 percent of the natural gas input to LNG facilities is used to provide the energy for compression and liquefaction of the gas. Published information about any purchased electricity used to liquify the natural gas is not available. Thus, this estimate of the GGI for LNG relies on the GGI of natural gas produced in the United States (as discussed in the module on crude petroleum and natural gas), the amounts of such gas used as an input to produce LNG, and the amount of produced LNG.

Results from the module on crude petroleum and natural gas show that in the United States, on average, GGI = 3.06 tonnes CO<sub>2</sub>e per tonne of natural gas. Assuming 10 percent of the natural gas is consumed in processing to make LNG, the GGI for LNG is determined as follows:

$$\begin{aligned} \text{GGI} &= (1 \text{ tonne natural gas} / 0.9 \text{ tonnes LNG}) (3.06 \text{ tonnes CO}_2\text{e} / \text{tonne natural gas}) \\ &= 3.40 \text{ tonnes CO}_2\text{e} / \text{tonne LNG}. \end{aligned}$$

## 3. Export Rebates

If there were an upstream GHG tax of \$20 per tonne of CO<sub>2</sub>, the export rebate per tonne of LNG would be (\$20/tonne CO<sub>2</sub>)(3.40 tonnes CO<sub>2</sub>e/tonne LNG) = \$68.00.

## 4. Import Charges

Since most of world's production of LNG is made by the same or similar processes as assumed for the United States, the GGIs developed for the United States should initially be used to establish import charges for LNG. If an exporter of LNG to the United States is using a different process or one that has a lower GGI than that developed for the United States, it may provide verifiable information of that situation to the US Regulator. Then, the Regulator will be able to adjust the import charge for the country and product based on verifiable information.

Note, however, that evaluation of the GGI for LNG must account for the GGI of the natural gas to be converted to LNG. This may vary significantly, especially depending on venting, flaring, and leaking of gas during production of in-ground natural resources.

If there were an upstream US GHG tax of \$20 per tonne of CO<sub>2</sub>, the initial charge per tonne for imported LNG would be (\$20/tonne CO<sub>2</sub>) (3.40 tonnes CO<sub>2</sub>e/tonne LNG) = \$68.00.

The same charge would apply to all other LNG imports until such time as the importer or exporter provides verifiable data that its LNG was made by a different process and had a different GGI. Again, note that it is important that the import charge should also account for the GGI of the produced natural gas used to manufacture LNG.

Finally, because of its large global warming potential, we note that flaring, venting, and leaking of natural gas during production, processing, and transport (and conversion to LNG) are subject to intense ongoing scrutiny, debate, and controversy, in part because they appear to be very site-specific. Under the Framework, contributions to the GGI would occur only from taxed sources of emissions. Thus, such venting, flaring, and leaking of natural gas during production itself and then its transformation to LNG would be covered if such emissions were taxed.

