

Annex 2: Environmental impacts in the supply chain

The impacts of using LNG on the climate are complex. The state of research is incomplete and inconsistent, and the overall assessment crucially depends on the source. Throughout the entire production and utilization chain, LNG causes significant emissions and impacts on our environment.

This chain follows the stages:

Exploration -> Gas extraction -> Gas processing -> Liquefaction -> Transport -> Discharge and storage -> Regasification and injection -> Utilization

For example:

In 2022, 79% of the total US dry gas production was extracted through fracking.¹ Meanwhile, in 2023, Germany sourced 84% of its LNG from the United States.² While the combustion of natural gas indeed emits fewer greenhouse gases than, for example, coal, a comprehensive view suggests that LNG is likely significantly more climate-damaging than other fossil fuels. While extraction, processing, and transport are very energy-intensive, much of the climate impact results from methane emissions. Over a 100-year period, methane has 28 times greater global warming potential than CO₂. Calculated over a 20-year period, methane is 84 times more potent than CO₂.³ Methane leaks occur along the entire gas utilization chain. They result from drilling, can occur during any transfer operation, or during storage due to faulty equipment.

Despite the significant risks posed by LNG use for the climate, the industry is experiencing a strong boom. The US is forecast to increase its shale gas and tight oil production by 130% from 2022 to 2050.⁴ LNG export capacity from North America is likely to more than double through 2027, with five LNG export projects currently under construction in the US, two in Canada, and three in Mexico.⁵ The expansion is linked to European buyers, with European companies having agreed to 10 contracts for shale gas in 2022 alone.⁶ Even though the US administration recently imposed a pause on yet-to-be-approved LNG projects in the USA, the industry will continue to grow worldwide. This is especially true considering the expectation that if Trump is re-elected, there will likely be an immediate, possibly intensified, resumption of all LNG projects.⁷

From 2026, the LNG terminal in Brunsbüttel will be supplied with 2 million tons of LNG from Qatar over 15 years.⁸ Qatar's natural gas extraction also poses significant risks to the climate.

¹ U.S. Energy Information Administration, How much shale gas is produced in the United States?, <https://www.eia.gov/tools/faqs/faq.php?id=907&t=8>.

² BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., Die Energieversorgung 2023, Jahresbericht 2023, December 2023, S. 20, https://www.bdew.de/media/documents/Jahresbericht_2023_final_18Dez2023_V2.pdf.

³ European commission, Methane emissions, https://energy.ec.europa.eu/topics/oil-gas-and-coal/methane-emissions_en#:~:text=Methane%20is%20the%20second%20most,than%20that%20of%20carbon%20dioxide.

⁴ Statista, N. Sönnichsen, Shale gas and tight oil plays production in the United States from 2000 to 2050, Oct 23, 2023, <https://www.statista.com/statistics/183740/shale-gas-production-in-the-united-states-since-1999/>.

⁵ LNG export capacity from North America is likely to more than double through 2027, 13 November 2023, <https://www.eia.gov/todayinenergy/detail.php?id=60944>.

⁶ Edward Donnelly, LNG fever: European firms sign mega-contracts as US shale gas imports boom, 9 January 2023, <https://www.investigate-europe.eu/posts/lng-fever-mega-contracts-shale-gas-imports-us>.

⁷ Reuters, Biden pauses LNG export approvals after pressure from climate activists, <https://www.reuters.com/business/energy/biden-pauses-approval-new-lng-export-projects-win-climate-activists-2024-01-26/>.

⁸ The Guardian, Germany agrees 15-year liquid gas supply deal with Qatar, <https://www.theguardian.com/world/2022/nov/29/germany-agrees-15-year-liquid-gas-supply-deal-with-qatar>

The country is estimated to have the world's largest natural gas reserves. With complete exploitation and utilization of its natural gas and oil reserves, CO₂ emissions of 50 billion tons are assumed.⁹ In 2022, the entire world emitted approximately 37 billion tons.¹⁰ A reduction in extraction is not in sight. Qatar is on track to significantly increase both its extraction and export capacities, securing this through contractual agreements, especially with Germany.¹¹

Australia has also significantly increased its extraction and export capacities in recent years. In 2022, the island surpassed Qatar as the world's largest exporter of LNG, with a total export volume of approximately 78.5 million tons, accounting for about 20% of total LNG shipments.¹²

Fracking not only plays a major role in terms of climate change but also has severe environmental and health impacts on local communities in fracking regions. Unconventional oil and gas development (UOGD) is water-intensive, produces vast quantities of wastewater, emits greenhouse gases such as methane, releases toxic air pollutants, and generates noise. It contributes to habitat loss and degradation, disrupts migratory pathways, has been linked to direct mortality, and can alter species interactions, population dynamics, and disease dynamics. There is an association between residential proximity to or density of UOGD activity and increased adverse pregnancy outcomes, cancer incidence, hospitalizations, asthma exacerbations, sexually transmitted diseases, mental health issues, and traffic accidents.¹³ Because of these impacts, Ireland has called for a halt to imports of fracked gas.¹⁴

LNG transport is also associated with climate-relevant emissions. These arise on the one hand from the operation of a container shipping fleet that must transport LNG from the exporting to the importing country, and on the other hand from methane leaks occurring during this process. While the actual extent of emissions is unclear due to the uncertain data situation, it is certain that LNG transport is especially associated with the risk of releasing highly climate-relevant methane. Examples for research on this topic are Balcombe et al, 2022¹⁵ or Münter/Liebich, 2023.¹⁶

Overall, it is estimated that LNG transport ships emitted 10.10 million tons of CO₂ equivalent in European waters in 2022. Compared to 2021, this represents a 50% increase from the previous

⁹ TheGuardian, Qatar's gas output increase could cause catastrophic global heating, report says, <https://www.theguardian.com/world/2022/dec/08/qatar-gas-output-increase-catastrophic-global-heating-report>.

¹⁰ Statista, CO₂-Emissionen weltweit in den Jahren 1960 bis 2022 (in Millionen Tonnen), <https://de.statista.com/statistik/daten/studie/37187/umfrage/der-weltweite-co2-ausstoss-seit-1751/>.

¹¹ Tagesschau, Einigung über Flüssigerdgas - Katar liefert LNG an Deutschland <https://www.tagesschau.de/wirtschaft/weltwirtschaft/katar-lng-101.html>.

¹² Reuters, Explainer: How would a strike at Australian LNG facilities affect gas markets?, <https://www.reuters.com/business/energy/how-would-strike-australian-lng-facilities-affect-gas-markets-2023-08-10/>.

¹³ Nicole C Deziel, Bhavna Shamasunder, Liba Pejchar, Synergies and Trade-Offs in Reducing Impacts of Unconventional Oil and Gas Development on Wildlife and Human Health, *BioScience*, Volume 72, Issue 5, May 2022, Pages 472–480, <https://doi.org/10.1093/biosci/biac014>.

¹⁴ Policy statement on the importation of fracked gas, <https://www.gov.ie/en/press-release/dbe48-policy-statement-on-the-importation-of-fracked-gaspublished/#:~:text=Notes%20to%20the%20Editor,the%20environmental%20risk%20it%20poses>

¹⁵ Balcombe, Heggio, Harrison, Total Methane and CO₂Emissions from Liquefied Natural Gas Carrier Ships: The First Primary Measurements, <https://pubs.acs.org/doi/epdf/10.1021/acs.est.2c01383>.

¹⁶ Münter, Liebich, Analysis of the greenhouse gas intensities of LNG imports to Germany, https://www.ifeu.de/fileadmin/uploads/Publikationen/WPKS-Study_Analysis_of_the_greenhouse_gas_intensities_of_LNG_imports_to_Germany.pdf.

year. Meanwhile, the International Maritime Organization has set a target in July 2023 to reduce greenhouse gas emissions from international shipping by at least 40% by 2030.¹⁷

Similarly, the situation arises with the loading, storage, and regasification of LNG. It is also unclear and highly situational to what extent greenhouse gases are released in this step of the chain, but it is certain that it happens.

The Federal Environment Agency of Germany provides a good overview of LNG chain emissions.¹⁸ A study by Robert W. Howarth also attracted considerable attention, attempting a comprehensive assessment of emissions from LNG use in the USA.¹⁹

Studies show that the combustion of natural gas imported through the planned LNG terminals will cause high CO₂ emissions. These emissions will make it nearly impossible for Germany to achieve its climate targets. If Germany were to use 100% of the eleven LNG terminals, CO₂ emissions from the combustion of the imported gas would account for 140 MtCO₂ per year from the end of 2026. This would be a third of the greenhouse gas emissions permissible under the target path in 2030 under the Klimaschutzgesetz (KSG), the German climate law. This does not include CO₂ and fugitive methane emissions from production and transport.²⁰ According to other calculations, the current most likely seven LNG terminals alone would emit 2.1 gigatons of CO₂ over their lifetime, thus consume three quarters of Germany's remaining budget to comply with the Paris climate limit of 1.5-degree (3100 MtCO₂).²¹

¹⁷ IMO, 2023, IMO Strategy on Reduction of GHG Emissions from Ships, <https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx#:~:text=The%202023%20IMO%20GHG%20Strategy%20envisages%2C%20in%20particular%2C%20a%20reduction,at%20least%2040%25%20by%202030.>

¹⁸ Wie klimafreundlich ist LNG?, Umweltbundesamt, https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-05-15_cc_21-2019_roadmap-gas_lng.pdf.

¹⁹ Robert W. Howarth, The Greenhouse Gas Footprint of Liquefied Natural Gas (LNG) Exported from the United States, https://www.research.howarthlab.org/publications/Howarth_LNG_assessment_preprint_archived_2023-1103.pdf.

²⁰ New Climate Institute, German LNG terminal construction plans are massively oversized, December 2022, <https://newclimate.org/sites/default/files/2022-12/German%20LNG%20terminal%20construction%20plans%20are%20massively%20oversized.pdf>

²¹ Deutsche Umwelthilfe e.V., Neue Berechnung der Deutschen Umwelthilfe: LNG-Pläne der Bundesregierung würden Großteil des deutschen CO₂-Restbudgets verbrauchen – Klimagrenze damit unerreichbar, Pressemitteilung v. 19. Mai 2022