Draft
Environmental Assessment

NFE Altamira FLNG, S. de R.L. de C.V.

NFE Altamira FLNG Facility

Office of Resource Sustainability

Office of Fossil Energy and Carbon Management

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ACRONYMS & ABBREVIATIONS

AEO	Annual Energy Outlook
ASEA	Agencia Nacional de Seguridad Industrial y de Protección al Medio Ambiente del Sector Hidrocarburos/National Agency for Industrial Security and Environmental Protection for the Hydrocarbon Industry [Mexico]
Bcf	Billion cubic feet
Bcf/d	Billion cubic feet per day
Bcf/yr	Billion cubic feet per year
CCS	Carbon Capture and Storage
CEQ	Council on Environmental Quality
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide-equivalent
CRE	Comisión Reguladora de Energía/Energy Regulatory Commission [Mexico]
DOE	U.S. Department of Energy
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERA	Environmental Risk Assessment [Mexico]
EViS	Evaluación de Impacto Social/Social Impact Assessment [Mexico]
FECM	Office of Fossil Energy and Carbon Management
FERC	Federal Energy Regulatory Commission
FLNG	Floating Liquefied Natural Gas
FTA	Free Trade Agreement
GHG	Greenhouse Gas
GWP	Global Warming Potential
IEA	International Energy Agency
INAH	Instituto Nacional de Antropología e Historia/National Institute of Anthropology and History [Mexico]
LGEEPA	Ley General del Equilibrio Ecológico y la Protección al Ambiente/General Law of Ecological Balance and Environmental Protection [Mexico]
LNG	Liquefied Natural Gas
MIA	Manifestación de Impacto Ambiental [Mexico review process - Environmental Impact Assessment]
MWh	Megawatt-hour
MMcf	Million cubic feet
NETL	National Energy Technology Laboratory
SEMARNET	Secretaría de Medio Ambiente y Recursos Naturales/Ministry of Environmental and Natural Resources [Mexico]
SENER	Secretaría de Energía/Ministry of Energy [Mexico]
NEPA	National Environmental Policy Act
NGA	Natural Gas Act
PHMSA	Pipeline and Hazardous Materials Safety Administration
ROI	Region of Influence
Tcf	Trillion cubic feet
Tj	Terajoule

1 Introduction

1.1 Background

The Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) received an application[1] from NFE Altamira FLNG, S. de R.L. de C.V. (NFE Altamira or Applicant),[2] on September 9, 2022 (Application). In this Application, NFE Altamira requests long-term, multi-contract authorization to export domestically-produced natural gas from the United States to Mexico through existing cross-border pipeline facilities and, after liquefaction in Mexico, to re-export[3] the U.S.-sourced natural gas in the form of liquefied natural gas (LNG) to other countries.[4]

The Natural Gas Act (NGA)[5] requires that proposed imports and/or exports of natural gas, including LNG, in applications to FECM requesting authorization of imports and/or exports from and/or to nations with which there are in effect free trade agreements (FTA) requiring national treatment for trade in natural gas (FTA countries), be deemed consistent with the public interest and granted without modification or delay.[6]

[1] NFE Altamira FLNG, S. de R.L. de C.V., Application for Long-Term, Multi-Contract Authorizations to Export Natural Gas to Mexico and to Re-Export Liquefied Natural Gas from Mexico to Free Trade Agreement and Non-Free Trade Agreement Nations, Docket No. 22-110-LNG (Sept. 9, 2022), https://www.energy.gov/sites/default/files/2022-09/22-110-LNG.pdf.

[2] The legal name of the Applicant is NFE Altamira FLNG, S. de R.L. de C.V., a Mexican trading company that is an indirect wholly-owned subsidiary of New Fortress Energy Inc. ("NFE"), which is publicly traded on the NASDAQ exchange.

[3] For purposes of this Environmental Assessment, "re-export" means to ship or transmit U.S.-sourced natural gas in its various forms (gas, compressed, or liquefied) subject to DOE's jurisdiction under the Natural Gas Act, 15 U.S.C. § 717b, from one foreign country (*i.e.*, a country other than the United States) to another foreign country.

[4] In preparing this Environmental Assessment, DOE sought additional information regarding greenhouse gas emissions from the Applicant. Technical details were discussed in two calls and documented in written questions and answers in each instance. *See* "Letter to NFE Altamira FLNG, S. de R.L. de C.V. Requesting Additional Information for Environmental Assessment" (July 18, 2023), "Responses to Informational Questions for DOE's Environmental Assessment" (July 26, 2023), "Request for Clarification for Environmental Assessment" (Aug. 23, 2023), and "Response to Request for Clarifications for Environmental Assessment" (Aug. 24, 2023), *available at* https://www.energy.gov/fecm/articles/nfe-altamira-flng-s-de-rl-de-cv-fecm-dkt-no-22-110-lng.

[5] 15 U.S.C. § 717b(c).

[6] DOE is required by NGA section 3(c) to authorize LNG exports to FTA countries. Section 3(c) provides that all such exports are "deemed to be consistent with the public interest" and that their authorization "shall be granted without modification or delay." Therefore, because DOE lacks discretion with respect to such approvals, the approvals do not require environmental analysis under the National Environmental Policy Act, 42 U.S.C. § 4321 *et seq*. The U.S. Trade Representative maintains a list of countries with which the United States has free trade agreements at https://ustr.gov/trade-agreements/free-trade-agreements.

In the case of applications to export LNG to non-FTA countries,[7] section 3(a) of the NGA[8] requires DOE to conduct a public interest review and grant authority to export unless DOE finds that the proposed exports would not be consistent with the public interest. In addition, DOE's decision whether to authorize natural gas exports to non-FTA countries must comply with the National Environmental Policy Act (NEPA).[9] This environmental assessment (EA), prepared pursuant to NEPA, also informs DOE's public interest analysis under the NGA.

1.2 Purpose and Need

1.2.1 Applicant

NFE Altamira states that the proposed facility is designed to meet significant future LNG demand. In its Application, NFE Altamira states that the facility "… will provide a safe and reliable source of much needed natural gas supply to global markets in the form of LNG, consistent with … the Applicant's commitment to making clean, affordable energy available to markets around the world."[10]

1.2.2 Department of Energy

DOE's purpose is to review the Application under NGA section 3(a), and to authorize the natural gas exports requested unless it finds that the proposed exports would not be consistent with the public interest.

1.3 Alternatives

DOE evaluated the Proposed Action of granting the requested authorization to NFE Altamira and a No Action Alternative in which the requested authorization would not be granted.

1.3.1 Proposed Action

1.3.1.1 Project Description

The Application requests authorization to export up to 158 billion cubic feet per year (Bcf/y) of natural gas through an existing cross-border pipeline, of which approximately 13 Bcf/y would be consumed as fuel in the liquefaction process and as process gas loss during the pretreatment process, and the remaining 145 Bcf/y would be liquefied for export at the proposed NFE Altamira FLNG facility (Facility).

[7] Non-FTA countries are those with which the U.S. does not have an FTA requiring national treatment for trade in natural gas, and with which trade is not prohibited by U.S. law or policy.
[8] 15 U.S.C. § 717b(a).
[9] 42 U.S.C. § 4321 *et seq*.
[10] Application at 4.

The Facility would include the installation of two "Fast LNG"[11] liquefaction systems, FLNG1[12] and FLNG2, co-located in Mexican territorial waters in the Gulf of Mexico near Altamira, Tamaulipas, Mexico (see Figure 1).[13] According to the Application,[14] each FLNG system would include three individual platforms: one for natural gas processing equipment, one for natural gas liquefaction equipment, and one for associated utilities and accommodations. FLNG1 would consist of three self-elevating ("jack-up") platforms, while FLNG2, located nearly adjacent to FLNG1, would utilize three fixed platform structures. The LNG produced by both FLNG1 and FLNG2 would be transferred to a moored LNG carrier that would act as a Floating LNG Storage Unit (FSU), via a flexible, partially submerged, 220-meter cryogenic hose transfer system. The stored LNG would subsequently be transferred from the FSU to ocean going LNG transport vessels for delivery to export destinations.

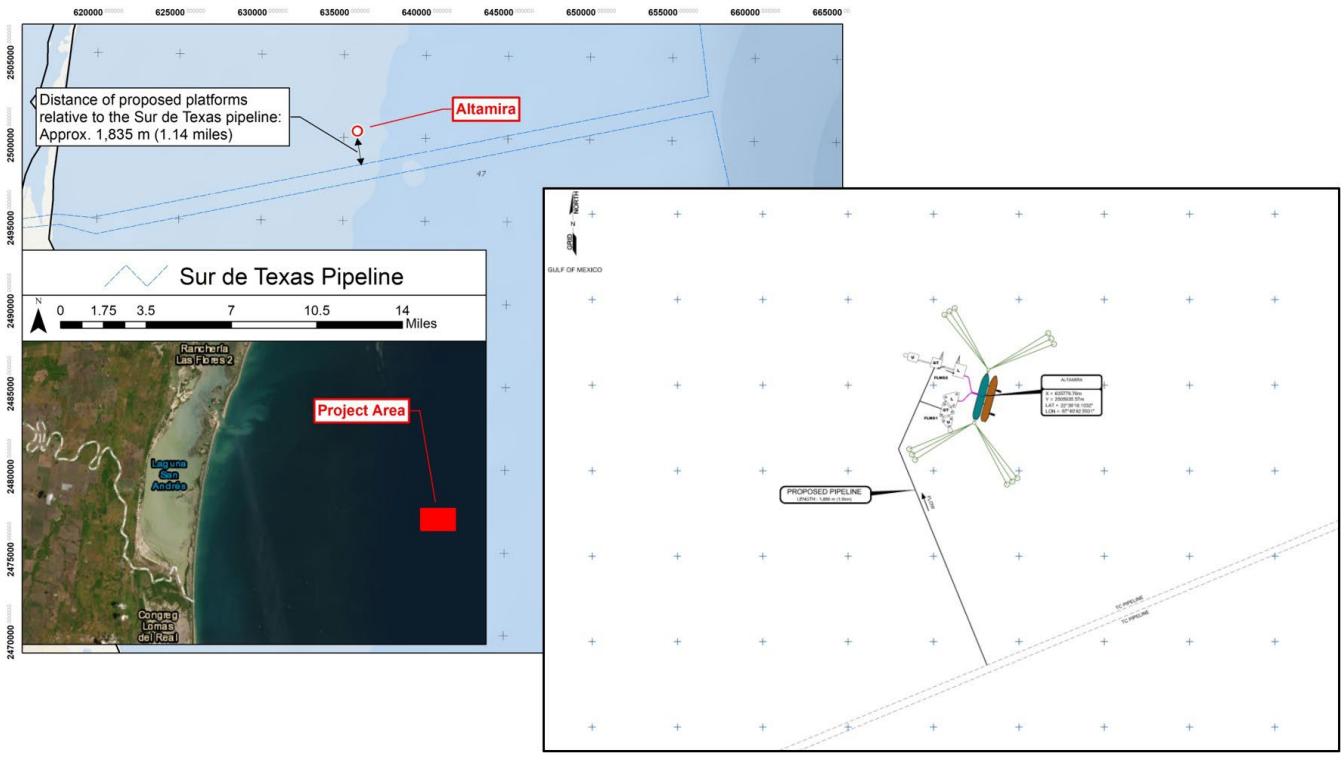

Figure 1. Location of NFE Altamira FLNG Facility and plat showing platform arrangement (Source: Google Maps and Application)

[11] NFE Altamira's "Fast LNG" approach is described on the website of its parent company, New Fortress Energy. *See* https://www.newfortressenergy.com/stories/altamira-fast-lng-1-brings-positive-energy-mexico#:~:text=Our%20first%20Fast%20LNG%20installation,the%20east%20coast%20of%20Mexico (last accessed Sep. 15, 2023).

[12] In the LNG industry, "FLNG" stands for Floating Liquefied Natural Gas, where liquefaction equipment is located on a floating structure rather than onshore.

[13] Application at 4-5.

[14] *See id.*

The Application states that the Applicant's FLNG systems are designed and engineered to employ a modular approach in order to enable faster creation of liquefaction capacity.[15] This approach involves assembling components onto decks in shipyards and subsequently installing them on mobile platforms (such as jack-ups) or on fixed platforms.[16]

The Application states that each of the two FLNG systems is designed to receive approximately 79 Bcf/y (0.216 Bcf/day) of natural gas, of which approximately 6.5 Bcf/y (0.018 Bcf/day) would be consumed either as process gas used during the pretreatment process or as fuel in the liquefaction process, for a total productive capacity of approximately 72.5 Bcf/y (0.199 Bcf/day) of natural gas per FLNG system, which is equivalent to approximately 1.4 million tons per year (MTPA) of LNG per FLNG system, or a total of 145 Bcf/y (0.397 Bcf/day or 2.8 MTPA) for the Facility.[17]

The Application further states that the Facility would source its natural gas from multiple supply hubs throughout the U.S. natural gas pipeline grid, and would transport such natural gas via pipeline from the United States to Mexico. The Applicant has identified Valley Crossing Pipeline as the proposed export point from the United States.[18] Valley Crossing Pipeline is a Texas intrastate pipeline located in South Texas and designed to export natural gas to Mexico (see Figure 2). It originates at the Nueces Header system near Agua Dulce, which has connectivity to a mix of approximately 10 intrastate and interstate pipelines.[19] The Valley Crossing pipeline system has the capacity to deliver up to 2.6 Bcf/d from the Nueces Header to an offshore interconnect (Marina del Golfo) at the U.S./Mexico international border.[20] A U.S. Energy Information Administration (EIA) database provides a history of U.S. exports to Mexico via the Brownsville, Texas border crossing, which uniquely corresponds to the Valley Crossing Pipeline. These data show that from January 2021 through May 2023, the export volume for the Valley Crossing pipeline has averaged 0.904 Bcf/d, or approximately 35% of total capacity.[21]

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[15] *See id.* at 5.
[16] The assembly process is described on the website of NFE Altamira's parent company, New Fortress Energy. *See* https://www.newfortressenergy.com/fast-lng (last accessed Sept. 15, 2023).
[17] *See* Application at 4-5 (as further clarified in "Response to Request for Clarifications for Environmental Assessment," Annex A, at 2, Question #5, Docket No. 22-110-LNG (Aug. 24, 2023), https://www.energy.gov/sites/default/files/2023-08/22-110-LNG_NFE%20Altamira_Response%20to%20Request%20for%20Clarifications%20for%20EA%2008.24.2023.pdf).
[18] *Id.* at 6-7.
[19] Valley Crossing Pipeline diagram and map, *available at* https://infopost.enbridge.com/infopost/VCPHome.asp?Pipe=VCP.
[20] *Id.*
[21] U.S. Energy Information Administration (EIA), Brownsville, TX Natural Gas Pipeline Exports to Mexico, 2029-2023, *available at* https://www.eia.gov/dnav/ng/hist/ngm_epg0_enp_ybrown-nmx_mmcfM.htm.

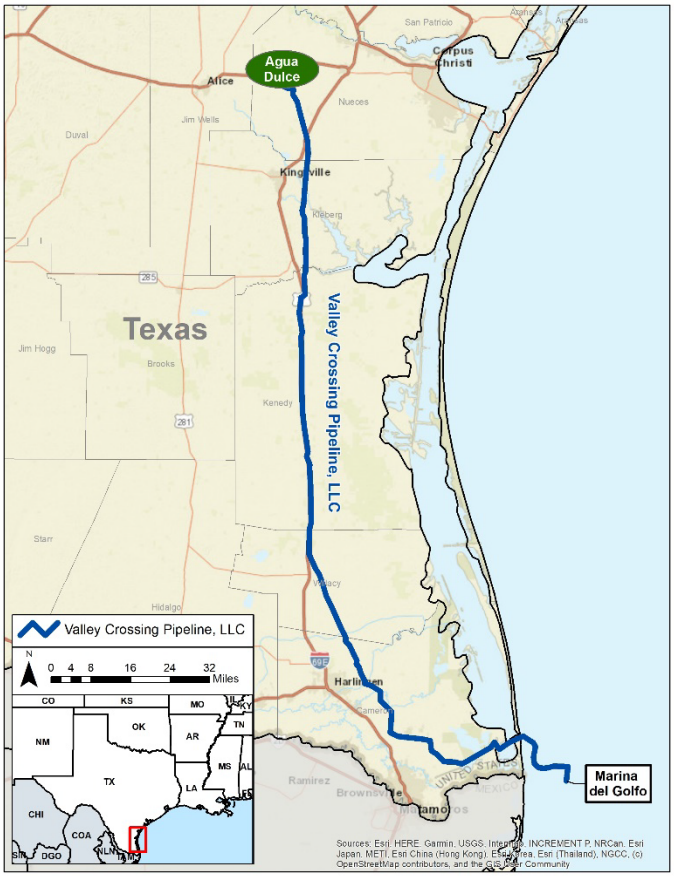

Figure 2. Map showing location of Valley Crossing Pipeline

The Valley Crossing Pipeline connects with the Sur de Texas-Tuxpan pipeline system (owned by a subsidiary of TC Energy), which travels south, offshore in Mexican territorial waters (see Figure 3).[22]

[22] TC Energy, https://www.tcenergy.com/operations/natural-gas/sur-de-texas-tuxpan-pipeline/#documents (last accessed Sept. 15, 2023).

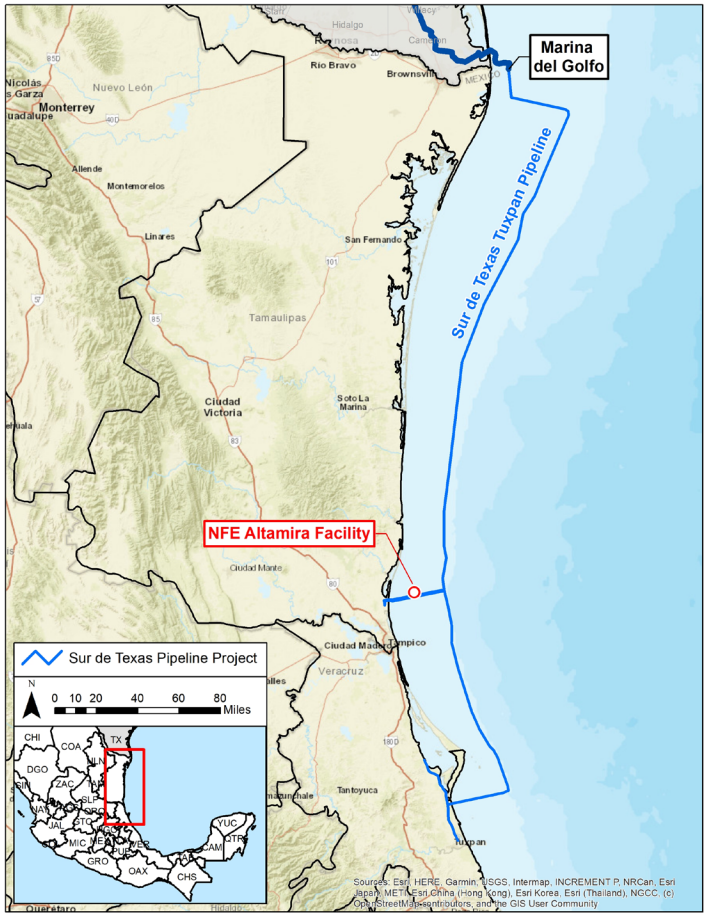

Figure 3. Map showing location of Sur de Texas-Tuxpan Pipeline[23]

The Sur de Texas-Tuxpan pipeline includes an east-west lateral that supplies the Altamira V powerplant.[24] The feed gas supply for the NFE Altamira Facility would be transported from this Sur de Texas-Tuxpan pipeline lateral via one, newly installed pipeline lateral (constructed as part of the Facility, see Figure 1).[25]

The Application anticipates that LNG carriers would call at the NFE Altamira Facility approximately 40 times per year.[26] The Application states that, other than temporary construction staging areas, there would be no onshore facilities associated with the Facility.[27] The construction and operation of the required pipeline lateral in Mexican territorial waters and both floating and fixed liquefaction facilities requires

[23] Source: https://www.tcenergy.com/siteassets/pdfs/natural-gas/sur-de-texas--tuxpan-pipeline/transcanada-2017-sur-de-texas-pipeline-project.pdf.
[24] J. Robinson and J. Hilfiker, *Analysis: Sur de Texas record exports point to downstream testing in Mexico,* S&P Global Commodity Insights (Feb. 26, 2020), https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/022620-sur-de-texas-record-exports-point-to-downstream-testing-in-mexico.
[25] Application at 7.
[26] *Id.*
[27] *Id.*

permits and authorizations from various Mexican federal regulatory entities (some or all of which have been received), as well as authorization from DOE for the export of U.S.-produced gas and for the re-export of LNG to FTA and non-FTA nations.

According to the Semi-Annual report filed by NFE Altamira with DOE in March of 2023, having received all required permits for this component of the Facility, construction has begun on the associated natural gas pipeline lateral.[28] On June 2, 2023, NFE announced[29] that it had received an export permit for the proposed Facility from Mexico's Ministry of Energy (Secretaría de Energía or SENER). Under the permit granted by SENER, NFE states that it is now authorized to export up to 7.8 million metric tons through April 2028.[30]

On August 8, 2023, NFE announced in its 2nd Quarter 2023 Results press release that it had installed the first of the three jack-up rigs (Pioneer III) for FLNG1.[31] Further, NFE stated that it expected to complete and install the remaining two FLNG1 rigs in August and achieve commercial operation status with respect to FLNG1 in September.

1.3.1.2 DOE's Proposed Action

DOE's proposed action is to authorize the exports described in the Application if DOE determines that such exports are not inconsistent with the public interest.

1.3.2 No Action Alternative

If the Application is not granted, DOE assumes, for the purposes of this EA, that the Facility would not be operated and the potential environmental impacts from the Facility would not occur. However, global demand for natural gas, including demand for LNG, is expected to experience growth, even accounting for the transition away from fossil fuels.[32] DOE therefore believes it is likely that some or all of the demand

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[28] NFE Altamira FLNG, S. de R.L. de C.V., Semi-Annual Report, Docket No. 22-110-LNG (Mar. 31, 2023), https://www.energy.gov/sites/default/files/2023-04/NFE%20Altamira%20FLNG%20Semi-Annual%20Report%20March%202023.pdf.

[29] New Fortress Energy Receives Mexico Export Authorization For Altamira Fast LNG Project (June 2, 2023), https://ir.newfortressenergy.com/news-releases/news-release-details/new-fortress-energy-receives-mexico-export-authorization.

[30] *Id.*

[31] New Fortress Energy, Press Release: New Fortress Energy Announces Second Quarter 2023 Results (Aug. 8, 2023), https://ir.newfortressenergy.com/news-releases/news-release-details/new-fortress-energy-announces-second-quarter-2023-results.

[32] Several forecasting entities project continued growth in natural gas demand. For example, EIA's International Energy Outlook 2021 projects global natural gas consumption to increase by more than 30% between 2019 and 2050, in its Reference Case, even as it projects renewable sources to pass natural gas by the end of the 2030s. *See* EIA, International Energy Outlook 2021, https://www.eia.gov/outlooks/ieo/consumption/sub-topic-01.php. McKinsey has also projected LNG demand growth averaging 3.4% per year to 2035, with continued growth of 0.5% per year through 2050. The firm's accelerated transition scenario still shows an increase in demand only slightly lower by mid-century. *See* McKinsey, Global

for LNG that the Facility is intended to serve would be met by other LNG facilities, if the Facility were not to be placed in service.

1.4 Scope of the Environmental Assessment

1.4.1 Extraterritorial Impacts

The environmental impacts subject to analysis in this EA are limited to those direct and indirect impacts that would occur in the United States and those that affect the global commons, such as global climate change resulting from emissions of greenhouse gases (GHGs). This EA does not analyze potential environmental impacts associated with elements of the application that would occur within the sovereign territory of Mexico (including its territorial waters) or any other country. These include the potential local and regional impacts of pipeline transportation of natural gas within Mexico to the Facility, the construction and operation of the Facility in Mexico (including LNG terminal operations), and terminal operations, transport, and use of LNG within receiving countries.

NEPA does not require an analysis of environmental impacts that occur within another sovereign nation that result from actions approved by that sovereign nation. Executive Order (E.O.) No. 12114 requires federal agencies to prepare an analysis of significant impacts from a federal action in certain defined circumstances and exempts agencies from preparing analyses in others. The E.O. does not require federal agencies to evaluate impacts outside the United States when the foreign nation is participating with the United States or is otherwise involved in the action.[33] The proposed Facility to be used in connection with this application will be sited in Mexico and meets this criterion – it would have to be constructed and/or assembled and sited in accordance with all applicable Mexican laws, regulations, and standards. Additionally, aside from the life cycle emission of GHGs and the marine transport of LNG in international waters, the federal action would not affect the global commons.

Gas Outlook to 2050, Summary Report, at 2 (Feb. 2021), https://www.mckinsey.com/~/media/mckinsey/industries/oil%20and%20gas/our%20insights/global%20gas%20outlook%20to%202050/global-gas-outlook-2050-executive-summary.pdf. Other forecasters, such as the International Energy Agency and BP, also show increasing global demand for natural gas through at least 2030. *See* Economist Intelligence, *Fossil fuel demand to continue expanding this decade* (July 10, 2023), https://www.eiu.com/n/fossil-fuel-demand-to-continue-expanding-this-decade/.

[33] *See* E.O. 12114, *Environmental effects abroad of major Federal actions*, § 2-3(b) (Jan. 4, 1979), https://www.archives.gov/federal-register/codification/executive-order/12114.html.

1.4.2 Summary of Mexico's Environmental Review Process

The extent to which the Facility and any associated pipeline facilities are constructed and/or assembled in Mexico are subject to review and approval by Mexican agencies under federal laws of that nation. While outside of the scope of this EA, DOE is providing information about Mexico's review process for the public's information. The agencies in Mexico with potential jurisdiction over the activities proposed within Mexico, with respect to environmental and cultural impacts, are listed in Table 1.

Agency	Environmental, Cultural and Safety Assessments
Environmental and Safety Agency for the Hydrocarbon Industry (ASEA)	Manifestación de Impacto Ambiental/Environmental Impact Assessment (MIA); Estudio de Riesgo Ambiental/Environmental Risk Assessment (ERA); Registration of Industrial, Operational, and Environmental Safety Management Systems; Unique Regulated Registry Number; Technical Justification Study demonstrating that the ecosystem's biodiversity will not be jeopardized where natural vegetation will be removed
Energy Regulatory Commission (CRE)	Transportation permit for natural gas through pipelines, with any new pipeline engineering to be verified by a third party with a report that supports the permitted design
Secretary of Energy (SENER)	Evaluación de Impacto Social/Social Impact Assessment (EvIS), which identifies, characterizes, and assesses social impacts that could be caused by the project; Social Management Plan designed to implement specific measures required to address positive or negative social impacts
National Institute of Anthropology and History (INAH)	Archaeological Survey conducted before construction; archaeological clearance if INAH finds that archaeological vestiges exist

Table 1. Mexican agencies responsible for environmental, cultural, and safety assessments for LNG and/or pipeline projects[34]

Mexico's primary statute governing environmental reviews of projects is the Ley General del Equilibrio Ecológico y la Protección al Ambiente/General Law of Ecological Balance and Environmental Protection (LGEEPA), which is administered by the Secretaría de Medio Ambiente y Recursos Naturales/Ministry of Environmental and Natural Resources (SEMARNAT). Within the SEMARNAT, the Agencia Nacional de Seguridad Industrial y de Protección al Medio Ambiente del Sector Hidrocarburos/National Agency for Industrial Security and Environmental Protection for the Hydrocarbon Industry (ASEA), is responsible for regulating and supervising industrial, operational, and environmental safety for projects related to the hydrocarbon sector, including the construction of natural gas pipelines and liquefaction facilities.

As part of ASEA's review of projects under LGEEPA, an MIA must be prepared. Similar to an Environmental Impact Statement (EIS) under NEPA, an MIA presents the results of comprehensive analysis and studies of potential environmental impacts associated with a project, including site

[34] *See* Application at 19-22.

preparation, construction, operation, and decommissioning, as well as an assessment of measures to mitigate environmental impacts and an analysis demonstrating compliance with Mexican laws and regulations, as well as prudent industry practices and international standards.

ASEA also oversees a facility's continued compliance with applicable laws, regulations, and conditions governing safety, risk mitigation, technical processes, and the environment. In addition to review of the MIA and ERA, ASEA reviews and issues authorizations for projects, such as pipelines and liquefaction facilities, that will impact existing land use.

Project proponents of pipeline and liquefaction facilities must perform an EvIS, which identifies, characterizes, and assesses social impacts that could be caused by the project along with a social management plan to address those impacts. The EvIS is subject to review and approval of the Secretaría de Energía/Ministry of Energy. In addition, permits are required from the Comisión Reguladora de Energía/Energy Regulatory Commission to engage in activities that are subject to third-party access and those activities that are not subject to third-party access but require a permit, including the self-supply of electric energy, transportation, liquefaction, regasification, and storage of natural gas in Mexico.

2 Potential Environmental Impacts

2.1 Affected Environment

The affected environment is limited to the areas potentially affected by the Proposed Action that are within the scope of the EA, as identified in section 1.4.

2.1.1 Incremental Natural Gas Production

Potential natural gas sources for the Facility include producing basins in the lower-48 states. The EIA projects that, by 2030, over 95% of natural gas produced onshore in the lower-48 states will be produced from "unconventional" resources, which include gas from tight sandstone formations, gas from shale formations or gas associated with oil in tight formations, and gas from coal beds ("coalbed methane").[35] According to EIA's 2023 Annual Energy Outlook (AEO), the share of onshore natural gas produced from these sources is expected to remain above 95% in 2050.[36] The most likely impacts associated with natural gas production would therefore relate to Facility-induced incremental production of those resources. DOE's environmental study, *Addendum to Environmental Review Documents Concerning Imports of Natural Gas from the United States* (Aug. 2014) (Addendum),[37] which is incorporated herein by reference,

[35] *See* EIA, *Annual Energy Outlook 2023*, Table 14, *available at* https://www.eia.gov/outlooks/aeo/.
[36] *See id.*
[37] U.S. Department of Energy, *Addendum to Environmental Review Documents Concerning Exports of Natural Gas from the United States* (Aug. 2014), https://www.energy.gov/sites/prod/files/2014/08/f18/Addendum.pdf.

identifies areas potentially affected by unconventional natural gas production, including water resources, air quality, induced seismicity, and land use.[38]

2.1.2 Incremental Cross-Border Pipeline Transportation of Natural Gas

NFE Altamira proposes to utilize the Valley Crossing Pipeline to export natural gas from the United States to Mexico, connecting to the Sur de Texas-Tuxpan pipeline at the international border. In its Application, NFE Altamira does not propose to construct and operate new pipeline facilities in the United States. Natural gas transported on behalf of the Facility would increase utilization of pipelines, and therefore has the potential to cause incremental impacts in emissions related to pipeline operations. (These potential impacts are addressed in section 2.2.2.1, below.)

2.1.3 Marine Transportation of LNG

Exports from the Facility off the coast of Mexico, in Mexican territorial waters, would occur via ocean transport. The potentially affected environment in marine transportation of LNG includes resources that could be impacted by a release of the LNG cargo, in liquid or gaseous form, as well as routine shipping-related risks, such as fuel leaks and engine emissions. These resources include the ocean environment and the atmosphere in the area around an LNG vessel at sea.

2.1.4 GHG Emissions and Climate Change

Rising atmospheric GHG concentrations are significantly altering global climate systems with the potential for long-term impacts on human society and the environment. The region of influence (ROI) for GHGs differs from other resource areas considered in this EA since the concerns about GHG emissions are primarily related to climate change, which is global and cumulative in nature.

Increasing GHG concentrations in the atmosphere are linked to a range of ongoing and potential changes to global climate. Assessments of future climate change are strongly dependent on predicted trends in GHG emissions, which depend on future policy and other actions to reduce GHG emissions. Climate change is linked to rising surface temperatures, changing levels of precipitation, reduction in sea ice cover, increasing ocean temperature, and rising sea levels. Climate change can result in changes in ecosystems, as well as an increase in the frequency and severity of extreme weather events, and can impact human health and society.

[38] The Addendum also addresses potential impacts on upstream GHG emissions (apart from their role in local or regional air quality), but those emissions are addressed holistically with emissions from other life cycle segments in section 2.1.4 ("GHG Emissions and Climate Change") below.

2.2 Potential Impacts

2.2.1 Natural Gas Production

The natural gas to be liquefied and exported by the Facility would first have to be produced from natural gas wells in the lower-48 states. As noted in section 2.1.1, a significant majority of onshore natural gas produced in the lower-48 United States is from unconventional resources.

2.2.1.1 Proposed Action

On August 15, 2014, DOE published the Addendum. DOE prepared the Addendum to be responsive to the public and to provide the best information available on a subject that had been raised by commenters in LNG export application dockets. The Addendum addresses unconventional natural gas production in the lower-48 states. It does not attempt to identify or characterize the incremental environmental impacts that would result from LNG exports to non-FTA countries.[39]

The Addendum determined that the current rapid development of natural gas resources in the United States likely will continue, with or without the export of natural gas to non-FTA nations.[40] Nevertheless, a decision by DOE to authorize exports to non-FTA nations could accelerate that development by some increment. The Addendum reviewed the academic and technical literature covering the most significant issues associated with unconventional natural gas production, including impacts to water resources, air quality, GHG emissions, induced seismicity, and land use.

The Addendum shows that there are potential environmental issues associated with unconventional natural gas production that need to be carefully managed, especially with respect to emissions of volatile organic compounds and methane, and the potential for groundwater contamination. However, DOE does not have the ability to determine which specific natural gas resources would be produced to serve the Facility.

2.2.1.2 No Action Alternative

In the No Action Alternative, LNG would not be supplied from the Facility. In this case, DOE assumes that other LNG facilities would serve incremental international demand for LNG, supplying some or all of the volume planned to be supplied by the Facility. Therefore, natural gas could be produced for liquefaction, in the United States or in another country.

If produced in the lower-48 United States for a North American project, any potential impacts related to incremental natural gas production would similarly occur in the No Action Alternative, which would therefore not have a currently identifiable environmental advantage over the proposed action. If produced

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[39] *See Sierra Club v. U.S. Dept. of Energy*, 867 F.3d 189, 198–99 (D.C. Cir. 2017) (upholding DOE's conclusion that, without knowing where local production of the incremental natural gas would occur, the corresponding environmental impacts are not reasonably foreseeable under NEPA).
[40] Addendum at 2.

outside of the United States for a foreign LNG project, it would be outside the scope of this analysis to assess impacts from natural gas production.

2.2.2 Natural Gas Pipelines

2.2.2.1 Proposed Action

DOE considered potential environmental impacts from natural gas pipeline transportation in the lower-48 states that may be caused by the Facility's natural gas demand, which would be equal to about 0.54% of U.S. pipeline system throughput in 2022.[41] All of the U.S. pipelines that could potentially transport natural gas to Mexico for the Facility's use are under federal or state jurisdiction. They have been, or, in the case of any pipelines that may be under development, are being or will be evaluated by the Federal Energy Regulatory Commission (FERC) and/or the relevant state regulatory authorities, for environmental and other impacts.[42]

Incremental pipeline throughput would not increase the flow of natural gas to levels above those permitted by FERC and/or state regulatory authorities, for existing or future pipelines. Incremental natural gas flow caused by the Facility's demand would therefore not be expected to cause environmental effects that exceed permitted levels.

DOE also considered pipeline safety and accidental emissions. Potential impacts relevant to this EA are any impacts associated with the operation of pipelines that might be incrementally greater with marginally higher throughput due to the Facility's demand. The Pipeline and Hazardous Materials Safety Administration (PHMSA) develops and enforces regulations for the safe, reliable, and environmentally sound operation of the Nation's pipeline transportation system.[43]

DOE reviewed PHMSA incident reports submitted by companies that operate U.S. pipelines that connect at border crossings between the United States and Mexico. DOE found that, between January 2010 and August 2, 2023, the operator of Valley Crossing reported only one incident (see Table 2). The incident occurred on March 12, 2020, when an emergency shutdown valve (ESD) was activated at the Agua Dulce compressor station in Nueces County, Texas, which is not associated with the pipeline's border crossing facilities. It was determined that the ESD functioned properly, but that it had been activated by a faulty fuse. The shutdown resulted in the emission of a total of approximately 3.5 million cubic feet (MMcf) of natural gas.

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[41] The Application requests authority to export up to 158 Bcf/yr. EIA reports that the U.S. natural gas transportation network "delivered about 29.1 [Tcf] of natural gas" in 2022 (158 Bcf ÷ 29.1 Tcf, or 29,100 Bcf = 0.54%). EIA, Natural Gas Explained: Natural Gas Pipelines, https://www.eia.gov/dnav/ng/ng_cons_sum_a_EPG0_vgt_mmcf_a.htm.

[42] For information about FERC's regulatory role for natural gas pipelines, see the web page at https://www.ferc.gov/industries-data/natural-gas/overview/natural-gas-pipelines#:~:text=FERC%20itself%20has%20no%20jurisdiction,needed%20pipelines%20and%20related%20facilities.

[43] For information on PHMSA's role in ensuring the safe operation of natural gas pipelines, see https://www.phmsa.dot.gov/regulations.

Company	System	Incident Reports	Total Vol. Gas Released (MMcf)	Causes
Valley Crossing	Transport	1	3.5	Equipment failure (1)

Table 2. Data on Incidents Involving the Valley Crossing Pipeline from PHMSA incident reports[44] from January 2010 to August 2, 2023

According to EIA data, from January 2010 through May 2023 (the most recent data available as of August 2023), approximately 17.43 Trillion cubic feet (Tcf) of natural gas was exported via pipeline to Mexico.[45] Therefore, the associated accidental emissions from this incident were equivalent to less than one-ten-thousandth of one percent[46] of total natural gas exported to Mexico by pipeline during this period, well below current estimates of average methane emissions associated with natural gas transport across the U.S. natural gas infrastructure.[47]

2.2.2.2 No Action Alternative

If the Facility did not become operational, any potential local or regional impacts associated with incremental pipeline transportation of natural gas for the Facility would not occur. If alternative incremental LNG production capacity were constructed in North America using natural gas from the lower-48 states, local or regional impacts would be similar to gas supplied to the Facility (although perhaps at different locations in the United States), and the No Action Alternative would not have a currently identifiable environmental advantage over the Proposed Action. If incremental liquefaction capacity were developed outside of the United States, impacts associated with pipeline transportation would occur within a sovereign foreign country and therefore would be outside the scope of this analysis.

2.2.3 Marine Transport of LNG

2.2.3.1 Proposed Action

DOE considered potential impacts associated with the marine transport of LNG from production facilities to destination markets. As part of a NEPA rulemaking finalized on December 4, 2020,[48] DOE conducted

[44] PHMSA, Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data, https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data.

[45] *See* EIA, U.S. Natural Gas Pipeline Exports to Mexico, https://www.eia.gov/dnav/ng/hist/n9132mx2m.htm.

[46] 3.5×10^6 cubic feet / 17.43×10^{12} cubic feet = 0.0000002.

[47] The EPA's 2023 GHG Inventory (GHGI) states that methane emissions from U.S. natural gas transport and storage activities in 2021 totaled about 44.5 MMT CO_2-eq (1590 kt of CH_4). https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf (Tables 3-66 and 3-67). This is equivalent to about 82.55 Bcf of methane. *See* Environmental Protection Agency (EPA) Conversion tables, https://www.epa.gov/cmop/coal-mine-methane-units-converter#metricTons. U.S. natural gas production totaled 34.5 Tcf in 2021. *See* https://www.eia.gov/naturalgas/annual/#:~:text=U.S.%20natural%20gas%20imports%20increased,Bcf%2Fd)%20in%202020 . This translates to a loss of 0.002 cubic feet of methane emitted to the atmosphere per cubic foot of natural gas transported—roughly 0.2%, since natural gas is mostly methane.

[48] *See* U.S. Dept. of Energy, National Environmental Policy Act Implementing Procedures, Final Rule; 85 Fed. Reg. 78,197 (Dec. 4, 2020).

a detailed review of technical documents regarding potential effects associated with marine transport of LNG.[49] These documents were identified in an accompanying Marine Transport Technical Support Document (Technical Support Document), which is incorporated herein by reference.[50] On the basis of the data referenced in the Technical Support Document, DOE concluded that "the transport of natural gas by marine vessels adhering to applicable maritime safety regulations and established shipping methods and safety standards normally does not pose the potential for significant environmental impacts."[51]

2.2.3.2 No Action Alternative

If the Facility did not become operational, some or all of the volume of LNG the Facility would have exported could be supplied to markets from other sources. Although varying with transportation distance (which could be shorter or longer), DOE finds that these impacts would be similar to those identified in the Marine Transport Technical Support Document, and would also "not pose the potential for significant environmental impacts."

2.2.4 GHG Emissions

2.2.4.1 Proposed Action

DOE's National Energy Technology Laboratory (NETL) conducted a study in 2014, updated in 2019 (collectively, GHG Studies), of GHG emissions attributable to LNG exports from the lower-48 states, to inform decisions on applications to export lower-48 natural gas in the form of LNG to non-FTA countries. DOE has determined that the findings of the GHG Studies are applicable to assessment of the GHG emissions from the Facility. DOE finds that its study of Life Cycle GHG emissions provides sufficient consideration of these emissions.

In 2014, NETL published *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (2014 LCA GHG Report).[52] The 2014 LCA GHG Report calculated the life cycle GHG emissions for LNG made from natural gas sourced from the lower-48 states and exported to markets in Europe and Asia. DOE commissioned this life cycle analysis (LCA) to inform its review of non-FTA applications, as part of its broader effort to evaluate different environmental aspects of the LNG production and export chain. The 2014 LCA GHG Report concluded that the use of U.S. LNG exports for power production in European and Asian markets would not increase global GHG emissions from a life cycle perspective, when compared to regional coal extraction in the global regions near the point of consumption, and consumption for power production.

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[49] *Id.* at 78,199.
[50] *See id*. at 78,198 n.16 (citing U.S. Dept. of Energy, Technical Support Document, Notice of Final Rulemaking, National Environmental Policy Act Implementing Procedures (10 C.F.R. Part 1021) (Nov. 2020)).
[51] *Id.* at 78,200; *see also id.* at 78,202. We note that, in the 2014 LCA GHG Report and 2019 Update, DOE also considered how emissions associated with the ocean transport of U.S. LNG in tankers contribute to total life cycle GHG emissions.
[52] U.S. Dept. of Energy, Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas From the United States, 79 Fed. Reg. 32,260 (June 4, 2014).

In 2019, NETL published an update to the 2014 LCA GHG Report, entitled *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas From the United States: 2019 Update* (2019 Update).[53] The conclusions of the 2019 Update were consistent with those of the 2014 LCA GHG Report—that, "[w]hile acknowledging uncertainty, to the extent U.S. LNG exports are preferred over coal in LNG-importing nations, U.S. LNG exports are likely to reduce global GHG emissions on a per unit of energy consumed basis for power production."[54] Additionally, "to the extent U.S. LNG exports are preferred over other forms of imported natural gas, they are likely to have only a small impact on global GHG emissions."[55] Both the 2014 LCA GHG Report and the 2019 Update are incorporated herein by reference. As discussed below, DOE assessed the applicability of the GHG Studies to the operation of the proposed Facility, and also considered possible risks for GHG emissions in the operation of an offshore terminal in comparison to an onshore terminal.

Results from the 2019 Update for each segment of the life cycle analysis, for that study's representative Asian market (Shanghai, China), are shown in Table 3 below as an example.[56] Because the GHG Studies examined use of fuels for power generation as a basis of comparison, emissions rates are expressed in terms of the amount of carbon dioxide-equivalent (CO_2-e) of GHGs emitted per unit of electricity generated -- carbon dioxide-equivalent emissions per megawatt-hour (CO_2-e/MWh).

Process Element	100-yr GWP
Natural Gas Extraction	21
Gathering and Boosting	50
Processing	18
Pipeline Transport	60
Liquefaction	41
Tanker Transport	76
LNG Regasification	4
Power Plant Operations	416
Electricity T&D	2
Total	**688**
Low	663
High	763

Table 3. Life cycle GHG emissions (100-yr GWP) for U.S. LNG shipped from New Orleans to Shanghai, China for power generation (kg CO_2-e/MWh)

[53] Nat'l Energy Tech. Lab., *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States: 2019 Update* (DOE/NETL-2019/2041) (Sept. 12, 2019), https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf.
[54] U.S. Dept. of Energy, Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas From the United States: 2019 Update – Response to Comments, 85 Fed. Reg. 72, 85 (Jan. 2, 2020).
[55] *Id.*
[56] 2019 Update, Appendix A, at A-2. Note that the 2019 Update's 100-yr GWP emissions estimates for its representative European market (Rotterdam, Netherlands), are comparable but somewhat lower: total expected-value emissions of 636 kg CO_2-e/MWh, with a low of 615 and a high of 709 kg CO_2-e/MWh. *See id.*, Appendix A, at A-1.

GHGs in this analysis were reported on the common mass basis of kilograms (kg) of CO_2-e using the global warming potential (GWP) of each GHG from the 2013 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). The 100-yr GWP is the timeframe used for comparison in this EA. Segments related to natural gas production and processing and to regasification and end use would be the same for the Facility as in the GHG Studies. DOE reasonably assumes that marine shipments of LNG from the Facility located off the coast of Mexico in the Gulf of Mexico would have similar attributes to shipments from a U.S. Gulf Coast location analyzed in the GHG Studies. Therefore, differences in calculated emissions between the proposed Facility and the GHG Studies model would primarily result from: 1) differences in pipeline emissions attributable to differences in natural gas pipeline transport distance between U.S. producing basins and the liquefaction plants and potential differences in emissions between Mexican pipelines and U.S. pipelines; and 2) differences in the emissions associated with offshore liquefaction in Mexico versus the U.S. We examine each of these two categories below.

Pipeline Transport – In the GHG Studies, extracted and processed natural gas is transported via pipeline, where GHG emissions are associated with: 1) the combustion of a portion of the natural gas in compressors; 2) intentional venting; and 3) fugitive losses of natural gas. Emissions from these sources are a function of the length of the transport distance, the number of compressor stations (a function of the length of transport), and the associated natural gas storage capacity (a function of the throughput), as well as maintenance and operational practices. DOE believes it reasonable to assume that throughput on natural gas pipelines is comparable in both scenarios, in which case the potential differences are reduced to the possible difference in pipeline transport distance from gas sources to the Facility, and to possible emissions differences between pipeline operations in Mexico and in the United States.

Analysis in the GHG Studies estimated that the average pipeline transport distance from natural gas extraction to an LNG terminal on the U.S. Gulf Coast was 971 km (~600 miles), that being the average pipeline transmission distance for LNG exports from the United States.[57] This distance is based on the characteristics of the entire transmission network and delivery rate for natural gas in the United States. The pipeline transport distance from U.S. production sources to the Facility would necessarily be longer, as the Valley Crossing Pipeline system begins at the Nueces Header in Agua Dulce, Texas and then runs south for approximately 177 miles to the point where it connects to the Sur de Texas - Tuxpan Pipeline at an offshore border crossing tie-in point, after which the Sur de Texas - Tuxpan Pipeline continues south from the tie-in point for approximately 500 miles to near Altamira, Mexico, the approximate location of the Facility. As a proxy for a typical gas production source, the Eagle Ford Shale producing basin is approximately 125 miles from the Nueces Header. These distances total roughly 800 miles (125 + 177 + 500 = 802). DOE examined the potential impact of this increased distance by assuming an approximately 33% increase in average transportation distance over the GHG Studies' modeled pipeline distance of 600 miles, for a total of 800 miles.

The GHG Studies estimated that total expected life cycle GHG emissions of U.S. LNG exports to Shanghai, China from the Gulf Coast would be 688 kg CO_2-e/MWh (*See* Exhibit A-2 in the 2019 Update). The GHG studies estimated that 8.7%, or 60 kg CO_2-e/MWh, of these emissions would be from pipeline

[57] Nat'l Energy Tech. Lab., *Life Cycle Analysis of Natural Gas Extraction and Power Generation* (DOE/NETL-2019/2039), at 4 (Apr. 19, 2019), https://www.netl.doe.gov/energy-analysis/details?id=3198.

transport.[58] DOE assumed a linear relationship between distance and emissions -- that extending the transportation distance from 600 miles to 800 miles (a 33% increase) would increase the pipeline transport contribution to GHG emissions from 60 kg CO_2-e/MWh to 80 kg CO_2-e/MWh (also a 33% increase), with emissions rates from pipeline transportation held constant at levels estimated for U.S. pipelines in the GHG Studies.[59] This would increase total estimated life cycle emissions in this example to 708 kg CO_2-e/MWh, an increase of about 2.9%.[60] The percentage of total lifecycle GHG emissions associated with pipeline transport under this scenario would be about 11%.[61]

Possible Differences Between Pipeline Emissions in Mexico and the United States

DOE has not identified a direct estimate for the emissions from pipelines in Mexico. For this EA, DOE has assumed that pipeline emissions in Mexico would be the same as from pipelines located in the United States. This is the same assumption DOE made in the GHG Studies for pipeline emissions in all countries.

However, DOE recognizes that higher and growing divergence in emissions rates between Mexican and United States pipeline transportation are possible given policy and regulatory differences with the U.S. regulatory system. These include EPA requirements to report greenhouse gas emissions for pipeline transportation[62] (and other components of the natural gas supply chain) and FERC requirements for accounting for lost and unaccounted for gas.[63] And in the future, U.S. pipeline operators may be subject to regulatory emission limits,[64] with those pipelines that do not meet regulatory limits subject to a waste emissions charge established in the Inflation Reduction Act of 2022.[65]

At the same time, DOE notes that the average pipeline age in Mexico[66] is less than that of most U.S. pipelines, and therefore, in the near-term, Mexican pipelines may experience fewer age-related

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[58] Using the 100-year GWP.
[59] In the GHG Studies, emissions profiles of transmission pipelines in other countries are held constant at the U.S. rate, with the pipeline transport distance being the determinant of emissions differences (2019 Update, Exhibit 5-5, at 13).
[60] An increase of 20 kg CO_2-e/MWh from a total of 688 kg CO_2-e/MWh: 20 / 688 = 0.0291, or about 2.9%.
[61] 80/708 = 11.3%.
[62] EPA's Greenhouse Gas Reporting Program (GHGRP) covers emissions from different areas of the oil and gas industry through several of its subparts. The reporting is required of domestic natural gas market participants in different phases of oil and natural gas value chains, including extraction, production, transport, and use. https://www.epa.gov/ghgreporting.
[63] Pipelines subject to FERC's jurisdiction are required to disclose volumes of natural gas lost and unaccounted for during pipeline operations in FERC Form 2. https://www.ferc.gov/sites/default/files/2020-04/form-2.pdf.
[64] *See* Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, 86 Fed. Reg. 63,110 (Nov. 15, 2021).
[65] Inflation Reduction Act of 2022, Pub. L. 117-169, § 60113 (2022).
[66] *See* EIA, Today in Energy, "U.S. natural gas exports to Mexico set to rise with completion of the Wahalajara system" (July 6, 2020) ("Since 2016, Mexico has been expanding its natural gas pipeline system, which has supported continual growth in U.S. natural gas exports."), https://www.eia.gov/todayinenergy/detail.php?id=44278. For the U.S., see PHMSA, Gas Transmission Miles By Decade Installed, https://portal.phmsa.dot.gov/analytics/saw.dll?Dashboard (retrieved Sept. 23, 2022). The data in the table indicate that 9% of the natural gas transmission miles of pipeline in the U.S. were installed since 2010.

maintenance issues that could increase the risk of methane emissions.[67] The Sur de Texas-Tuxpan pipeline, which has been identified as the single Mexican pipeline for the proposed Facility, began operating in 2019.[68]

DOE notes that, in any case, the extent to which the Mexican pipeline emissions rate would influence total life cycle emissions is limited, given that the pipeline transportation emissions would be approximately 11% of the total life cycle emissions for a delivery to Asia, based on the GHG Studies, with the longer pipeline transport distance described above.[69]

LNG Liquefaction – In the GHG Studies, LNG plant operations and associated emissions were based on the following assumptions:

- The LNG plant includes pre-treatment of the input pipeline-quality gas, liquefaction of the pre-treated gas, and on-site temporary storage of LNG before it is loaded onto an ocean tanker.
- The pre-treatment processes include: acid gas removal (removal of CO_2 and H_2S from the pipeline feed gas, to avoid freezing and plugging in downstream units); molecular sieve dehydration (removal of water to avoid freeze-up and unplanned shutdowns); and heavy hydrocarbon removal to protect the main heat exchanger from freezing and plugging, via adsorption or cryogenic distillation.
- The liquefaction plant employs a Propane Pre-Cooled Mixed Refrigerant (C3MR) process in combination with the pre-treatment technologies, represented through four different scenarios.
- Based on the publicly available data on U.S. plant export capacities and ship capacity assumptions, the residence time of LNG on site is estimated to be between 1.33 days and 1.60 days. During storage, boil-off gas (~0.02% to 0.1%) is assumed to be re-liquefied, which then enters back into the supply-chain.
- Pre-treatment and liquefaction energy requirements are assumed to be met through combusting a stream of natural gas as it leaves the pre-treatment facility and before it enters the liquefaction facility.

The Applicant states, in "Response to Informational Questions for DOE's Environmental Assessment" dated July 26, 2023,[70] that the Facility will utilize Chart Industries' Integrated Precooled Single Mixed

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[67] *See* PHMSA, Pipeline Replacement Background (Apr. 26, 2021), https://www.phmsa.dot.gov/data-and-statistics/pipeline-replacement/pipeline-replacement-background ("[F]ollowing major natural gas pipeline incidents, U.S. Department of Transportation and the Pipeline Hazardous Materials Safety Administration issued a Call to Action to accelerate the repair, rehabilitation, and replacement of the highest-risk pipeline infrastructure. Among other factors, pipeline age and material are significant risk indicators.").

[68] Mexico's Sur de Texas-Tuxpan pipeline begins flowing gas (Sept. 4, 2019), https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/090419-mexicos-sur-de-texas-tuxpan-pipeline-begins-flowing-gas.

[69] Pipeline emissions, including estimated increased emissions due to the longer transport distance, would comprise about 12.4% of total life cycle emissions for the 2019 Update's representative European destination.

[70] Document received by Docket No. 22-110-LNG Docket Room on July 26, 2023, https://www.energy.gov/sites/default/files/2023-07/22-110-LNG_NFE%20Altamira%20Data%20Responses%2007.26.2023.pdf.

Refrigerant (IPSMR®) liquefaction technology. The IPSMR® process is a single mixed refrigerant process that incorporates high efficiency brazed aluminum heat exchangers to enable a very compact modular design.[71]

According to information provided by the Applicant, the proposed Facility would be designed to operate three ~11 MW simple cycle Siemens gas turbines for power production on each of the two proposed FLNG units. These turbines have an estimated energy conversion efficiency of 27%. In comparison, the 2019 Update (which modeled onshore LNG operations), represented natural gas combined cycle power plants with an energy efficiency of approximately 50%. This difference in power production efficiency results in higher carbon dioxide emissions per unit of LNG ready for transport from the liquefaction plant.

At the same time, methane emissions from the proposed Facility would be lower than the 2019 Update's estimates, primarily due to the use of dry gas seals on liquefaction compressors, resulting in much lower methane slip. The net effect of increased carbon dioxide emissions and lower methane emissions for the liquefaction step results in higher carbon dioxide-equivalent emissions per unit of natural gas liquefied and stored at the liquefaction plant, estimated to be an 83% increase. This increase in estimated emissions for the liquefaction step corresponds to an increase of approximately 4.9% of the total estimated life cycle emissions in this example.[72]

However, this estimated increase in liquefaction plant GHG emissions would not change the conclusion of the 2019 Update that exported natural gas from the United States, and by extension, from the proposed off-shore Mexican liquefaction operation in the Gulf of Mexico, would result in lower life cycle GHG emissions when compared to heavier hydrocarbon-based energy production (*i.e.*, coal power production).

In DOE's models in the 2019 Update, liquefaction operations contribute approximately 10% to the total life cycle global warming potential, considering all life cycle steps. Accordingly, an increase in emissions in the liquefaction step would not have a large impact on overall modeled GHG emissions. Even at the higher liquefication GHG emissions intensity described above for steady state operations proposed for the Facility, estimated total life cycle GHG emissions do not exceed the uncertainty bounds of the modeled results in the 2019 Update used by the DOE to support review of LNG export applications, with respect to life cycle greenhouse gas emissions performance.

DOE therefore finds that the expected life cycle emissions profile of the Facility is comparable to the representative LNG Project analyzed in the GHG Studies, and finds it reasonable to apply the GHG Studies in reviewing life cycle emissions from the Facility. The source of natural gas for the Facility (the lower-48 U.S.) is the same source analyzed in the GHG Studies. Pipeline transport within the U.S. would also be comparable.

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[71] Ducote, D., Selecting the Right Mid-Scale LNG Solution with Chart's IPSMR® Process Technology (Apr. 3, 2019), https://www.gti.energy/wp-content/uploads/2019/10/123-LNG19-03April2019-Ducote-Doug-paper.pdf.

[72] (0.83*41 kg CO_2-e/MWh)/688 kg CO_2-e/MWh = 0.049).

Potential Differences in Risk for an Offshore Platform Versus an Onshore LNG Facility

The offshore configuration proposed for the Facility exhibits two features that make it different from the onshore LNG plant operations analyzed in the GHG Studies: (1) the use of fixed platforms and extendable leg platforms (*i.e.*, jack-ups) to contain gas processing and liquefaction equipment, and (2) the use of a floating LNG tanker in place of a fixed conventional onshore insulated LNG tank to hold LNG prior to transfer to an LNG tanker for export. The potential impact of each of these features on possible GHG emissions is discussed below.

Equipment located on an offshore platform is exposed to environmental forces, most importantly wind and wave action during an extreme weather event, that may be more severe than those experienced at a typically more protected onshore location. In the Gulf of Mexico, such events include hurricanes. Although most of the hundreds of operating oil and natural gas production platforms in the Gulf of Mexico escape damage during hurricanes when proper safety procedures are followed after advance notice of a hurricane's path is provided by weather services, damage may occur.

Two factors could act to mitigate the risks of significant methane emissions from hurricane damage to a facility built on offshore platforms: (1) the high likelihood of operational shutdown prior to a hurricane, and (2) the historical lower prevalence of hurricanes at the Facility's western Gulf of Mexico location relative to the northern Gulf.

First, risk can be mitigated by careful planning and prompt action; operations could be shut down if severe weather is forecast for the project location and, given enough warning, the floating storage vessel could be disconnected and moved under its own power out of danger. In addition, if time allows, moveable platforms could even be moved offsite. These actions could reduce the risk of significant methane emissions resulting from damage during a hurricane.

Weather agencies' hurricane course predictive capabilities are robust, and offshore operators typically have days in which to shut down operations on offshore platforms and reduce the chances of methane emissions resulting from storm damage.

Second, the risk of a hurricane taking a path through the Facility's proposed location off the coast of Mexico near Tampico, Tamaulipas, in the Gulf of Mexico, is potentially lower, relative to the risk faced by the large number of platforms operating in the U.S. waters of the northern Gulf of Mexico.[73] According to NOAA Historical Hurricane Tracking data, since 1851 and as of mid-September 2023, there have been only three Category 3 or stronger hurricanes recorded as passing within 80 nautical miles of the proposed Facility site.[74] All of these (Charlie in 1951, Hilda in 1955, and Inez in 1966) were recorded as Category

[73] *See* Nat'l Hurricane Ctr., https://www.nhc.noaa.gov/outreach/history/ (last accessed Sept. 15, 2023).
[74] See NOAA, https://coast.noaa.gov/hurricanes/#map=7.15/22.591/-97.732&search=eyJzZWFyY2hTdHJpbmciOiIyMi41ODY5OTIsIC05Ny43MzE3ODgiLCJzZWFyY2hUeXBlIjoiY2VudGVyIiwib3NtSUQiOiIxMzIxMjYiLCJsYXQiOjIyLjU4Njk5MiwibG9uIjotOTcuNzMxNzg4LCJjYXRlZ29yaWVzIjpbIkg1IiwiS

3 hurricanes when passing near the proposed Facility site (meaning sustained wind speeds of 111 to 129 miles per hour). This frequency can be compared to a total of twenty Category 3 or higher hurricanes passing within 80 nautical miles of New Orleans, Louisiana during the same time period.

In making this comparison, we note that ongoing climate change could act to increase the number and intensity of hurricanes in the Gulf of Mexico,[75] or alter the potential tracks of hurricanes in different parts of the Gulf of Mexico. There is some debate over the potential for increased frequency of Gulf hurricanes.[76] Accordingly, the relative risk of a hurricane impacting the Facility location may change over time.

Given the likelihood of operational shutdown prior to extreme weather events at the Facility location (based on industry practice), and the potential lower relative likelihood of hurricanes arriving at the Facility location as compared to the northern Gulf of Mexico, the risk of methane emissions from weather-related damage may not be significantly greater for the Facility's proposed offshore location than for the onshore location assumed for the GHG Studies.

However, independent of the risks of methane emissions from storm damage at an offshore LNG facility, there remains a small risk of jack-up leg collapse even when a platform is stationary (as would be the case in this instance), regardless of weather conditions. While careful seafloor surveys prior to placement can reduce risks, the proposed Facility's co-location of three jack-ups adjacent to one another and loaded with multiple equipment decks presents an unconventional situation for which there is little historical precedent in terms of safety performance. Further, the placement of three jack-ups in close proximity to one another could increase the risk of cascading damage should any of the legs on any one of the platforms fail, resulting in potentially significant methane emissions as well as extensive damage to the Facility. DOE notes that the Applicant has an incentive to ensure ongoing safe operations at the Facility, in fulfillment of commercial obligations and adherence to industry standards. However, given that such a situation could occur without warning, there is a small risk of increased methane emissions for this Facility's design relative to a conventional onshore LNG facility.

Given the uncertainties related to the offshore Facility configuration and location, DOE is unable to estimate either the likelihood or potential severity of GHG emissions impacts related to a severe weather event or operational difficulties related to the jack-up structures.

In addition to the location of equipment on fixed and floating platforms, the use of a floating storage vessel rather than a fixed onshore tank presents another difference relative to the facility modeled in the GHG

DQiLCJIMyJdLCJ5ZWFycyI6W10sIm1vbnRocyI6W10sImVuc28iOltdLCJwcmVzc3VyZSI6eyJyYW5nZSI6WzAsMTAzMF0sImluY2x1ZGVVbmtub3duUHJlc3N1cmUiOnRydWV9LCJidWZmZXIiOjYwLCJidWZmZXJVbml0IjpbIk5hdXRpY2FsIE1pbGVzIl0sInNvcnRTZWxlY3Rpb24iOnsidmFsdWUiOiJpbnRlbnNpdHlfaGlnaCIsImxhYmVsIjoiSW50ZW5zaXR5ICAhIaWdoKSJ9LCJhcHBseVRvQU9JJjp0cnVlLCJpc1N0b3JtTGFiZWxzVmlzaWJsZSI6dHJ1ZX0= (last accessed Sept. 15, 2023).

[75] *See* Bruyere, C. L., *et al.*, Impact of Climate Change on Gulf of Mexico Hurricanes (Aug. 16, 2017), https://opensky.ucar.edu/islandora/object/technotes%3A552.

[76] *See* Sullivan, J., One is bad enough: Climate change raises the threat of multiple hurricanes (Mar. 1, 2023), https://www.princeton.edu/news/2023/03/01/one-bad-enough-climate-change-raises-threat-multiple-hurricanes.

Studies. The proposed Facility incorporates such a floating tanker, connected to the LNG-producing platforms via flexible cryogenic conduits. At a conventional onshore LNG liquefaction facility, LNG is generally stored in large-volume, above-ground, low-pressure, double-walled tanks with a large blanket of insulation between the walls to help maintain a cryogenic temperature. However, ambient heat will warm LNG over time, vaporizing a portion of the LNG as "boil-off gas" (BOG). This BOG must be routed out of the storage tank to avoid an increase in pressure. BOG generated inside conventional onshore LNG storage tanks is generally not vented to the atmosphere, but is instead re-routed to power generation equipment and used to generate electricity for the facility. Alternatively, it can be re-cycled and re-liquefied.

LNG tankers, essentially floating LNG storage tanks, are also insulated to maintain cryogenic temperatures but similarly experience boil-off. Tanker BOG may be captured and burned as engine fuel, depending on the type of engines in place, or an onboard reliquefication system may be used to recover BOG and return it to the cargo tank.

The amount of LNG that is evaporating from an LNG tanker cargo or from an onshore storage tank is expressed as a percentage of total liquid volume per unit time (boil off rate or BOR). Typical values for older LNG tankers are up to 0.15% per day while modern LNG carriers may have a BOR of only 0.10% per day.[77] The typical BOR for onshore LNG storage tanks is less: about 0.05% per day.[78]

Information provided by the Applicant in "Response to Informational Questions for DOE's Environmental Assessment" dated July 26, 2023, states that the design boil-off rate for the storage tanker to be employed at the Facility is 0.10% per day and that the boil-off gas will be used as fuel gas for the Facility.[79] As no methane is to be vented or flared under normal operating conditions, there would be no difference in terms of expected methane emissions at the Facility's floating storage unit when compared to a conventional onshore storage tank, and thus no expected increase in emissions at the proposed Facility relative to the GHG Studies.

The Application does not provide details on the design and operation of the flexible cryogenic hose systems to be used for transferring LNG between the platforms and the FSU. The world's first offshore floating LNG system began operation in 2017, but only five such systems were in service worldwide as of April 2023.[80] DOE found no evidence of reported methane emissions stemming from the use of flexible

[77] Wärtsilä, Boil-Off Rate (BOR), https://www.wartsila.com/encyclopedia/term/boil-off-rate-(bor)#:~:text=The%20amount%20of%20liquid%20that,a%20BOR%20close%20to%200.1%25.
[78] Boil-Off Gas (Bog) Calculations For Cryogenic Liquefied Natural Gas Tanks (Sept. 3, 2012), https://www.cheresources.com/invision/blog/4/entry-301-boil-off-gas-bog-calculations-for-cryogenic-liquefied-natural-gas-tanks/.
[79] Document received by Docket No. 22-110-LNG Docket Room on July 26, 2023, https://www.energy.gov/sites/default/files/2023-07/22-110-LNG_NFE%20Altamira%20Data%20Responses%2007.26.2023.pdf.
[80] Offshore, *Africa leading growth of FLNGs in mid-late 2020s* (Apr. 4, 2023), https://www.offshore-mag.com/rigs-vessels/article/14291903/africa-leading-growth-of-flngs-in-midlate-2020s.

cryogenic conduit systems at any of these (or similar) facilities, although the overall performance history is not extensive.

2.2.4.2 No Action Alternative

If the Facility did not become operational, other LNG production capacity could be constructed in the United States or another country to serve some or all of the LNG demand the Facility is intended to serve. Since it is uncertain where this production would take place, it is not possible for DOE to make a quantitative comparison of estimated life cycle GHG emissions. DOE acknowledges that the differences described could result in additional GHG emissions associated with Mexican LNG exports, as compared to alternative LNG sources and/or changes in natural gas production and consumption. However, DOE finds it not unreasonable to assume that GHG emissions would be broadly similar, and, given the global nature of climate change, would have similar incremental impacts.

3 List of States & Tribes Contacted

3.1 Tribes Contacted

Texas
Kickapoo
Ysleta Del Sur

3.2 States Contacted

State Governments
Texas

4 List of Preparers

4.1 U.S. Department of Energy

Brian Lavoie, Sr. Natural Gas Analyst

Jennifer Wade, Director, Division of Natural Gas Regulation

Tim Skone, P.E., Senior Environmental Engineer

Appendix A: Agency and Tribal Correspondence

SUBJECT LINE: Notice of Environmental Assessment to [state/Indian Tribe on the list]

To Whom it May Concern:

The U.S. Department of Energy recently announced that an environmental assessment (EA) under the National Environmental Policy Act (NEPA) is being prepared pursuant to the review of an application to export U.S. natural gas from a planned natural gas liquefaction project in Mexico. The application includes transfer by pipeline of natural gas from the U.S. to Mexico.

NEPA requires federal agencies to assess the potential environmental impacts of major federal actions significantly affecting the environment. Using the NEPA process, agencies evaluate the environmental and related social and economic effects of their proposed actions. An EA is a concise public document that provides sufficient evidence and analysis to enable a determination to prepare an environmental impact statement or a finding of no significant impact.

The EA being prepared is related to the LNG export proceeding shown below:

Applicant	**DOE Docket**	**Notice of Environmental Assessment**
NFE Altamira FLNG, S. de R.L. de C.V.	22-110-LNG	Notice of EA NFE Altamira 2023-06.27.23.pdf (energy.gov)

You are being contacted as a State or Indian Tribe located near where the cross-border natural gas pipeline(s) that may service the planned liquefaction projects are located. At this time, the planned liquefaction project anticipates sourcing U.S. natural gas from a specific existing pipeline, or from one or more additional cross-border pipelines that may be constructed in the future, as listed below:

- Valley Crossing Pipeline, LLC. Border crossing approved in *Valley Crossing Pipeline, LLC*, FERC Docket No. CP17-19-000, 161 FERC ¶ 61,084 (2017). The approved border-crossing facility extends from a point in Texas state waters approximately 30 miles east of Brownsville, Cameron County, Texas, to the international boundary with the State of Tamaulipas, Mexico in the Gulf of Mexico, to a connection point with the Sur de Texas – Tuxpan offshore natural gas pipeline system. The pipeline has a delivery capacity of up to 2.6 billion cubic feet per day of natural gas.

- Future cross-border pipelines interconnecting with the Sur de Texas - Tuxpan Pipeline offshore natural gas pipeline system.

DOE anticipates providing a draft of the EA later this summer, and a 30-day public comment period will then commence.

If you have any questions related to this notice or have updated contact information, please reply to this email.

Thank you,

Office of Resource Sustainability

Division of Natural Gas Regulation

Office of Fossil Energy and Carbon Management

U.S. Department of Energy

Email: fergas@hq.doe.gov

Website: https://www.energy.gov/fecm/regulation